Orion Power Unit-2 Dhaka Ltd.

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR 635 MW COAL BASED THERMAL POWER PLANT AT MATARBARI, MAHESHKHALI, COX'S BAZAR

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ACRONYMS AND ABBREVIATIONS

AAQ	Ambient Air Quality
AAQM	Ambient Air Quality Monitoring
AAS	Atomic Absorption Spectrometry
AERMOD	Air Quality Dispersion Modeling
ADB	Asian Development Bank
AFNOR	Association Française de Normalisation
AIDS	Acquired Immune Deficiency Syndrome
AIIB	Asian Infrastructure Investment Bank
AM	Ante Meridiem
ANL	Ambient Noise Level
AOI	Area of Influence
APCR	Air Pollution (Control) Rules, 2022
APHA	American Public Health Association
ARIPA	Acquisition and Requisition of Immovable Property Act
ARIPO	Acquisition and Requisition of Immovable Property Ordinance
As	Arsenic
ASA	Association for Social Advancement
ASPCL	Ashuganj Power Station Company Limited
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BDL	Below Detection Limit
BDRCS	Bangladesh Red Crescent Society
BDT	Bangladeshi Taka
BECA	The Bangladesh Environment Conservation Act
BFD	Bangladesh Forest Department
BFIDC	Bangladesh Forest Industries Development Corporation
BFRI	Bangladesh Forest Research Institute
BIWTA	Bangladesh Inland Water Transport Authority
BMCR	Boiler Maximum Continuous Rating
BMD	Bangladesh Meteorological Department
BNH	Bangladesh National Herbarium
BNBC	Bangladesh National Building Code
BOD	Biological Oxygen Demand
BOO	Build, Own and Operate
BPDB	Bangladesh Power Development Board

BPIP	Building Profile Input Program
BRTA	Bangladesh Road Transport Authority
BRTC	Bangladesh Road Transport Corporation
BOD	Biological Oxygen Demand
BTG	Boiler Turbine Generator
BWDB	Bangladesh Water Development Board
CAAB	Civil Aviation Authority of Bangladesh
CAMEO	Computer Aided Management of Emergency Operations
Ca	Calcium
CaO	Calcium Oxide
CBD	Convention on Biological Diversity
Cd	Cadmium
CDM	Clean Development Mechanism
CEA	Carbon Estimation Area
CEET	Carbon Emission Estimation Tool
CEMS	Continuous Emission Monitoring System
CEO	Chief Executive Offier
CFC	Chlorofluorocarbons
CHP	Coal Handling Plant
CHTs	Chittagong Hill Tracts
Cl	Chlorine
cm	Centimeter
CMB	Central Monitoring Basin
CNG	Compressed Natural Gas
CPP	Cyclone Preparedness Programme
CO	Carbon Monoxide
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
CPGCBL	Coal Power Generation Company Bangladesh Limited
CPR	Cardiopulmonary Resuscitation
CR	Critically Endangered
CSR	Corporate Social Responsibility
CSWG	Community and Social Welfare Group
CW	Cooling Water
DAE	Department of Agricultural Extension
dB	Decibel

DC	District Commissioner
DD	Data Deficient
DDM	Department of Disaster Management
DEG	The German Investment Corporation
DEM	Digital Elevation Model
DG	Diesel Generator
DG	Director General
DFIs	Development Finance Institutions
DIA	Disaster Impact Assessment
DM	Demineralisation
DO	Dissolved Oxygen
DoE	Department of Environment
DoF	Department of Fisheries
DPHE	Department of Public Health Engineering
DSS	Dust Suppression System
DSW	Directorate of Seamen and Emigration Welfare
DWT	Deadweight tonnage
EC	Electrical Conductivity
ECA	Environment Conservation Act
ECA	Ecologically Critical Area
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rules
EGCB	Electricity Generation Company of Bangladesh
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMF	Electric and Magnetic Fields
EMP	Environmental Management Plan
EMoP	Environmental Monitoring Plan
EMS	Environmental Management System
EN	Endangered
ENT	Ear, Nose and Throat
EPAS	Environmental Perimeter Air Station
EPC	Engineering Procurement and Construction
EPAP	Equator Principles Action Plan
EPFIs	Equator Principles Financial Institutions
EPR	Extended Producer Responsibility
EPRGs	Emergency Response Planning Guidelines
EQMS	Environmental Quality and Management System

EQS	Environmental Quality Standards
ERP	Emergency Response Plan
ESIA	Environmental and Social Impact Assessment
ESMS	Environmental and Social Management System
ESP	Electrostatic Precipitator
ETP	Effluent Treatment Plant
FAHS	Fly Ash Handling System
FAO	Food and Agriculture Organization
FC	Fecal Coliform
FC	Floating Crane
FCPS	Fellowship of College Physician and Surgeon
FD	Forced Draft
FD	Forest Department
FGD	Flue Gas Desulfurization
FGD	Focus Group Discussion
FI	Financial Intermediary
FMO	The Netherlands Development Finance Company
FPIC	Free, Prior, and Informed Consent
FTV	Floating Transfer Vessel
GBV	Gender based violence
GCV	Gross Calorific Value
GDP	Gross Domestic Product
GoB	Government of Bangladesh
GHG	Green House Gas
GIIP	Good International Industry Practice
GIS	Geographic Information System
GLCs	Ground Level Concentrations
GPS	Global Positioning System
GRC	Governance, Risk and Compliance
GRM	Grievance Redressal Mechanism
GSB	Geological Survey of Bangladesh
GW	Groundwater
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbons
HAZMAT	Hazardous Materials
HDPE	High-density Polyethylene
HFCs	Hydrofluorocarbons
HFO	Heavy Fuel Oil

HHs	Households
HIV	Human Immunodeficiency Virus
HP	High Pressure
HSD	High-Speed Diesel
HSEMS	Health, Safety and Environmental Management System
HVAC	Heating, Ventilation and Air Conditioning
IA	Implementation Agreements
IBA	Important Bird and Biodiversity Area
ICP	Informed Consultation and Participation
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICZMP	Integrated Coastal Zone Management Plan
ID	Induced Draft
IEE	Initial Environmental Examination
IEEE	Institute of Electrical and Electronics Engineers
IFC	International Finance Corporation
ILO	International Labour Organization
IMCO	Inter-Governmental Maritime Consultative Organization
IMO	International Maritime Organization
INMARSAT	International Maritime Satellite Organization
IP	Intermediate Pressure
IPM	Integrated Pest Management
IPP	Independent Power Producer
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
KII	Key Informant Interview
KLD	Kilo Liters per day
KPI	Key Point Installation
KV	KiloVolt
KWh	Kilo Watt hour
LC	Least Concern
L/C	Letter of Credit
L/D	Length to diameter
LDO	Light Diesel Oil
LNG	Liquefied Natural Gas
LOC	Level of Concern
LOI	Letter of Intent
LP	Low Pressure
LRP	Land Resettlement Plan

MARPOL	The International Convention for the Prevention of Pollution from Ships
MBBS	Bachelor of Medicine and Bachelor of Surgery
MCR	Motor Continuous Rating
MEAs	Multilateral Environmental Agreements
MIDI	Moheshkhali-Matarbari Integrated Infrastructure Development Initiative
MIS	Management Information System
MoEFCC	Ministry of Environment Forest and Climate Change
MoFL	Ministry of Fisheries and Livestock
MoL	Ministry of Land
MoLE	Ministry of Labour and Employment
MoPEMR	Ministry of Power, Energy and Mineral Resources
MoSW	Ministry of Social Welfare
MoU	Memorandum of Understanding
MPA	Marine Protected Area
MPa	Megapascals
MSBN	Marine Set Bag Net
MSC	Maritime Safety Committee
MSDS	Material Safety Data Sheet
MSL	Mean Sea Level
MSV	Main Steam Valve
MT	Metric Tons
MVA	MegaVolt Amperes
MW	Mega Watt
NAAQS	National Ambient Air Quality Standards
NAPA	National Adaptation Plan of Action
NBSAP	National Biodiversity Strategy and Action Plan
NDCs	National Determined Contributions
NEMAP	National Environment Management Action Plan
NEC	National Executive Council
NEP	National Environmental Policy
NCS	National Conservation Strategy
NGO	Non-governmental Organization
NIRAPAD	Network for Information, Response and Preparedness Activities on Disaster
NPSWSS	National Policy for Safe Water Supply and Sanitation
NIOSH	National Institute for Occupational Health and Safety
NLTP	National Land Transport Policy
NOx	Nitrogen Oxides

NO_2	Nitrogen dioxide
NOC	No Objection Certificate
NOSCOP	National Oil and Chemical Spill Contingency Plan
NT	Near Threatened
NTU	Nephelometric Turbidity Unit
NWMP	National Water Management Plan
NWPGCL	North-West Power Generation Company Limited
OECD	Organisation for Economic Co-operation and Development
OHS	Occupational Health and Safety
OISD	Oil Industry Safety Directorate
OPDL-2	Orion Power Unit-2 Dhaka Limited
OPRC	Oil Pollution Preparedness, Response and Co-operation
OSHA	Occupational Safety and Health Administration
OTC	once through cycle
O & M	Operations and Maintenance
PA	Protected Area
PAPs	Project Affected Persons
PBS	Palli Bidyut Samity
PC	Pulverized Coal
PCM	Public Consultation Meeting
PEL	Permissible Exposure Limit
PFCs	Perfluorocarbons
PL	Post Larvae
PET	Polyethylene terephthalate
PM	Post Meridiem
PP	Project Proponent
PM	Particulate Matter
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
ppm	parts per million
PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Paper
PS	Performance Standard
PSMP	Power System Master Plan
PWD	Public Works Department
QRA	Quantitative Risk Assessment
RAP	Resettlement Action Plan
REB	Rural Electrification Board

RF	Reserved Forest
RPCL	Rural Power Company Limited
RPM	Revolutions per minute
RO	Reverse Osmosis
RSV	Re-heat Stop Valve
SAR	Sodium Adsorption Ratio
SCC	Site Clearance Certificate
SCR	Selective Catalytic Reduction
SDS	Safety Data Sheet
SEP	Stakeholder Engagement Plan
SLCPs	Short-Lived Climate Pollutants
SME	Small and Medium Enterprise
SPARRSO	Space Research and Remote Sensing Organization
SO_2	Sulphur dioxide
SOLAS	Safety of Life at Sea
SPM	Suspended Particulate Matter
SPM	Single Point Monitoring
SRDI	Soil Resources Development Institute
SRTM	Shuttle Radar Topography Mission
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
STI	Sexually Transmitted Infections
STG	Steam Turbine Generator
STP	Sewage Treatment Plant
SUA	Convention for the Suppression of Unlawful Acts of Violence against the Safety of Maritime Navigation
SW	Surface Water
TC	Total Coliform
TDS	Total Dissolved Solids
TMCR	Turbine Maximum Continuous Rating
TMP	Traffic Management Plan
ToR	Terms of Reference
TSS	Total Suspended Solids
UFO	Upazila Fisheries Office
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNO	Upazila Nirbahi Officer
USC	Ultra-Super Critical

USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
UVS	Ultraviolet Spectrometer
VCE	Vapor Cloud Explosion
VES	Visual Encounter Surveys
VOC	Volatile Organic Compound
VU	Vulnerable
WARPO	Water Resources Planning Organisation
WB	World Bank
WBG	World Bank Group
WHO	World Health Organization
WRF	Weather Research and Forecasting
WTF	Wave Tidal and Fluvial
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
ZOI	Zone of Influence

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

E1. Introduction

E1.1 Background

According to The Power System Master Plan (PSMP) 2016, Bangladesh aspires to become a high-income country by 2041. Therefore, the development of energy and power infrastructure pursues not only quantity but also quality to realize long-term economic development and to match the objective, improvement of power quality for the forthcoming high-tech industries needs to be addressed holistically.

Now a days the acute crisis of Oil & Gas due to the effect of the Russia-Ukraine war, many developed countries are changing their strategies for generating electricity. Many developed countries re-open their coal-based power plant to meet their electricity demand. Government of Bangladesh also has taken several alternative plans to meet the electricity crisis. Government of Bangladesh has given high emphasis on implementing the proposed 635 MW Coal-based power plant i.e., Orion Power Unit-2 Dhaka Limited at Matarbari, Maheshkhali. Previously the power plant was planned to set up in Gazaria, Munshiganj. BPDB has suggested to shift the location to more suitable location at Matarbari. The proposed power plant will be set up by OPDL-2 on 225 acres land owned by Coal Power Generation Company Bangladesh Limited (CPGCBL) to ensure the best utilization of this land as well as most reliable operation of this project. The major benefits of this area are Matarbari deep seaport is only within 5 km, availability of water and no transshipment will be required for coal transporation. The navigation channel is 350 meters (1,150 ft) in length with a maximum permissible draught of 16 meters (52 ft). Ships with a capacity of 70,000 DWT can dock here. The generated electricity will be evacuated through Maheshkhali-Modunaghat-Vulta 765kv transmission line (Initially charged 400 kv). From the socio-economic and power energy security point of view the project is very important.

E1.2 Purpose of the Study

The proposed project is under the red category according to the Environmental Conservation Rules 2023. Hence, the Environmental Impacts Assessment (EIA) report is required for the proposed power plant to get prior site clearance and Environmental Clearance (EC) from the DoE. The present EIA report has been prepared based on the Terms of Reference (ToR) approved by DoE, vide Memo No: 22.02.0000.018.72.129.22- 186 and based on the primary data collected during October 2022 - January 2023. The overall objective of the present study is to conduct an EIA study of the proposed 635 MW coal-fired power plant at Moheshkhali Upazila in Cox's Bazar District to obtain site clearance and ECC from the DoE.

E1.3 Methodology of the EIA Study

Methodology adopted for the EIA updating study are as follows:

- Study of the relevant documents on policy, legal and administrative framework and their review, particularly on environmental aspects and effluent discharge limits, health and safety requirements, identification of sensitive areas and endangered species, land use, land acquisition etc.
- Primary survey has been conducted to collect baseline information in devised formats;
- Analysis of collected data has been conducted;
- Documentation of baseline conditions has been conducted through on-site environmental monitoring and sampling;
- Application of air and noise modeling.
- Identification of major project activities, both during pre- construction, construction and operational phases of the project.

- Identification and prediction of environmental impacts of project activities on the surrounding environment
- Identification of the most significant environmental and social impacts and suggestions for mitigation measures in order to reduce/eliminate negative impacts and to enhance positive impacts.
- Arrangement of public consultation meeting and disclosure meeting to consult with potentially affected people as well as community people;
- Development of Environmental Management Plan (EMP) for pre-construction, construction phase as well as operational phases of the project.

E2 Policy, Legal and Administrative Framework

According to the Section 12 of the Environment Conservation Act 1995, no project will be established or undertaken without obtaining permission, in the manner prescribed by the Environment Conservation Rules 2023, an Environmental Clearance Certificate from the Director General. Therefore, every development projects/industry, which are specified under the Schedule–1 of the Environment Conservation Rules 2023, require obtaining site and environmental clearance from the Department of Environment. Coal based thermal power plant greater than 50 MW falls under the Red category. Thus, EIA study is required to be carried out for the project to obtain site clearance and environmental clearance certificate. All applicable national and international frameworks have been described under chapter 2.

E3 Project Description

Orion Power Unit-2 Dhaka Limited has proposed to setup a coal fired power plant at Matarbari mauza in Matarbari Union of Moheshkhali Upazila under Cox's Bazar District of Chattogram Division, Bangladesh (**Figure E-1**). Kohelia River and salt pan are on East, Matamuhuri River and salt pan are on North, and Kutubdia Channel and Bay of Bengal are on the west and southwest of the project area respectively. Whereas the south side of the project area is covered by mainly rural settlement, saltpan, homestead vegetation, agricultural land, and scattered ponds etc. The project site land is currently being used for salt and shrimp cultivation.

The proposed project is a 1x635MW sub-bituminous coal based thermal power Plant. The proposed power plant will have a net capacity of 635 MW. Coal will be imported from Australia and Indonesia. Annual coal requirement has been estimated to be 1.47 million tons. Coal will be directly transported from coal source to the Martabari deep seaport by 60,000-70,000 dwt coal carrier ship. A 4.7 km coal conveyer belt will be built to transfer the coal from port to the coal yard. The plant will consist of one ultra-supercritical pulverized coal fired boiler with built in dry low NOx burners suitable for outdoor installation with a stack of 220-meter high and a tandem-compound, multi cylinder design condensing type steam turbine. The plant will have an Electrostatic Precipitator (ESP) to arrest dust and Flue Gas Desulfurization (FGD) system for reduction of sulfur di-oxide. The proposed plant will comprise of an opposed wall fired Benson once through two pass radiant- type super critical boiler with a super heater steam system and a single reheats steam system and will be able to operate in sliding pressure mode. The cooling water system will be once through cycle (OTC) which will provide the water for condenser that will be drawn from sea and cooling water will be discharged to the Kutubdia channel. The generated power will be evacuated through the Maheshkhali-Modunaghat-Vulta 400 kV double circuit transmission line connecting to the Maheshkhali 400 kV switchyard. The key project information is presented in **Table E-1**.

Figure E-1: Location of the Proposed Project

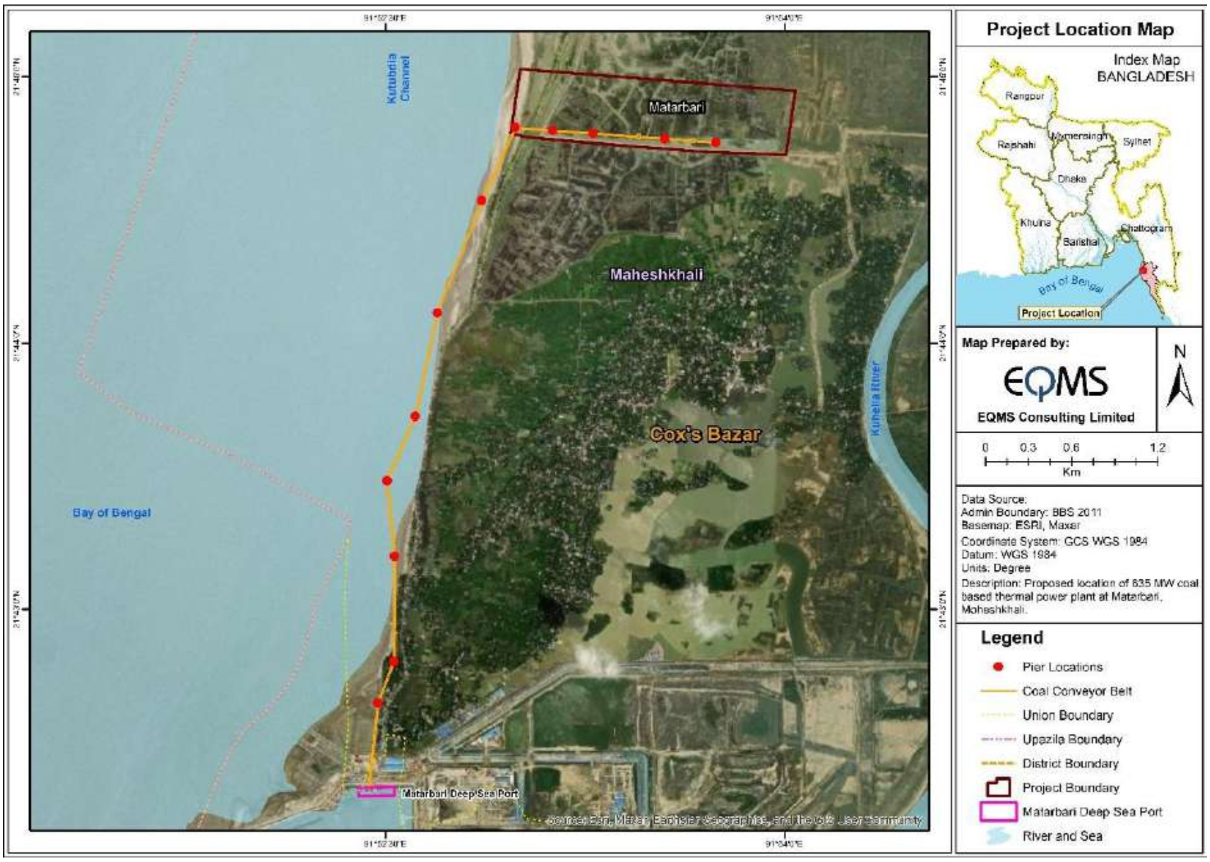


Table E-1: Key Project Information

Plant Configuration	Ultra-supercritical PC (Pulverized Coal)
Carbon capture	Nil
Gross power output	700 MW
Net power output	635 MW
Plant Load Factor	85 %
Primary fuel (type)	Bituminous and Sub-bituminous Coal having GCV of 26,050 KJ/Kg (after mixing) and Sulfur content (0.9%)
Source of fuel	Coal will be imported from Australia and Indonesia
Coal Consumption	212 tones/hour (at 100% plant load factor)
Land Area	Total 225 acres (Plant area- 204.64 acres, Connecting road- 1.73 acres, Coal corridor- 18.63 acres)
Stack height	220 m
Water Intake (Make up water)	81513 m^3/hr
Water discharge after treatment	81259 m^3/hr
Water consumed	254 m^3/hr
Water Source	Bay of Bengal

Source: OPDL-2

Resource Requirement

Land Requirement- Total 225 acres land will be required to set up the proposed power plant of which 201.64 acres for power plant, 1.73 acres for access road and 18.63 acres for coal corridor.

Fuel Requirement- It is estimated that 4000-5000 litre/day diesel will be required during construction stage. During operation stage, 168.4 ton/hr coal will be required whereas 4042 ton/day and 1.47 million ton per annum. Approximately, 5000 KL per annum LDO and HFO will be required during operation for start-up.

Water Requirement- The water demand for the construction works will be about 40 m^3/hour to 100 m^3/hour during normal and peak demand respectively which will be sourced from underground. The potable water requirement will range from 90 KLD – 180 KLD and will also be sourced from the underground.

During operation, about 81,513 m^3/hr of surface water will be sourced from Bay of Bengal for cooling purposes. A total of 81,259 m^3/hr water will be discharged to the Kutubdia Channel.

Manpower Requirement: During construction phase, the labour requirement will range from 1000–1500 during normal operations and 2500-3000 workers for peak construction activities. During the operation stage, total 135 no. of employees will be required of which 28 manager and 107 staff.

E4 Description of Environment

A study area of 10 km from the project boundary has been taken into consideration for baseline survey. The baseline information was collected from both primary and secondary sources. Ambient air quality, noise level, surface and groundwater were collected and analyzed. Ambient air quality has been analyzed for both dry and wet seasons. The population and housing census, 2011 data of Bangladesh Bureau of Statistics has been analyzed for 10 km study area to know the demography and socio-economic condition of the study area. The primary socio-economic survey was conducted within a 5 km radius from the project periphery.

E4.1 Meteorology

Meteorological data for the last thirty years (1991-2020) of Kutubdia weather station were analyzed. Based on the data analysis it has been demonstrated that monthly maximum temperature varies from 26.7°C to 36.4°C whereas monthly minimum temperature varies from 13.4°C to 24.6°C.

The last 30 years data from the Kutubdia meteorological station shows that the annual average of total rainfall is recorded as 3117 mm/year. The monthly average relative humidity varies from 74.7% to 87.8% with an average humidity of 81.1%. Humidity remains higher in the monsoon (June to September) season and comparatively lower in the winter season.

E4.2 Air Quality

In the project area and its surroundings, there are no major air pollution sources. Air quality samples were taken from five locations twice covered both wet and dry seasons. During wet season, the concentration of SPM was found from 50.3-68.2 µg/m^3, PM_{10} (22.0-32.7 µg/m^3), $PM_{2.5}$ (16.5 – 20.2 µg/m^3), SO_2 (5.6 – 11.6µg/m^3), NO_2 (9.2 – 17.8 µg/m^3) and CO (65.0-130.0 µg/m^3) were found to be in compliance with the national standards presented under the Air Pollution (control) Rules 2022.

During the dry season, the concentration of air quality parameter was found as SPM (56.0-93.0 µg/m^3), PM_{10} (22.6-44.5 µg/m^3), $PM_{2.5}$ (16.5 – 32.8 µg/m^3), SO_2 (5.8– 13.5 µg/m^3), NO_2 (9.5 – 18.7 µg/m^3) and CO (64.0-380.0 µg/m^3).

E4.3 Noise Level

Noise level was recorded from five locations during the monitoring period. Ambient daytime noise level (Leq_{day}) was recorded in the range of 47.6 to 54.6 dB (A). In contrast, the study area's ambient nighttime noise levels (Leq_{night}) varied from 38.2 to 44.7 dB (A). The noise levels of all the locations have found below the Noise Pollution Control Rules, 2006.

E4.4 Water Quality

A total of ten water samples were collected during the survey period of which six were surface, and four were groundwater. Analysis of the water quality shows that groundwater quality is well within the standard for drinking water of ECR, 2023-Schedule 2 B. Few parameter of surface water quality exceed the standard for coastal water quality of ECR Schedule 2A(2).

E4.5 Biological Environment

The project site has fallen under Coastal plain (8a) bio-ecological zone. Floral species composition was assessed from the primary survey data of six quadrats plotted in the AOI. A total of 59 species under 30 families of floral species were enumerated during the field survey from the six (6) quadrat samples and highest number of floral species (11 species) were recorded under the Fabaceae family. Mangrove species used for plantation of this area are *Avicennia officinalis*, *Avicennia marina* and *Sonneratia apetala*. However, the abundance of the plants within the project area is very low because salt pans occupy 89.28% of the project lands.

The transect method was applied to know the status of the avian fauna in the study area. A total of 74 species belonging to 36 families of avifauna were recorded in the project study area. Among the recorded bird species, Black-headed ibis (*Threskiornis melanocephalus*) is Vulnerable (VU) and Eurasian Curlew (*Numenius arquata*) is Near Threatened (NT), according to the IUCN Red List of Threatened Species of Bangladesh, 2015. The other avian species found in this are the least concern (LC) both locally and globally according to IUCN Red List.

During field investigation, a total of 7 amphibians belonging to 4 families have been recorded in the Project area. Dominating amphibians in the study area are Southeast Asian toad, Indian skipper frog, Indian Bull frog and Spotted Tree Frog. All amphibians are the least concern according to the IUCN Red List of Threatened Species of Bangladesh, 2015.

A total of 12 reptiles belonging to 7 families were listed during the survey period. Among the species Bengal Monitor (*Varanus bengalensis*) is Near Threatened (NT) whereas rest of the species are the least concern according to the IUCN Red List of Bangladesh, 2015 and Global IUCN Red List Status (Version 2022-2).

It has been recorded 9 terrestrial mammal species belonging to 8 families in the study area. All mammalian species found are Least Concern (LC) both locally and globally according to IUCN Red List.

Total 59 species of fish under 37 families and 15 species of crustaceans under 6 families were recorded from the study area followed by fish market survey, consultation with local people, focus group discussion with fishermen. Most of the fish found in the study area were captured species. According to the IUCN Red List of Bangladesh, 1 Vulnerable (*Gudusia chapra*), 1 Near Threatened (NT) (*Mystus gulio*), and 1 Endangered (*Ompok pabda*) species was recorded. In addition, the proposed project site in not located inside of any Hilsa sanctuary and spawning ground. The nearest Hilsa sanctuary is the Char Ilisha to Char Pial (90 km stretch of Shahbazpur channel, a tributary of Meghna River), which is located approximately at an aerial distance of 108 km North-west from the project site.

A total of 11 species of phytoplankton under 3 groups and 9 species of zooplankton under 5 groups were identified from the predefined six sample collection locations. On the other hand, 14 taxa/species of benthos were identified.

During the field study, there was no direct sighting of dolphin occurrences. Consultation with local community, fishermen and local staff of the Bangladesh Forest Department revealed that, Irrawaddy dolphin (*Orcaella brevirostris*) and Indo-pacific humpback dolphin (*Sousa chinensis*) are rarely seen in the Kutubdia Channel during the monsoon.

No nesting of marine turtles was found in the study area as their spawning and oviposition is controlled by tidal behavior. Consultation with a Local Marine Turtle Conservation Worker of Marinelife Alliance (an NGO worked for Turtle conservation) confirms that, sea turtles used to come to lay their eggs in Dhalghata Sea Beach (Adjacent to Sutaria Bazar of Dhalghata) and Hacher Char area frequently which is far from the project location. But in 2022 and 2023, frequency of turtle nesting and breeding is lower than the previous year due to the predation activities of homeless dogs.

No ecologically sensitive area is in and around 10 km of the project site. The most notable protected area in the region is the Fasiakhali Wildlife Sanctuary, which is approximately at an aerial distance of 16.5 km South-East from the site. No ECA is located within the AOI. The nearest ECA from the site is Sonadia Island which is at an aerial distance of 24.3 km away from the site. Nearest marine protected area is Nijhum Dwip marine protected area which is 62.62 km far from the project site.

E4.5 Socio-economic Environment

This study has identified the social impacts of the proposed project on the local community. The 10 km study area (Buffer area) has been selected to grab the holistic insights of diverse social aspects in the study area. Based on the field observation, it is deemed that the magnitude of social impact might be limited to 5 km radius and likely to be more visible. Therefore, the 5 km study area has been considered as core area where the envisaged impacts might be manifested. To get the in-depth knowledge regarding social baseline conditions of overall area, rigorous study has been done during field visits. The socio-economic survey has been conducted within a 5 km radius of the project area.

In terms of education and literacy amongst the sample, the majority of the respondents were found to be primary level almost 35.6%. According to the Population and Housing Census (2011), agriculture including crops cultivation, fishing, direct farming, sharecropping, agricultural laborers etc. is the dominant source of employment in the study area. Approximately, 56539 male and 2274 females are involved in agricultural activities. Moreover, significant number of the population; 11817 male and 2142 females of the study area are employed in service sector. Also, 1458 male and 206 female are in the industrial sector. In the study area, households that use water-sealed sanitary latrine and non-water-sealed sanitary latrine facility are 18.1% and 39.7% respectively. Whereas about 32.7% households avail non-sanitary facilities. The rest 9.5% of households have no access to hygienic latrine facilities.

E5 Environmental Impacts and Mitigation Measures

During the study period, all possible sources of impact were identified for pre-construction, construction, and operation phase of the proposed power plant. The following sections describe the possible environmental and social impact due to the proposed project construction and operation.

E5.1 Impact Assessment and Mitigation Measures during Pre-Construction Stage

Impact on Landform: Total 225 acres land will be required to set up the power plant of which 204.64 acres land will be required for power plant, 18.63 acres for coal corridor and 1.3 acres for approach road construction. The proposed land is low land and primarily used for salt and shrimp cultivation. The land use pattern of the project site will be changed from low land fish farming and salt pan area to high land industrial category.

Mitigation Measures: Land development should be confined within the project boundary, and special care needs to be taken as the earth filling material cannot move to the adjacent land. Greenbelt development program shall be taken as early as possible after completion of the construction activities.

Impact on Sites from where Material would be Collected: The present average land elevation of the project site is + 1.25 meters which needs to be raised at +10.0 m by river dredged material to avoid flood and storm surge. The dredge materials collection process in the sea/river will increase noise, turbidity and number of vessels movement, which may impact on aquatic ecosystem and disturbance to the river traffic temporarily. Any accidental spillage of fuels and lubricants and improper management of the solid and liquid waste from the dredgers/vessels will impact on the aquatic ecosystem.

Mitigation Measures: The contractor must select the dredging site to avoid the sensitive locations. Necessary permission must be taken from the concerned authority prior to starting dredging. Maintain the dredgers and other water vessels regularly.

Impact on Drainage Pattern: There is a creek/canal at the western side of the project site which is flowing from north-south direction along the eastern side of the embankment. Also, a canal is entered from northern boundary and flowing NW-east direction in the project site and crossed the eastern boundary. Due to the land filling in the existing project site and closing the existing canal, drainage system in the project site and surrounding area will be impacted.

Mitigation Measures: Land development will be confined within the project boundary. Ensure the proper drainage facility of the project site and surroundings. Monitor the surrounding drainage condition during the monsoon season to avoid waterlogging.

Impact on Ambient Air Quality: During site cleaning, land filling, site establishment, earthwork and transportation activities in dry condition significant dust will be generated. Gaseous emission from the operation of machinery, equipment's, vessels and vehicles will impact on ambient air quality.

Mitigation Measures: Water sprinkling shall be regularly carried out in order to arrest the fugitive dust on landfill sites. Limit the speed of the vehicles (it shall be 20 km/hour) and cover the vehicles during the movement or transportation of soil for landfilling. Vehicles, DG sets and machinery to be properly and timely maintained and serviced regularly to control the emission of air pollutants. Dust monitoring should be carried out every day by the contractor in the landfilling site.

Impact on Ambient Noise Level: Major sources of noise generation during pre-construction stage are dredging activities, vessel movement, dredged material unloading pump operation, machine operation for site cleaning, filling, levelling, compaction and vehicle movement on the road and project site. Noise generation from the equipment and vehicle movement will impact the nearby resident. Noise generation from dredging will impact on aquatic ecosystem.

Mitigation Measures: Inform the local community before starting the landfilling activities. Provide appropriate Personal Protective Equipment (PPE) for the workers. Avoiding unnecessary engine operations & horns and maintaining the vehicle and equipment regularly. Use muffler and silencer to reduce the noise level from the equipment and machinery.

Impact on Waterbody: Dredging activities in the waterbodies will change the bottom topography and increase the turbidity. Solid waste, liquid waste and accidental spillage of oil and lubricant from the dredger will be significantly impact on the water resources as well as the aquatic life. Without secondary settling pond, runoff during dredged material dumping to the proposed site will increase the sediment content in the surrounding waterbody.

Mitigation Measures: Site cleaning waste should be dump primarily in a specific area in the project site and immediately remove to the approved site. A secondary settling pond should be established to settle down the sand material. Accidental spill management plan should be introduced in the site. Introduction of land/soil erosion and dust control practices on the project site.

Impact on Soil: The project area soil and surrounding land will be impacted if contaminated dredge soil is used for land development. Different machinery, equipment and vehicles will be used during land development. Accidental leakage during vehicle and equipment maintenance and operation may impact on soil quality.

Mitigation Measures: Establishing the project boundary prior to sand filling. The storage areas of oil, fuel and chemicals will be surrounded by bunds or other containment device to prevent spilled oil, fuel and chemicals from reaching the receiving waters. A site-specific Emergency Response Plan will be prepared by the Contractor for soil clean-up and decontamination.

Social Impact

Land Loss: Among the 225 acres required land, Total 166.25 acres land is private land, and 58.75 acres land is government khas land. The proposed land has already been acquired by the government from the local community. The compensation for those who have had their land acquired has been paid through DC office.

Mitigation Measures: PAPs losing land shall be involved in project‘s job opportunity based on their qualification.

Loss of Livelihood due to Land acquisition: The predominant land use of the proposed project acquired land is salt pan during the dry season and shrimp culture during the monsoon and post-monsoon season. Approximately 204 salt pan workers and 20 shrimp cultivators will lose their livelihood.

Mitigation Measures: OPDL-2 shall prepare a livelihood restoration plan and eligibility for livelihood restoration measures. Enhancement of sustainable livelihood of the affected saltpan and shrimp workers through skill development for alternate employment. Unskilled labor during the project construction phase would be sourced from the local community.

Physical Displacement: There is no titled housing structure within the project site. Only nine squatters are living beside the embankment within the project site whereas twelve squatters are living within the 20 meters proposed coal corridor. A total of 21 squatters need to be displaced.

Mitigation Measures: Provide technical and financial assistance for the relocation of the affected households. Initiate CSR activities to enhance their livelihood and involve the displaced person in project work.

Employment Generation: The pre-construction phase activities will generate direct and indirect employment opportunities for the local community within the Maheshkhali Upazila and other areas in the country.

Mitigation Measures: Employing local people for site cleaning and development activities as per the expertise to the maximum extent possible. Working conditions and terms of employment should be fully compliant to the Bangladesh labour laws.

Impact on Ecosystem and Biodiversity

Impact on Terrestrial Flora: Very small vegetation clearance will be required during land development stage. Excessive dust deposition on plants might reduce the photosynthetic process of floral species and hamper plant growth.

Mitigation Measures: Trees/Vegetation clearance should be reduced as much as possible. Select coal conveyor routes in such a way as to avoid felling of Jhau trees. Regular monitoring and keeping records of tree removal from the project site. Greenbelt development around the project site and surrounding area as early as possible.

Impact on Terrestrial Fauna: Impact on terrestrial fauna during the pre-construction stage may happen due to loss or degradation of habitats, excessive light from site development activities, dust, noise, and vibration from the operation of machineries, equipment, and vehicles for site development. During land development, birds shall move to other adjacent places for foraging activity.

Mitigation Measures: Machinery with less noise production should be used as far as practicable. Directional lighting facilities should be followed at the project site to avoid disturbance of the movement of nocturnal wildlife species.

Impact on Aquatic Ecosystem: Dredging activity for sourcing land filling material may lead to a loss of the aquatic invertebrate (benthic) community. Underwater noise may impact on fish and other aquatic mammals. Wastewater discharge and accidental spillage to water will deteriorate the water quality which will impact on aquatic ecosystem.

Mitigation Measures: Dredging should be done in the designated place. Siltation control curtains should be used to minimize the dredging impacts. Oil leakage or spillage from land filling, levelling, and compacting associated machinery shall be contained and cleaned up regularly.

Impact on Occupational Health and Safety

Site development work would generate dust, fumes and noise that could lead to possible respiratory problems, hearing loss and other health-related problems. There is a possibility of potential injuries and harm to the health of workers during the site development activities.

Mitigation Measures: Appropriate and adequate personal protection equipment (PPE) should be provided to all workers. Provide health care and first aid facilities are readily available on the project site. Establishment of safety signs in the accident-prone area/source in the project site and dredging site. Controlled vehicles speed on the proposed project site, it shall be 20 km/hour. Contractors shall ensure the availability of water for the worker's camp. No child and/or forced labour will be employed by the EPC contractor. The record of the accidents and incidents on the project site will be maintained using a register. Working conditions and terms of employment will be fully compliant to the Bangladesh labour laws.

E5.2 Impact Assessment and Mitigation Measures during Construction Stage

Impact on landuse; According to the OPDL-2, approximately 225 acres of land will be required for the establishment proposed power plant. Primarily the existing proposed project area land is a salt pan area. Land development activities will change the existing landform and land use of the project site.

Mitigation Measures: Prior to starting the construction, project area should be bounded. The vertical clearance of the coal conveyor belt should be adjusted in such a way that the natural beauty of the Matarbari beach is maintained.

Impact on Ambient Air: Dust will generate from earthwork, foundation work, construction of building, loading and unloading equipment etc. Exhaust emissions of SO_2, NOx, CO, CO_2, and PM will be attributed predominantly to the construction of the plant; DG set operation and road vehicles such as movement of trucks and vehicles during construction work.

Mitigation Measures: The EPC contractor should develop and implement a Construction Environment Management Plan. The movement of construction vehicles shall maintain speed limit 20 km/hr. Loose material should be covered, and material transport will be totally enclosed with impervious sheeting. Implementation of regular watering and sprinkling dust suppression regime. Waste from construction will not be burned. Periodic checking of vehicles and construction machinery to ensure compliance to emissions standard.

Impact on Nosie: The potential sources of noise generation include equipment, machinery, pilling, and transportation used for the construction activities. The waterway and road traffic volume will be increased during the construction phase, which will be the source of noise to the closest receptor along the road and river side. Noise generation from the project activities will affect the adjacent community, occupational health and terrestrial as well as aquatic fauna.

Mitigation Measures: The EPC contractor should ensure that all equipment and its mufflers are regularly serviced. The EPC contractor should limit operation times of noisy equipment, vehicles and activities, where possible. Conduct regular inspections and spot checks of all noise generating equipment. Temporary noise barriers shall be provided surrounding the high noise generating construction equipment. Restrict the nighttime work. Periodic checking of vehicles to ensure compliance to sound standard following the National Motor Vehicles Standard.

Impact on Water Bodies: Effluents from the construction area mainly contain suspended solids while the sanitary waste from the labour colonies contains suspended as well as organic matter. The loose construction material like sand, cement etc. and excavated earth/construction debris may get washed off during heavy precipitation and finally reach the nearby River. Pilling work for jetty will increase the suspended solid and accidental spillage may pollute the river water quality.

Mitigation Measures: Channelize all surface runoff from the construction site through a stormwater drainage system and provide adequate size double chambered sedimentation tank. Oil leakage or spillage shall be contained and cleaned up immediately. Adequate sanitary facilities, i.e. toilets and showers, will be provided for the construction workforce. Solid shall be segregated, transported and disposed of to waste disposal facility.

Impact on Groundwater Quality: Groundwater contamination during the construction phase may occur from unplanned events such as leaks and spills of oil, lubricants, fuel from heavy equipment, improper handling of sewage or chemical/fuel storage. There is a potential for long-term direct impacts to groundwater quality from construction activity if proper mitigation measures not taken.

The water demand for the construction works will be about 40 m^3/hour to 100 m^3/hour during normal and peak demand respectively and will be sourced from deep tube well (>500 ft). There are no household adjacent to the power plant boundary. The main source of drinking water of the villages is shallow tube well (within 100-200 ft). Since the project will withdraw the required water from deep tube well whereas the villagers use the shallow tube well hence the impact will not significant.

Mitigation Measures: Ensure proper spill control and management at site. Fuel should be kept on concrete floor with bund. Ensure storage of hazardous material and waste in proper manner and dispose of the waste in hazardous waste landfill site. Septic tanks/STP shall be provided to treat sanitary wastewater.

Impact on Soil: Soil contamination during the construction phase may result from leakage and spillage of oil, lubricants, fuel from heavy equipment or leakage from chemical/fuel storage. If improperly managed, hazardous waste could create impacts not only to land but also to local air quality, water quality, and human health.

Mitigation Measures: Establishing the project boundary prior to start construction. A site-specific emergency response plan shall be prepared for soil clean up. The storage areas of oil, fuel and chemicals will be surrounded by bunds or other containment device to prevent spilled oil, fuel and chemicals. Disposal of waste by licensed contractors/local municipality.

Impact on Workers Health and Safety: The construction activities include site preparation, infrastructure utilities installation and building structures. The loading and unloading operation of the construction material may cause an injury if not handled properly. During construction works, physical injury results due to road accidents, construction accidents, and other occupational hazards. Overexertion, injuries and illness are potentially the most common health hazards associated with construction activities.

Mitigation Measures: Adequate health care and sanitation facilities for construction workers will be provided by the contractor at the construction campsite. Ensure adequate first aid facilities in the construction site. Safe drinking water must be provided to the workers. Periodic health check-up shall be ensured. Regular tool-box training shall be conducted prior to start work. Provide appropriate PPE to all workers.

Impact due to Solid Waste Generation: During the construction period, various hazardous and non-hazardous waste will be generated. Due to the improper management and disposal of wastewater into the open environment will impact on soil quality and surrounding environment.

Mitigation Measures: Establishment of the waste management plan at the project construction site. Collect and segregate all solid waste. Solid waste burning in the construction site is strictly prohibited. Regular monitoring will be carried out by the contractor to record the generation and disposal of waste in daily basis.

Social Impact: The construction phase activities will facilitate merging of the local workforce (mostly unskilled) with the migrant workforce (mostly skilled). Additionally, on-the-job skill enhancement in technical detailing and design, health and safety, work-based skills, and other areas will improve the skills of the local workforce. Employment generation will have a positive impact on the lives of the people. Besides, local community will be benefited by the different types of local business. There is a possibility of conflict between the local community and workers.

Mitigation Measures: OPDL-2 management should provide priority to the local people during job recruitment. Job advertisements should be made through mediums that are easily accessible to the local community.

Impact due to wastewater Generation: The construction wastewater and domestic sewage could be very significant if not well managed and controlled and could possibly pollute the receiving water bodies. The principal receptor would be nearby surface water body (Kutubdia Channel and Matamuhuri-Kuhelia River), the sea (Bay of Bengal). Due to the improper management and disposal of wastewater into the open environment will impact on soil quality, sediment quality, surface water quality, groundwater quality and aquatic environment.

Mitigation Measures: Channelize all surface runoff from the construction site through a stormwater drainage system and provide adequate size double chambered sedimentation tank. All waste oils and chemicals should be stored in drums or tanks in a bunded compound. Construction camp wastewater (both grey and black water) will be stored in soaking pits/ septic tanks and treated in STP.

Impact due to Transportation of Raw Materials

The proposed project will be using the existing water way or roads for the purpose of transportation of materials and personnel. An increase in both road and marine traffic is expected as a result of the vehicles and vessels carrying construction materials to the project site. However, the extra traffic load due to vehicles and vessels carrying construction materials during construction stage is not so high to impose high level impact on the road and river.

Mitigation Measures: Proper Traffic Management Plan (TMP) should be prepared by the contractor during the start of construction & follow it strictly. Limit the speed of construction vehicles in the construction site and project approach road. Instruct the drivers to avoid unnecessary horns and engine operation in the construction site and approach road. Proper indication of accident-prone area, education and religious institutes in the project site and approach road.

Impact on Ecology

Impacts on Terrestrial Flora: Dust will be generated in the proposed project site due to very small vegetation clearance, construction of access road. It will be dispersed by wind action. Excessive dust deposition on plants might reduce the photosynthetic process of floral species and hamper plant growth which may result to causing diseases.

Mitigation Measures: Suppression of fugitive dust emissions through spraying water in the construction area. Supply fuel to the workers for cooking and train them not to use wood as a fuel. Greenbelt development around the project site and surrounding area as early as possible.

Impacts on Terrestrial Fauna: Noise and vibration generated from operation of machineries used for site construction, construction of 4.7 km elevated coal corridor may affect the habitat and behavior of terrestrial fauna (Herpetofauna, terrestrial mammals, and Shore birds) residing in the adjacent areas of the project site. Artificial lighting will negatively affect behavior, survivorship, and reproduction of migratory and shore birds.

Mitigation Measures: The noise generating activities should be scheduled during the daytime only. Provide acoustic enclosures and noise barriers in areas of high noise generating sources to avoid discomfort to local wildlife. Use low-intensity lighting, which reduces the brightness of the lights and helps to reduce the glare. Control the vehicle speed limit (20 km/hr) in the project site and approach road.

Impacts on Aquatic Ecosystem: Accidental spillage of oil and other chemicals during unloading activities in jetty area and from storage may reach the Kutubdia Channel directly or by runoff and impact the aquatic ecosystem. Accidental discharge of untreated sewage from the facility will increase the BOD load in the receiving surface waterbodies and will ultimately affect the primary productivity of the adjacent discharged area as well as fisheries resources. High sediment content from construction of jetty and water intake channel may increase the turbidity of the surface water that may disturb fish breathing even may lead some species to death.

Mitigation Measures: Follow the mitigation measures provided under waterbodies and wastewater generation. Also, provide restriction on construction workers for fishing in the river. Avoid the coal conveyer belt construction during turtle breeding season. A Turtle Conservation Plan should be developed.

Impact on Community Health and Safety: Inhabitants residing close to the project site and surrounding roads will be affected due to noise and dust generated from vehicular movement. The influx of workers into the community may have an impact on public health, particularly an increase in disease prevalence. Inadequate sanitation facilities and waste disposal from the construction labor camp can result in vector-borne diseases and other infectious diseases. Construction activities are expected to increase traffic load on the site approach road, potentially posing a public safety risk to nearby residents.

Mitigation Measures: Inform the local community before starting the construction activities. Avoiding formation of stagnant water pools in and around the site. Regular water spying in the high dust generating area. Limit the speed of construction vehicles (20 km/hr) in the construction site and project approach road. Avoid use of unnecessary vehicle horns.

E5.3 Impact Assessment and Mitigation Measures during Operation Stage

The potential impacts during the operation phase of the proposed project are air quality, noise, water bodies, waste generation, ash disposal, occupational health and safety, social impact, terrestrial flora, terrestrial fauna, and aquatic ecosystem, impact due to coal transportation.

Impact on Air Quality

The operation phase of the proposed plant will involve air emissions from fuel combustion and fugitive dust emissions from coal handling, storage and transportation and coal preparation activities.

Impact due to Coal Handling, Transportation, Storage and Preparation: The moisture content of the coal to be transported is expected to be near the design coal range of 15%. Considering that about 4042 MT of coal will be handled per day, the total fugitive emission from coal handling has been estimated at 1.25 kg/day.

The coal preparation activities will involve emissions of fugitive dust during the coal screening, crushing and conveyance for magnetic separation. Considerable amounts of fine particles will also be emitted from the coal preparation activities that will get dispersed over much greater distances from the source.

Mitigation Measures: Automatic dust detectors will be provided in the coal yard and in case the dust level exceeds beyond a threshold value, water sprinkling will be carried out. Coal stockyard should be covered so that wind cannot disperse storage coal. Coal conveyor belts should be covered to avoid wind. Greenbelt development program will be adopted in and around the project site.

Impact due to Fuel Combustion: The AERMOD model has been run for two scenarios e.g. only proposed 635 MW coal based power plant operation (scenario I) and a total of three power plant operation (scenario II). Due to the proposed plant operation, the 24-hourly and annual predicted maximum NO_2 concentration found as 7.98 µg/m^3 and 1.34 µg/m^3. 1- hourly maximum SO_2 concentration was found 114 µg/m^3 whereas 24- hourly SO_2 concentration was found 4.75 µg/m^3. 1-hourly maximum CO concentration was found 109 µg/m^3 whereas 8- hourly CO concentration was found 13.7 µg/m^3. Since there is no fraction of particulate matter as PM_{10} and $PM_{2.5}$ in national standard and WHO guidelines hence, it has been assumed that $PM=PM_{10}=PM_{2.5}$, the proposed power plant will have the same contribution of PM_{10} as PM which is considered worst case scenario. The 24- hourly and annual maximum PM_{10} or $PM_{2.5}$ concentration was found 0.91 µg/m^3 and 0.15 µg/m^3. It shows that only proposed power plant operation will meet the ambient air quality standard of Air Pollution Control Rules 2023.

In cumulative scenario, 24-hourly and annual predicted maximum NO_2 concentration found as 20.2 µg/m^3 and 4.0 µg/m^3. The 1-hourly and 24-hourly predicted maximum SO_2 concentration found as 412.0 µg/m^3 and 35.8 µg/m^3. The 1-hourly and 8-hourly predicted maximum PM_{10} concentration found as 2.2 µg/m^3 and 0.4 µg/m^3. The cumulative scenario shows that only 1-hourly SO_2 concentration will exceed the ambient air quality standard whereas other parameters concentration will be within the standard.

Mitigation Measures: The flue gas to be exhausted at 220m stack height. ESP, Low Nox burner and FGD will be used to reduce particulate matter, NO_2 and SO_2. Continuous Emission Monitoring System (CEMS) will be installed to detect the emission level. Automatic monitoring process and presenting on the real-time Web Pages should be implemented. Regular inspection and maintenance of all equipment of the plant. Periodic ambient air quality will be monitored as stipulated in the monitoring plan.

Green House Gas Emission: The total $C0_2$ production due to coal combustion has been estimated as 2.693 million tonnes/year. GHG emission contribution of the proposed project in the year 2030 will be 2.83% of the electricity generation sector in Bangladesh.

Mitigation Measures: Continuous monitoring and recording of CO_2 emission from the stacks through CEMS. Ensure that all equipment and machinery is maintained in accordance with manufacturer's specifications.

Impact on Ambient Noise Level: Noise level has been observed from five locations and noise level have been found 47.6-54.6 dBA at daytime and 38.2-44.7 dBA at nighttime. Predicted sound pressure level have been recorded from 40.7-57.2 dBA at daytime and 40.2-56.4 at nighttime at the noise level monitoring locations. Total sound pressure level at daytime varies from 53.2-57.7 dBA and 44.5-56.5 dBA at nighttime. The nighttime predicted noise level at NL2 and NL3 have been exceeded which will be offset when all structures and greenbelt established.

Mitigation Measures: Noise insulation should be implemented surrounding the turbine and generator casing. Construct high and thick boundary wall that could act as noise damper. Greenbelt development should be carried out all around the project boundary. The OPDL-2 should conduct regular inspection and spot checks of all noise generating equipment. Periodic check the noise level at the sensitive location around the plant.

Impacts on Water Bodies

Impacts on Surface Water Quantity: About 81513 m^3/hr of surface water will be sourced from Kutubdia Channel for the proposed project. The major water demand for the proposed power plant is cooling water system and it has been estimated as 81,259 m^3/hr. Total 81,259 m^3/hr water will be discharged back to the sea. Only 254 m^3/hr or 0.07 m^3/s water will be consumed by the power plant. The water flow rate of the Channel is 3,200 m^3/s. Considering the consumed water (254 m^3/hr or 0.07 m^3/s), it will be 0.002% of the water flow, which can be considered as very insignificant.

Mitigation Measures: Records will be maintained to monitor the quantity of water being used. Efforts shall be made to ensure that the reuse of processed water is carried out. Permission must be taken from respective authority as per water rules 2018.

Impacts on Surface Water Quality:_The proposed power plant will adopt a once-through cooling system. Circulating water after heat exchange will return to Kutubdia Channel of the Bay of Bengal through drainage system. It will increase the surface water temperature of the Kutubdia channel and the adjacent river. Hot water discharge and other treated water discharge in the river will impact on water quality which ultimately impact on aquatic ecology.

Mitigation Measures: All the waste that would be produced during the power plant operation units and workers facilities must be treated in the ETP and STP plant. Domestic sewage, coaly wastewater, oily wastewater, industrial wastewater will be recycled after treatment. Treated sewage shall comply with the ECR 2023 prescribed standards (Schedule 4: Standard for wastewater). Treated sewage and wastewater shall comply with the ECR 2023 prescribed standards (Schedule 3: Standard for sewerage water and Schedule 4: Standard for wastewater).

Discharge of Once through Cooling Water

According to the project design, maximum 5°C temperature will increase than the ambient water temperature once discharges back 81,259 m^3/hr condensed cooling water. A plume water modeling has been carried out for different scenarios to determine the mixing zone of hot water. It has been found that temperature will rise more during summer season than winter. The temperature will drop to less than 2°C within 200 meters whereas less than 1°C after 500 meters. Maximum temperature raise is found 31.35℃ from ambient temperature (28.5℃) within 50m of the outlet point during low tide of summer season whereas 31.19℃ temperature found within 50 m during high tide in summer season. Maximum 29.07℃ temperature is found during high tide in winter season with 50 meters of outlet point towards north direction. Environment Conservation Rule, Schedule 4 restricts release of industrial water above 5°C and with this rise of temperature the cooling water discharge would never reach this limit. The warm water will disperse towards the north direction during high tide and south direction during low tide. Insignificant water temperature will rise towards west direction during both seasons. It is evident that most of the aquatic organism of this tropical region can tolerate 32℃. Hence, significance has been assessed as Medium High due to the temperature increase of ambient water.

Mitigation Measures: Discharge system shutdown in event that discharge temperature of cooling water exceeds standard (no more than 5°C of ambient water temperature as per Schedule 4-Standards for Waste from Industrial Environment Units or Project Waste of Environmental Conservation Rules 2023). Treated water effluent shall be mixed with cooling water to drop down the temperature. Monitor the water temperature at the discharge point daily and keep record.

Impact due to Solid Waste Disposal: Ash is the main solid waste generated in the coal-based thermal power plant. The waste includes fly ash, bottom ash and boiler slag. The coal consumption has been estimated as 4042 tons/day in the proposed project. Approximately 363.8 tons/day fly ash and 72.8 tons/day will be produced. The ash residues may contain heavy metal and some organic compounds or potentially hazardous materials. Improper management of ash will lead to air, water and soil pollution.

Mitigation Measures: The OPDL-2 will develop and implement a waste management plan for the operational phase of the power plant project. Employees should be provided with appropriate PPE for handling the ash. Color coded bin shall be set-up in the plant. Waste shall be segregated and disposed of in a proper way.

Impact due to Ash Disposal: Approximately 363.8 tons/day fly ash and 72.8 tons/day will be produced due to plant operation. Fly ash could deposition on the plant leaf surface and hamper photosynthesis. Coal and coal waste products, including fly ash, bottom ash and boiler slag, contain many heavy metals. Failure of waste management and ash management system may cause release of these hazardous wastes to environment that might also contaminate food chain.

Mitigation Measures: An advanced technique like ESP, ash silo and ash pond have to be maintained regularly for ash management. Fly ash shall be sold to the cement industries as much as possible. Composite geomembrane shall be installed on the surface of the bottom and inside slope for the ash yard. A leachate collection system should be incorporated in the ash yard design and treat them in treatment plant. Ground water monitoring shall be carried out regularly near the ash yard.

Impact on Ecology

Impacts on Terrestrial Flora: The major pollutants from the operation of coal based thermal power plant are PM, SO_2 and NO_2. Accidental dispersion of flue gas, fly ash and bottom ash might create impacts of terrestrial flora. Nitrogen and Sulphur containing air pollutants can affect plants health indirectly, via chemical reactions, or directly after being deposited on plant leaves. The direct impact of airborne nitrogen is due to toxic effects, eutrophication, and acidification.

Mitigation Measures: Coal dust suppression should be done by water sprinkling at the coal transfer points. A plantation plan should be implemented for greenbelt development with appropriate indigenous species. The leaf surface acts as reaction centers for removing atmospheric pollutants. So, the plant has left of large surface areas are suggested for development of green belt.

Impacts on Terrestrial Fauna: The higher noise level produced from power plant operation may cause disturbance and behavioral changes of the faunal species like shore bird species found north-western part from the proposed project site. Artificial lighting may result in the attraction of some wildlife living in the project adjacent area, leading to their disoriented movement and confusion behavior.

Mitigation Measures: Provide acoustic barriers in areas of high noise generating sources to avoid discomfort to terrestrial fauna adjacent to project site. Avoid unnecessary lighting in the project site at nighttime. All coal transfer points should be provided with dry fog dust suppression system.

Impacts on Aquatic Ecosystem: The proposed power plant is adopting once-through cooling system, so it has direct impact on fish and crustacean diversity as well as other aquatic organisms which may lead to bring permanent change to diversity and composition. Accidental discharge of surface runoff from sedimentation tank during heavy rainfall, spillage of oil during fuel handling into the sea have the potential to affect the water quality of adjacent waterbody and reduce the diversity of aquatic flora, planktonic profile, and fauna.

Mitigation Measures: Monitoring of temperature at the discharge point at a frequency of everyday. Discharged cooling water temperature cannot exceed 5°C than surface water temperature as per ECR 2023 (Schedule-4). Restrict the night lighting along the coastline/coal conveyer belt area. The intakes for the water pumps in the main pump-house will meet the IFC guidelines, including recommended intake velocity less than 0.30 m/s and a mesh size of 9.5 mm. Spill control measures shall be readily available in the plant.

Impact on Occupational Health: Employees working in the operation phase could be carriers of contagious disease, which could lead to health problems in the community. The occupational health and safety risks associated with the project are Non-ionizing radiation, heat, noise, confined spaces, electric hazard, fire and explosion hazards, chemical hazards and dust.

Mitigation Measures: Use of personal protective equipment (PPE) in the workplaces. Regular checking, monitoring and careful operations with the standard procedure. Warning signs shall be put in the high health risk area. Ensure adequate first aid box and medical facility in the plant.

Impact on Public Health and Safety: Community Health and Safety risk include exposure to emissions, noise and vibration nuisance, non-ionizing radiation generated by the power transmission grid, dust emission, improper management of waste (solid, liquid, hazardous), improper drainage from the workers camp, accidents and injuries associated with increases in vehicular traffic, workers and pedestrians on existing roads, and traffic nuisance and the consequence potential health risk due to degraded air quality, visual impact and resulting emotional stress and increased public insecurity.

Mitigation Measures: Update technology and emission controlling equipment should be ensured by the OPDL-2. A proper drainage system should be ensured in the project premises and surrounding area. All the waste from the power plant and workers' facilities should be collected properly disposed as per best practices. OPDL-2 should form a grievance redress team to solve the social issue due to the project operation. Prepare a CSR plan and implement it accordingly for the local people.

Impact on Traffic Movement: It is expected that, on average, 10 to 20 vehicles per day will be mobilize in the project site. Hence, increases in the volume of traffic have no major significant impact of accidents and noise levels along the access road.

Mitigation Measures: OPDL-2 should develop a Traffic management plan for the operational phase. Establishment of safety signs, warning light post, speed breaker should be ensured by the project authority and all signs should be written in local language. Limit the vehicle speed near the narrow approach road, school, bazar, mosque and settlement area.

Social Impact

Employment Generation and In-Migration of Skilled Workforce: During the operation, few unskilled local people will get job opportunities. Although the number of jobs created during this phase is likely to be small, there are likely to be some indirect positive effects on the local community as a result of the workers renting houses and rooms and the need for transportation services, which includes the regular requirement for commuting short-term visitors and industrial provisioning of a variety of materials. The effects in terms of job creation will have a positive impact on the employment situation.

Mitigation Measures: OPDL-2 must endeavor to provide the local community for any job opportunities, prioritizing the residents immediately neighboring and/or displaced by the project.

Impact on Economic Enhancement: This project will definitely alter the simple and quiet rural nature of the locality, which exists today. As there will be flow of financial and material resources, there remains a large possibility of growth of population in the business, trade, commerce, and service sectors. Demand for different resources and business opportunity will be increased as a result local economy will also be enhanced.

Mitigation Measure: Establish youth and women empowerment training centre and introducing diverse income generating activities training. OPDL-2 should promote and support economic empowerment initiatives for the local community through its CSR programme.

E6 Evaluation of Impacts

Potential impacts have been identified of the proposed power plant in detail. Chapter six (6) represents a detailed evaluation of the impacts on the basis of nature, extent and location, duration, Intensity/severity, Potential for irreplaceable loss of resources, probability and magnitude. After taking the inbuilt pollution abetment measures, those impacts significances have been ultimately categorized into different classes like very low, low, medium low, medium high, high and very high etc. Impacts are evaluated considering with mitigation measures and without mitigation measures.

E7 Mitigation of Impacts

Mitigation of negative impacts and enhancing the positive impacts are the prime intent of this environmental study that is represented in a separate chapter (e.g. Chapter 7). Potential impacts of the proposed power plant have been identified at every step of development, the mode of impacts have been the detailed ins and outs to understand its significance towards socio-economic, ambient environment, landscape and water resources. Aftermath, this study suggests necessary mitigation measures to the project with the objective of limiting negative impacts as minimum as possible in compliance with GoB's rules and regulation and enhancing environmental, ecological and societal benefit.

E8 Analysis of Alternatives

This chapter discusses the alternative considerations that have been studied before finally proposing the present project. The alternatives are considered for the following major issues.

a. The requirement of the proposed project to meet the power demand.
b. Selection of the proposed site
c. Selection of the project configurations and technology

E9 Environmental Management Plan

As per the scope of EIA study, a detailed EMP has been developed that shall be duly implemented in project pre-construction, construction and operation phase in order to minimize the negative impacts. The environmental and social management plan has been described elaborately in Chapter-9 in this report. Responsibilities for implementation and supervision of environmental management plant have also been definite in this section. The capital cost for environmental management of the proposed plant is estimated to be BDT 21.45 million.

E10 Environmental Monitoring Plan

Successful implementation of the EMP depends on regular monitoring with the selected indicators at specified locations in and around the project area. During all phases, air quality, noise level, water quality will be monitored in a regular basis as stipulated in the monitoring plan. During the operation period, online air monitoring system shall be fully functional throughout the entire lifetime of the project, and it will be displayed to the DoE office as well. Environmental management plan during pre-construction and operation stages will be implemented by EPC contractor. The EHS personnel of OPDL-2 will monitor the effectiveness of the EMP implementation. The contractor will generate a monthly report which will be submitted to the supervision consultant and OPDL-2. Quarterly Progress Reports that can be submitted to the regional office and head office of the DoE required as a part of environmental clearance process shall also be prepared and submitted based on the necessary monitoring and reporting formats. Environmental management and monitoring plan during operation phase will be implemented by O&M authority. The monitoring cost has been incorporated in the report as 0.89 million for pre-construction phase, 12.8 million for construction phase and 5.18 million for per year operation phase of the proposed power plant project. A detailed monitoring plan for the proposed project is also depicted in Chapter-10 in this report.

As per the monitoring plan, third party / independent monitoring bodies will be engaged for monitoring of all the activities during pre-construction, construction and operation phase.

E11 Work Plan

The pre-construction phase will be 6 months duration and construction phase will be 36 months duration. The expected commercial operation will be started in June 2026.

E12 Public Consultation

A range of stakeholder engagement and consultation methods have been used to identify concerns, issues and suggestions for the Project. This included any suggested management and mitigation measures. This involved Government consultation, face-to-face interviews, small group meetings, focus group discussions and a household level survey.

Outcomes from this consultation showed that the community was generally supportive of the proposed project and that the community believed that project would bring some benefits to them and the local area. Such perceived benefits included the potential for local employment relating to the project and the potential that infrastructure investment in the local area may occur as a result of the project. The major concern of the people is to engage local people during the construction and operation of the project.

Key concerns that government stakeholders and local people were found to have about the project included safety aspects of the project, the potential for pollution to occur and that there might be some damage caused to local roads or other infrastructure during construction. This EIA has addressed each stakeholder's concern with the development of specific mitigation and management measures.

E13 Hazard and Risk Assessment

Hazard and risk assessment is important for any energy-related industries. Chapter 13 describes disaster, hazard and risk assessment. The proposed project may possess mechanical risk from turbine and generator; electrical risk from power transformer, switchyard, control room, transmission line; risk of fire and explosion from boiler, live steam line, and fuel stockpile; risk of toxic/carcinogenic chemical exposure from chemical storage and accidental discharge of sulfuric acid from SOx absorber.

Risks associated with handling of chemicals and fuels in the proposed power plant revolve around handling and storage of chlorine, ammonia solution, LDO/HFO and HCl. The risk of the proposed power plant has been identified precisely in this EIA study by using ALOHA. The concentration which is immediately dangerous to life and health (IDLH) value for chlorine has been identified as is 20 ppm within 644 meters due to 5 mm leak of chlorine tonner. The mitigation measures of risk associated with chlorine tonner leakage and fuel oil storage have been incorporated in the EIA report. Disaster impact assessment and subsequent mitigation measures are also incorporated in the report.

E14 Conclusion and Recommendation

The project entails various impacts on the study area, some negative and some positive. This EIA study finds out the significant environmental and social impact during pre-construction, construction and operation phase. it is found that major impacts on environment in the area due to implementation of the power plant project would be livelihood loss, vegetation/tree removal, closing of existing canal, air pollution, noise pollution, surface water pollution, ground water pollution, soil pollution, sediment pollution and impacts on aquatic ecology in pre-construction phase and construction phase. During operation stage, the main impact is associated with the generation of SO_2, NO_2, and Particulate matter from power generation processes and their impact on the nearby areas. However, with mitigation measures like ESP's, use of coal with low sulphur content and FGD, these will be reduced to have minimum impact in the study area. There are also very significant positive impacts during construction and operation phase like local people job opportunities and increase business opportunities. Based on the analysis conducted in this environmental and social assessment, it is concluded that overall, the Project will result in positive socio-economic benefits and the negative environmental impacts that have been identified are mostly short-term and localised in nature, and can be minimized adequately through good design, appropriate application of mitigation measures, monitoring and regular supervision of implementation.

Finally, the following recommendations are made based on EIA study that should be considered for achieving the goal of optimum minimum environmental impact and optimum benefits:

- Findings and suggestion of EIA study in project planning, design and operation should be considered and implement with strong monitoring;
- People those who are living within the project boundary as squatter should be compensated and created scope for alternative livelihoods;
- A drainage study including detailed survey must be conducted by the project proponent to avoid the waterlogging in the proposed project surrounding area;
- Income and employment opportunities for the local community and strengthen the CSR activities for the local community;
- All activities (pre-construction, construction and post-construction stage) should be implemented according to EMP;
- Conduct fish and turtle survey in Kutubdia channel during construction and operation phase of the proposed project;
- Cooling water discharge temperature must be within 5°C than ambient water temperature;
- The intakes for the water pumps in the main pump-house will meet the IFC guidelines, including recommended intake velocity less than 0.30 m/s and a mesh size of 9.5 mm;
- Obtain the Clearance Certificate from WARPO for taking make up water from underground and Kutubdia channel during construction and operation stages;
- The plant should be operated ensuring all pollution abatement measures, e.g. ESP, FGD, Low NOx burner, effluent treatment plant, etc. are in order, and regular monitoring has to be done to evaluate their performance;
- Prepare a health impact assessment prior to commencement of the construction work;
- Environmental monitoring plan stipulated in the EIA study should be followed at every stage of the proposed power plant.

CHAPTER 1
Introduction

1 INTRODUCTION

1.1 Background

According to The Power System Master Plan (PSMP) 2016, Bangladesh aspires to become a high-income country by 2041. Therefore, the development of energy and power infrastructure pursues not only quantity but also quality to realize long-term economic development and to match the objective, improvement of power quality for the forthcoming high-tech industries needs to be addressed holistically.

With reference to the above issues and in connection to the captioned subject it is to mention here that ORION has been awarded for the implementation of a 635 MW (Net) Ultra Super Critical Coal Based power plant under IPP to meet up the demand - supply gap and to meet the vision of the country through setting up such mega power plants. Orion Power Unit-2 Dhaka Limited (OPDL-2) was awarded the Letter of Intent (LOI) by Bangladesh Power Development Board (BPDB) as the "First Ranked Bidder" for designing, financing, insuring, construction, ownership, commissioning, operation, and maintenance of electricity generation facility at Gazaria, Munshiganj. Subsequently, OPDL-2 signed the Power Purchase Agreements (PPA) and Implementation Agreements (IA) to Build, Own and Operate (BOO) a 635 MW Coal Fired Power Plant in Munshiganj on April 21, 2016.

For implementing the projects, OPDL-2 considered a site at Munshiganj (greater Dhaka area), along the bank of the Meghna River. OPDL-2 procured more than 120 Acres of land in that location near the Meghna River and a major industrial area. The land is suitable for such a power plant.

But due to environmental issues worldwide, the use of Coal-based power plants was decreasing day by day. Specially it was decreasing in the developed countries of the world. Most of the developed countries were also discouraging the implementation of Coal-fired power plants. In Bangladesh, OPDL-2 was also not an exception. Bangladesh also faced several National/International pressures to discard Coal-based power plants. Consequently, the Government of Bangladesh discarded many Coal-based power plants in Bangladesh which were previously awarded to different private power producers.

Nevertheless, in recent days of the acute crisis of Oil & Gas due to the effect of the Russia-Ukraine war, many developed countries are changing their strategies for generating electricity to avoid dependency on Russian Oil & Gas. Such as Germany has recently re-opened all of their Coal-based power plants to avoid consuming Russian Oil as well as to generate the least costly electricity.

Despite the above situation, the Government of Bangladesh has given high emphasis on implementing the proposed Coal-based power plant i.e., Orion Power Unit-2 Dhaka Limited for which the Government has instructed to implement the project at a different location which is at Moheshkhali. As part of the Power System Master Plan (PSMP) 2016, Bangladesh Government had taken Moheskhali-Matarbari Integrated Infrastructure Development Initiative (MIDI) where several Coal based thermal power projects were considered and a deep-sea port is under development where coal-carrying mother vessel can directly approach to the shore. As per the Bangladesh Power Development Board (BPDB) and Power Division, Ministry of Power, Energy and Mineral Resources (MOPEMR), this location is the most suitable in Bangladesh for developing Coal based Thermal Power Plants. Here power evacuation facility is also available. As several initial planned coal projects were cancelled by Bangladesh Government due to environmental issues earlier, BPDB and MOPEMR advised OPDL-2 to shift the project site to the Moheskhali area on land owned by Coal Power Generation Company Bangladesh Limited (CPGCBL) to ensure the best utilization of this land as well as most reliable operation of this project i.e., OPDL-2.

The main benefit of the site is that here inland transportation of coal is not required. Here, mother vessels like Panamax/ Supramax with 60,000- 70,000 DWT can directly approach to coal unloading jetty. Considering the similar design of Japanese ports i.e., Kashima and Niigata, Matarbari port has been developed as the first deep seaport in Bangladesh. The navigation channel is 350 meters (1,150 ft) in length with a maximum permissible draught of 16 meters (52 ft). Ships with a capacity of 70,000 DWT are able to dock here. As no inland transportation is involved in this project in the new location, there is also no dependency on river dredging by BIWTA as well as no uncertainty of Coal transportation during rough weather. Besides this, environmental impact due to inland transportation, ship-to-ship loading/unloading etc. is also eliminated from the project scope.

This power plant is planned under "Moheshkhali-Matarbari Integrated Infrastructure Development Initiative (MIDI)". The proposed power plant location is located near to the existing Matarbari 600X2 Coal Power plant and will be benefitted to transfer of coal through the conveyer belt (4.7 km away) from the proposed coal terminal.

According to the ECR 2023, the coal-based power plant is under the RED category project. Consequently, IEE & EIA are pre-requisite before implementation of the red category project. OPDL-2 has entrusted EQMS to carry out the IEE and EIA study.

1.2 Purpose of the Project

The main purpose of the project is to generate electricity with less and affordable cost. As of February 2023, about 49.07% power generation comes from natural gas followed by HFO (26.74%), Coal (11.46%), HSD (5.71%), Imported (4.94%), Solar (1.10%) and Hydro (0.98%). In Bangladesh, natural gas crisis become worsen since its demand is increasing in different sector rather than supply and reserve. Currently, fuel crisis becomes acute due the Russia-Ukraine war and LNG price goes highest peak. Hence, Bangladesh is not buying any LNG from the spot market. Other liquid fuels price also hiked. As a result of which power generation is disrupted. Fuel diversification is very important in power generation to avoid this problem. Considering the situation, GoB has given permission to OPLD-2 to setup a 635 MW coal-based power plant at Matarbari, Maheshkhali. The generated power will be evacuated through 400 kv transmission line which is being under development.

The proposed power plant, being a coal-based power plant will add 635MW electricity to national grid that will improve present electricity generation capacity of Bangladesh. This project will contribute to reduce the power cut. The project will necessitate the overall development of the project area in terms of more employment opportunities, increased rural electrification and boost to local business.

1.3 Purpose of the Study

The Environmental Impacts Assessment (EIA) report has been prepared for the proposed power plant to get prior Environmental Clearance (EC) from the DoE. The present EIA report has been prepared based on the Terms of Reference (ToR) approved by DoE and based on the primary data collected during October 2022 - January 2023. The overall objective of the present study is to conduct an EIA study of the to obtain Environmental Approval/ECC from the DoE.

The proposed coal-based thermal power plant falls under the Red category project as per ECA, 1995 and the followed up rules ECR 2023, and needs Site Clearance Certificate and Environmental Clearance Certificate from Department of Environment (DoE). The project gets an exemption from the Initial Environmental Examination (IEE) study and approval of Terms of Reference (ToR) for the EIA study from DoE on 12 October 2022 with the vide Memo No: 22.02.0000.018.72.129.22- 186. The Approved Terms of Reference is presented in **Appendix A**.

The overall objective of the study is to conduct Environmental Impact Assessment (EIA) study of the proposed 635 MW coal-fired power plant at Moheshkhali Upazila in Cox's Bazar District with the purpose of obtaining approval of EIA report as well as Environmental Clearance Certificate from the DoE.

The environmental and social impact assessment has been carried out against the following reference framework:

- Terms of Reference provided by Department of Environment.

- Applicable national and local regulatory requirements.
- EIA guidelines for industries, 2021
- Equator Principles, July 2020
- IFC's General EHS Guidelines and
- IFC's Environmental, Health, and Safety Guidelines for Thermal Power Plants.

1.4 Project Proponent

Orion Power Unit-2 Dhaka Limited, a member company of ORION which is recognized as one of the leading industrial conglomerates in the country. Being a diversified group, Orion has extensively focused on Power Generation & Energy Sector and has implemented 5 HFO based Power Plants of 100 MW (approx.) each at a record completion period and the largest solar based Power Plant of 100 MW, hence distributing total of 611 MW (Net) electricity to the national grid.

Orion Power Unit-2 Dhaka Limited (OPDL-2) is the project proponent. OPDL-2 signed the Power Purchase Agreements (PPA) and Implementation Agreements (IA) to Build, Own and Operate (BOO) a 635 MW Coal Fired Power Plant. The official name and contact details of the project proponent are given in **Table 1-1**.

Table 1-1:Contract Detail of the Project Proponent

Items	Detailed Description
Project Name	635 MW Coal based Thermal Power Plant at Matarbari, Maheshkhali, Cox's Bazar
Company Name	Orion Power Unit-2 Dhaka Limited
Address	Orion House, 153-154 Tejgaon Industrial Area, Dhaka-1208, Bangladesh
Contact Person	Mehedi Islam Aneek, Assistant Vice President
Contract No.	+8801714082308
e-mail	mehedi.opesl@orion-group.net

1.5 Brief Description of the Project

The Project will be constructed in the Matarbari Union of Moheshkhali Upazilla in Cox's Bazar District, Chittagong Division. The proposed project site (the Site) is approximately 70 km south of Chittagong and 40 km northwest of Cox's Bazar.

Approximately an amount of 225 acres of land will be required for the proposed coal-fired power plant project. The land use of the proposed project site is currently being used for shrimp cultivation and salt pan. The proposed land has already been acquired and is under Coal Power Generation Company Bangladesh Limited (CPGCBL). The OPDL-2 has leased the land from CPGCBL to conduct the study. A land lease agreement between CPGCBL and OPDL-2 has been signed to set up the power plant on 27 February 2023. The existing elevation of the land is +1.25 m which needs to be developed +10.0 m.

The Site is bordered by a water course and River on the Northern side and Eastern sides, the Kutubdia Channel as part of the Bay of Bengal on the Western side, and the Matarbari Town on the southern side. The project site is accessible through both road and river ways.

The Project will be based on an Ultra-supercritical technology with a gross and net power generation capacity of 700 MW and 635 MW respectively. The plant will comprise of one boiler and one steam turbine unit. The coal for the project will be sourced from Australia and Indonesia and will be bought to the Matarbari port in mother vessels and will be discharged to plant through 4.7 km long conveyer belt. The cooling water for the project will be sourced from Kutubdia Channel. The power generated from the plant will be evacuated by 400kv double circuit transmission line connecting to that Maheshkhali 400kv switchyard.

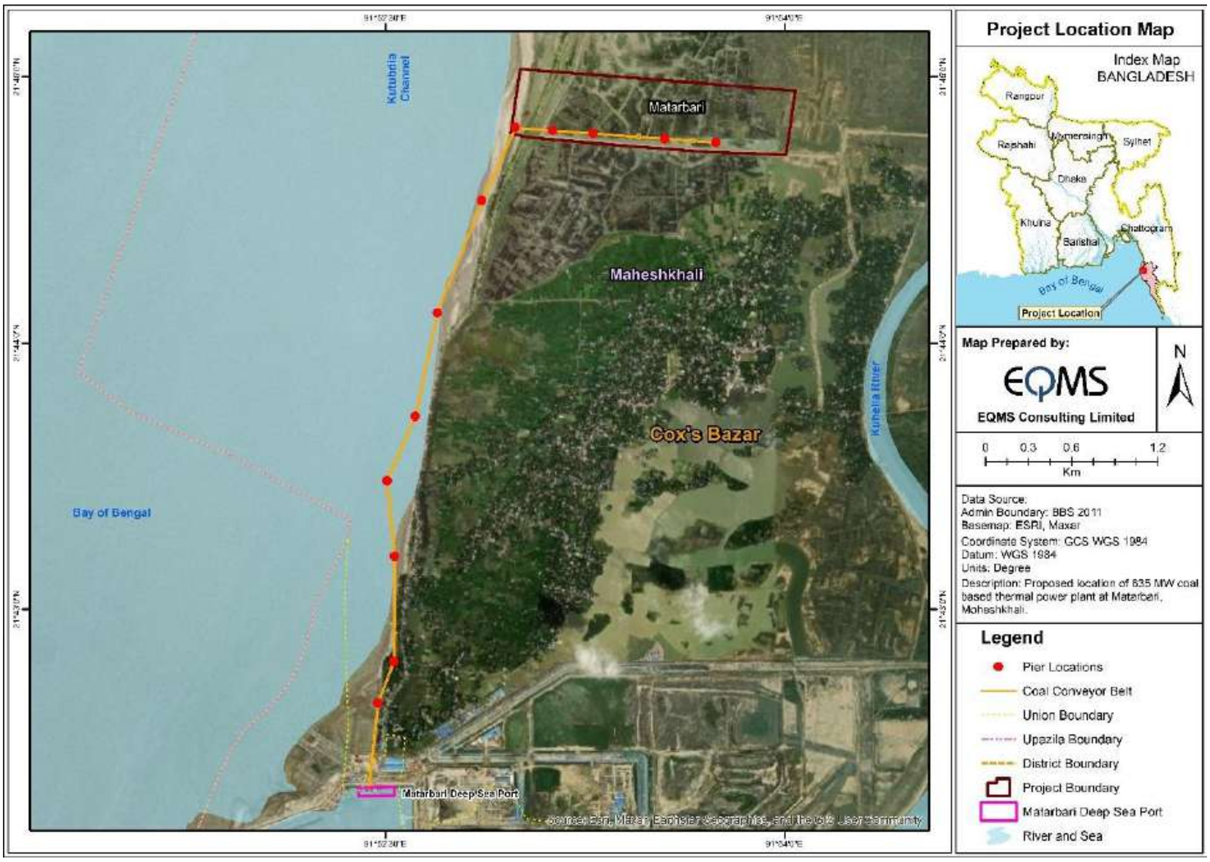
1.6 Nature and Size of the Project

The size of the project is 635 MW, and the nature of the proposed project is an Ultra supercritical Bituminous coal based thermal power Plant. Single unit plant will consist of one ultra-supercritical direct pulverized coal-fired boiler with built in dry low NOx burners suitable for outdoor installation with a stack of 220 meters high. Ultra-supercritical, direct pulverized coal-fired with front-rear wall direct impact firing or corner tangential firing, single pass, single reheating, balancing ventilation, dry bottom, outdoor, steel structureπtype boilers. Turbine uses ultra-supercritical, intermediate reheat, single-axis, four-cylinder four-steam, condensing steam turbine.

1.7 Location of the Project

Orion Power Unit-2 Dhaka Limited has proposed to setup a coal fired power plant at Matarbari mauza in Matarbari Union of Moheshkhali Upazila under Cox's Bazar District of Chattogram Division, Bangladesh. The proposed power plant will have a net capacity of 635 MW. Kohelia River and salt pan are on East, Matamuhuri River and salt pan are on North, and Kutubdia Channel and Bay of Bengal are on the west and southwest of the project area respectively. Whereas the south side of the project area is covered by mainly rural settlement, saltpan, homestead vegetation, agricultural land, and scattered ponds etc. The project site land is currently being used as salt and shrimp cultivation. The geographical location map of the proposed project is shown in following **Figure 1-1**.

Figure 1-1: Location of the Proposed Project Area



Source: OPDL-2 & EQMS

1.8 Importance of the Project

The proposed power plant will add 635 MW of electricity to the national grid which will improve the country's present electricity generation as well as trigger our national economic development. Not only that but industrial development will also be initiated after implementation. It will contribute to reduce the load shedding. It will create employment opportunities for the local people and improve the transportation system in the project area, which will ultimately play an important role in poverty reduction and develop social safety net conditions. Moreover, this coal-based power plant will thereby play an important role in fuel diversification to electricity generation and reduce pressure on natural gas reserves.

1.9 Scope of EIA Study

This report fulfils the requirements of the EIA under the ECR, 2023 and has been prepared in accordance with the approved TOR (refer to **Appendix A**) by the DoE. The detailed scope of the EIA study is as outlined below:

- Development of an integrated project description of the project components including its sub-components, which are under the purview of the Project Proponent (PP).
- Development of a regulatory, policy and administrative framework relevant to the Project.
- Assessment of baseline conditions (Physical, Biological, and Socio-economic Conditions);
- Assessment of environmental quality (Air, Water, Noise, Soil and Sediment).
- Assessment of detailed ecological conditions in and around the project site.
- Identification, prediction, quantification, and evaluation of potential aspects and impacts of the proposed project on the environment.
- Formulation of an Environmental Management Plan and associated/specific mitigation plans for identified impacts.
- Mitigation measures and monitoring plan for effective implementation of mitigation measures of the project.
- Formulation of public and stakeholder consultation for the proposed project; and
- Preparation of the EIA report based on the DoE-approved TOR for obtaining ECC from the DOE, Bangladesh.

1.10 Methodology of the Study

The approach and methodology are outlined based on information available about the proposed project, our previous experience of understanding similar kinds of projects, regulatory requirements in Bangladesh and the requirements to meet the DOE standards.

1.10.1 Approach to the EIA Study

To attain the earlier mentioned scope of work, the studies would be based on the review of the available project-related information and including primary and secondary baseline environment and social data, prediction and evaluation of impacts of significance. The following approach and methodology are proposed to complete the EIA study.

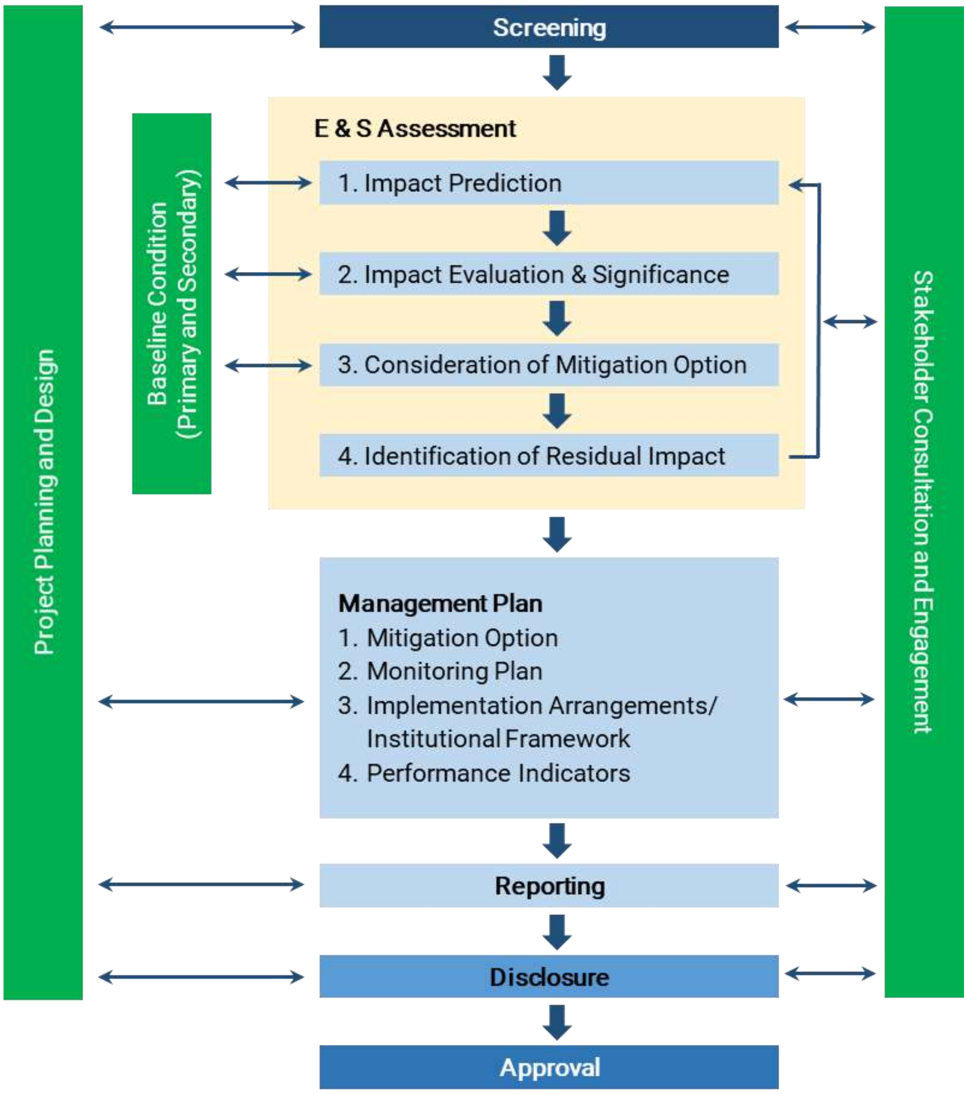
The EIA of the project has followed a systematic process of:

- **Screening Study:** The proposed project falls under the "Red" Category as per Schedule-1 of the Environment Conservation Rules, 2023, therefore, would require SCC and ECC from the DoE based on EIA, carried out as per the approved terms of reference for the EIA study.
- Consult **environmental and social baseline conditions** against which the assessment has been undertaken.
- **Consult with stakeholders** and integrate their views into the project design and mitigation.
- Systematically **predict and evaluate the positive and negative changes** in these baseline conditions.

- All impacts and benefits of the project should be documented and fully explained within the **EIA report**.
- **Identify the mitigation measures** that the client has taken to avoid, reduce, remedy offset, or compensate for adverse impacts, and to provide or enhance benefits from the project; and
- Develop an **Environmental Management Plan (EMP).**

The approach proposed for conducting the Environmental Impact Assessment (EIA) study for the selected project is presented in **Figure 1-2**.

Figure 1-2: Approach to the EIA Study



Source: EQMS

1.10.2 Methodology for the EIA Study

To attain the earlier mentioned scope of work, the EIA study has been prepared based on the collection of primary and secondary baseline environmental information, impact assessment, and delineation of EMP. The methodology proposed to complete the EIA study is divided into the following tasks as presented below.

1.10.2.1 Screening and Categorization

Screening

EQMS reviewed the existing available data of the Project with the client and secondary information available in the public domain regarding the Project, Project location and its surroundings. The screening process was undertaken to identify environmental, social and other sensitivities associated with the Project. A review of the applicability of the reference framework with respect to the proposed project was also undertaken as part of this screening phase.

The EQMS team had a brief introduction meeting with OPDL-2 prior to site reconnaissance visit. EQMS undertook initial 4 days site visit to understand the site setting, environmental and social sensitivities and to identify the relevant local stakeholders as well as analyse the local requirements and national level stakeholders who would be important for secondary data generation and regulatory approval process of the project.

Categorization

EQMS has categorized the Project by following the Environmental Conservation Rules, 2023. As per the ECR 2023, this project falls under the red category (Item 3: Power Plant).

1.10.2.2 Scoping

At the initial stage of the EIA, preliminary information was obtained, and discussions held to aid in the determination of what legal and other requirements apply to the Project. This step was conducted utilising a high-level description of the project and its associated facilities.

1.10.2.3 Environmental and Social Baseline Data Collection

Primary Baseline Data Collection:

With the assistance of the Client, EQMS has identified an accredited environmental laboratory of repute that has been engaged in the collection of baseline information on micrometeorology, ambient air quality, surface, and groundwater quality, soil and sediment quality, ambient noise quality as per aspects detailed in the following **Table 1-2**.

Table 1-2: Primary Baseline Data for the EIA

SL#	Environmental and Socioeconomic Attributes	Locations and Frequency	Remarks
A.	***Environmental Monitoring and Surveys***		
A.1	**Micro meteorology** Ambient temperature, barometric pressures, wind direction, wind speed, relative humidity, and rainfall	1 location near the project site: hourly for 8 weeks	An automatic micro-meteorological station with a data logging facility has been installed near the proposed project for continuous monitoring for 8 weeks.
A.2	**Ambient Air Quality:** Suspended Particulate Matter (SPM), Particulate Matter (PM_{10}), ($PM_{2.5}$), Oxides of Nitrogen (NOx), Sulphur Dioxide (SO_2), and Carbon Monoxide (CO)	5 locations: 8 weeks 24 hourly, once a week	Five ambient air quality monitoring locations has been set up for the baseline study.
A.3	**Surface Water Quality:** pH, Temperature, Turbidity, Electrical Conductivity, TDS, Total Hardness, Total Alkalinity, Chloride, Sulphate, Nitrate,	6 Locations: once during the study period.	Surface water has been collected from six locations.

SL#	Environmental and Socioeconomic Attributes	Locations and Frequency	Remarks
	Fluoride, Sodium, Potassium, Total Nitrogen, Total Phosphorus, DO, BOD, COD, Heavy Metals (As, Cd, Hg, Ni, Mn, Cr+6, Pb, Fe, Cu, Zn), TC, FC		
A.4	**Ground Water Quality:** Aluminium, Ammonia, Arsenic, Barium, Benzene, BOD, Boron, Cadmium, Calcium, Chloride, Chlorine (residual), Chloroform, Chromium (hexavalent), Chromium (total), COD, FC, TC, Colour, Copper, DO, Fluoride, Hardness (as $CaCO_3$), Iron Kjeldahl Nitrogen (total), Lead, Magnesium, Manganese, Mercury, Nickel, Nitrate, Nitrite, Odour, Oil and grease, pH, Phosphate, Phosphorus, Potassium, Selenium, Silver, Sodium, Suspended particulate matters, Sulfide, Sulfate, TDS, Temperature, Tin, Turbidity,	4 Locations: once during the study period.	Groundwater samples has been collected from tube wells/ wells within the ZOI.
A.4	**Soil Quality:** Physical Parameters: Particle Size Distribution, Texture, pH, Salinity, SAR, Electrical Conductivity, Organic Carbon, organic matter, NPK, TDS, Na, Mg, Ca, Cl, F, Zn, Cu, Pb, Hg, Cd, As, Bulk Density, moisture content, Water Holding capacity, Permeability, Porosity,	4 Locations: once during the study period.	Soil samples has been collected to understand soil characteristics and soil types from the project site and other locations within the study area.
A.5	**Sediment quality:** pH, texture, Electrical conductivity, Acidity, Alkalinity, Silica, Cr^{+6}, Cd, Pb, Co, Mn, Cu, Zn, Ni, As, Hg (inorganic), Hg (organic), Cation Exchange Capacity, Total Organic Carbon	6 Locations: once during the study period.	Sediment has been collected from six locations.
A.6	**Ambient Noise Quality:** Ambient noise levels, once over 24 hours at sensitive receptors (schools, settlements, health centers, etc.)	5 Locations: once during the study period.	Ambient noise quality monitoring has been utilized to determine hourly equivalent noise levels.
A.7	**Land Use**	The land use land cover map was prepared for a 10 km radius around the project site	Land use of the zone of influence (ZOI) area has been prepared based on satellite imagery.
A.8	**Traffic Volume**	1 Location for road traffic: once during	A traffic study has been undertaken at an important point on the approach road

SL#	Environmental and Socioeconomic Attributes	Locations and Frequency	Remarks
		the study period. 1 location from River traffic	to the site to assess the existing total daily traffic, peak hour traffic, and traffic composition.
B.	***Ecological Monitoring and Surveys***		
B.1	**Biodiversity and Ecology (Terrestrial)** The following ecological component has been surveyed: • Identifying endangered or protected species or endemic floral and faunal species prevailing in the ZOI. • Identifying vegetation cover and the status of natural habitats or species. • Identifying and assessing ecological resources within the ZOI.	Core ZOI (5 km) and Buffer ZOI (5-10 km) A one-time rapid survey (maximum for 3-4 days)	The ecological baseline information has been updated through a limited study
B.2	**Aquatic Ecology** The aquatic ecology of the ZOI has been established through a primary survey and supplemented with information collected from secondary sources. Water samples shall be collected for plankton and benthos.	6 Locations: once during the study period.	The ecological baseline information has been updated through a limited study
C.	***Socio-economic Survey***		
C.1	**Socio-economic and Public Health:** The focus of this study has been as follows: • Demographic information includes population size, migration rate, age, gender, religion, ethnicity, education, nationality, etc. • Public health profile and disease pattern. • Occupation and livelihood pattern of the local people (including information on fishing livelihoods, if any). • Common Property Resources (such as grazing lands, etc.) within the project site	Socio-economic and health aspects related information have been collected from Core ZOI and Buffer ZOI.	EQMS has prepared the socio-economic baseline information through collecting secondary information, stakeholder consultation, and sample HH survey (50 numbers)
C.2	**Aesthetics/ Cultural Environment** Identification of historical/ archaeological sites/monuments/cultural/religious/tourist interests within the ZOI.	Aesthetic and cultural-related information was collected from Core ZOI	Information has been collected with respect to historical, religious, and cultural monuments of regional, national, and

SL#	Environmental and Socioeconomic Attributes	Locations and Frequency	Remarks
	Information on community infrastructures (e.g., cultural/religious resources accessibility)	and Buffer ZOI.	international or archaeological importance, which may be affected or located near the proposed project activities or in the surrounding area.

Secondary Baseline Data Collection

Readily available secondary information has been collected for the following aspects:

- **Meteorological Data:** temperature, rainfall, humidity, wind speed, and direction of the project area has been collected considering the nearest available meteorology station of the Bangladesh Meteorological Department.
- **Environmental Attributes:** Ambient Air Quality, Surface Water Quality, Groundwater Quality, Ambient Noise level, Soil, and Sediment of the proposed project area has been collected from published literature and different organizations like the Department of Environment, Department of Public Health Engineering, Bangladesh Water Development Board, Soil Resources Development Institute and published EIA report relevant to the project area, etc.
- **Physiography:** physiographic environment of the project area has been collected from the Soil Resource Development Institute, Food and Agriculture Organization, and United Nations Development Programme report.
- **Topographical Data:** topography data has been collected from the United States Geological Survey website.
- **Geology:** the geological setting of the project area has been collected from the Geological Survey of Bangladesh, Bangladesh Space Research and Remote Sensing Organization, Bangladesh Petroleum Exploration Company, the United States Geological Survey website, and published books, journals, articles, etc.
- **Soil:** types of soil, texture, etc. has been collected from the Soil Resource Development Institute, Department of Agriculture Extension, Food and Agriculture Organization, United Nations Development Programme report, & published books, journals, articles, etc.
- **Hydrology:** water level, discharge, rainfall, cross-section, and other hydrological data has been collected from Bangladesh Water Development Board, Flood Forecasting and Warning Center, Water Resources Planning Organization, Institute of Water Modelling, Center for Environmental and Geographic Information Services, etc.
- **Groundwater Hydrology:** groundwater data has been collected from the Department of Public Health Engineering and Bangladesh Water Development Board, etc.
- **Biological Environment:** ecological aspects like ecologically critical areas, protected areas, reserve forests, mangroves, wildlife sanctuaries, migratory bird staging areas, fishing zone, marine protected areas, critical and vulnerable species, habitat conditions, etc. has been collected from International Union for Conservation of Nature, Department of Forest, Department of Environment, Encyclopedia of Flora and Fauna of Bangladesh, Non-Government Organizations working with the relevant sector.
- **Socio-economic and Cultural Environment:** the socio-economic condition of the project area has been collected from the population and housing census published by the Bangladesh Bureau of Statistics.
- **Hazards, Vulnerability, and Disasters:** waterlogging, riverbank erosion, flood, earthquake, cyclone, tornado, tidal surges, lightning, etc. has been collected from the Department of Disaster Management, Bangladesh Meteorological Department, Bangladesh Red Crescent

Society, Bangladesh Water Development Board, Flood Forecasting and Warning Center and published reports, etc.

1.10.2.4 Impact Assessment and Mitigation Measures

The key issues identified during the Scoping Phase have been analyzed upon the baseline information. Each issue consists of components that on their own or in combination with each other give rise to potential impacts, either positive or negative, from the project onto the environment or from the environment onto the project. In the EIA, the significance of the potential impacts has been considered before and after identified mitigation is implemented, for direct, indirect, and cumulative impacts, in the short and long term. The main impact assessment steps are summarized below and comprise of:

- Potential Impact Prediction: determination of what could potentially happen to resources/receptors because of the Project and its associated activities.
- Impact Evaluation: Evaluation of the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor.
- Mitigation and Enhancement Measures: Identification of appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- Residual Impact Evaluation: Evaluation of the significance and scale of the environmental impacts predicted to remain after the application of mitigation measures.

1.10.2.4.1 Potential Impact Prediction

Prediction of environmental impacts is the most important component in the impact assessment study as it provides quantitative information on likely environmental impacts from a project well in advance. The diverse range of potential impacts considered in the impact assessment process typically results in a wide range of prediction methods being used, including quantitative, semi-quantitative and qualitative techniques.

1.10.2.4.2 Impact Evaluation

Once the identification of potential impacts is completed, each potential impact is described in terms of its various relevant characteristics (e.g., nature, extent, duration, intensity/ severity, irreplaceable loss of resources, and probability).

A. Nature of Impacts

The nature of impacts is an assessment of the type of effect the activity is likely to have on the surrounding affected environment. The description includes what is being affected and its magnitude. The nature of the impact will be classified as positive or negative and direct, indirect, and induced.

Direct	Potential/possible Impacts will be generated directly from the project activities and its associated facilities, which are directly linked with the project. (e.g., discharge of untreated wastewater from construction camps into a nearby water body may lead to a decline in water quality).
Indirect	Potential/possible Impacts will be generated from secondary sources which are induced by the project activities. (e.g., impacts of air emissions such as CO_2 on climate change, NO_X may lead to acid rains, VOC may lead to low-level atmospheric ozone when combined with NO_X in the presence of sunlight).
Induced	Potential/possible Impacts will be generated (which are not part of the Project) due to the effect/consequence/outcome of the Project (e.g., an influx of camp followers resulting from the importation of a large project workforce).

B. Extent and Location of Impacts

Extent and location indicate the spatial area that may be affected by the proposed project activities or its associated facilities (**Table 1-3**).

Table 1-3: Geographical Extent of Impacts

Extent	Description
Project Site	Potential/possible impacts' area only at or within the project site/project boundary.
Local	Potential/possible impacts' area is not only limited to the site, but also its immediate surrounding areas/receptors.
Regional	Potential/possible impacts' area extends to the immediate surrounding areas along with adjacent areas.
National	Potential/possible impacts' area considered at a national level.
Trans-Boundary	• Impact considered not only within the national level but also within the neighboring country. • Impact considered a global level.

C. Duration of Impacts

Duration measures the lifetime/existence/continuation of the impact (**Table 1-4**).

Table 1-4: Duration of Impacts

Duration	Description
Short Term	Potential/possible impact duration is a very limited time or length of construction/decommissioning period.
Medium Term	Potential/possible impact duration will continue after the construction period but stop/discontinue/cease within a tenure of 10 years.
Long Term	Potential/possible impact duration will continue for more than 10 years or the entire operational life of the project.
Permanent – Mitigated	Potential/possible impact will remain after the operational life of a project but appropriate mitigation measures reduce the impact.
Permanent – No Mitigation	• Potential/possible impact will remain after the operational life of the project. • No mitigation measures will reduce the impact after implementation.

D. Intensity/severity of Impacts

Intensity/severity is the degree to which the project affects or changes the environment; it includes a measure of the reversibility of impacts (**Table 1-5**).

Table 1-5: Intensity of Impacts

Intensity	Description
Insignificant	Changes due to potential/possible impact are minor, not visible/noticeable, natural functioning of the environment not affected.
Low	• Natural functioning of the environment is minimally affected. • Natural, cultural, and social functions and processes can be reversed to their original state if mitigation measure is taken.

Intensity	Description
Medium	• Environment remarkably distorted/disturbed/impacted, still functions, if in a modified way. • Negative impacts cannot be fully reversed.
High	• Cultural and social functions and processes distorted/disturbed/impacted. • Potentially ceasing to Environmental function temporarily. • Negative impacts cannot be fully reversed.
Very High	• Natural, cultural, and social functions and processes permanently cease, and valued, important, sensitive, or vulnerable systems or communities are substantially affected. • Negative impacts cannot be reversed.

E. Potential for Irreplaceable Loss of Resources

Potential for Irreplaceable Loss of Resources is the degree to which the project will cause a loss of irreplaceable resources (**Table 1-6**).

Table 1-6: Potential for Irreplaceable Loss of Resources

Potential for Irreplaceable Loss of Resources	Description
Low	No irreplaceable/unique resources will be impacted.
Medium	Irreplaceable/unique resources can be replaced, with mitigation measures/efforts and will be replaced after a certain period of time.
High	Potential/possible Impact replaces a particular/vulnerable resource.

F. Probability

Probability is the likelihood or the chances that the impacts will occur (**Table 1-7**).

Table 1-7: Probability of Impacts

Probability	Description
Unlikely	Under normal conditions, no potential/possible Impact expected.
Low	The probability of the impact to occur is low due to its design or historic experience.
Medium	There is a distinct probability of the impact occurring.
High	It is most likely that the impact will occur.
Definite	The impact will occur regardless of any prevention measures.

G. Magnitude

The magnitude is calculated as extent + duration + intensity + potential impact on irreplaceable resources.

Magnitude essentially describes the intensity of the change that has the potential to occur in the resource/receptor as a result of the potential impact. The magnitude designations themselves are universally consistent, but the definitions for these designations vary depending on the resource/receptor.

In the case of a potential positive impact, no magnitude designation (aside from 'positive') is assigned. It is considered sufficient for the EIA to indicate that the project has the potential to result in a potential positive impact, without characterizing the exact degree of positive change that may occur.

H. Significance

The significance will be rated by multiplying the consequence of the impact and the probability of occurrence (i.e., Magnitude × Probability = Significance).

Table 1-8: Significance of Issues (Based on Environmental Parameters)

Significance	Description
Positive Impact	Potential/possible impacts that have a beneficial impact on affected media
Very low	No action required.
Low	• Impacts are within the acceptable range. • Potential/possible impacts such as localized or short-term effects on habitat, species, or environmental media.
Medium-Low	• Impacts are within the acceptable range but should be mitigated to lower significance levels wherever possible. • Potential/possible impacts such as localized, long-term degradation of sensitive habitat or widespread, short-term impacts on habitat, species, or environmental media.
Medium-High	• Potential/possible impacts are significant and require attention; • mitigation is required to reduce the negative impacts to acceptable levels; • Potential/possible impacts such as localized but irreversible habitat loss or widespread, long-term effects on habitat, species, or environmental media.
High	• Impacts are of great importance, mitigation is crucial. • Potential impacts such as significant, widespread, and persistent changes in habitat, species, or environmental media. • Potential impacts such as persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.
Very High	• Impacts are unacceptable. • Potential impacts such as loss of a significant portion of a valued species or loss of effective ecosystem function on a landscape scale.

Potential social impacts are inherently variable because community response to a potential impact, perceptions of existing and changing conditions, and the degrees of vulnerability are all heavily dependent on local conditions and the human factor. The significance designations for potential social impacts take into consideration social science expertise and previous experience in Bangladesh regarding the relationships between individuals, communities, government agencies, NGOs, and special interest groups, and different industries.

Table 1-9: Potential Social Impact Significance

Significance	Definition
Positive Impact	Potential/possible impacts that have a beneficial impact on affected stakeholders.
Very Low	Potential/possible impacts that are practically indistinguishable from the social baseline, with little to no potential impacts to or concerns from affected external stakeholders.
Low	Potential/possible impacts that are short-term nuisance or inconvenience; potentially affected external stakeholders concerned but likely able to adapt with relative ease.

Significance	Definition
Medium-Low	Potential/possible impacts such as localized or short-term effects; potentially affected stakeholders concerned but likely able to adapt with relative ease.
Medium-High	Potential/possible impacts such as local-to-regional (sub-national) or medium-term effects; potentially affected stakeholders concerned and raise the issue as a high priority but may be able to adapt with some targeted support or assistance.
High	Potential/possible impacts such as local-to-national or long-term effects; potentially affected stakeholders concerned and raised as a high priority; may not be able to adapt without targeted support or assistance to maintain a pre-impact livelihood.
Very High	Potential/possible impacts such as local-to-global or irreversible long-term effects; potentially affected stakeholders concerned raise the issue as a high priority and are likely, not able to adapt without targeted support or assistance.

To determine potential public health impacts, the assessment team considers the public which has the potential to be exposed to various aspects and potential impacts of the project, whether it is a permanent resident with continuous exposure or periodic exposure to a fisherman transiting through the project area. The significance determinations for potential public health impacts take into consideration local and regional public health expertise and previous experience in Bangladesh regarding the relationships between individuals, communities, health care providers, government agencies, NGOs, and different industries.

Table 1-10: Potential Public Health Impact Significance

Significance	Definition
Positive Impact	Potential/possible impacts that have a beneficial impact on the affected stakeholder.
Very low	No impact to the public.
Low	Potential/possible illness or adverse effect with limited or no impacts on the ability to function and medical treatment is limited or not necessary.
Medium-Low	Potential/possible illness or adverse effects with mild to moderate functional impairment requiring medical treatment or management.
Medium-high	Potential/possible serious illness or severe adverse health effects requiring a high level of medical treatment or management.
High	Potential/possible serious illness or chronic exposure of a few resulting in life-shortening effects.
Very High	Potential/possible serious illness or chronic exposure of many resulting in life-shortening effects.

1.10.2.4.3 Mitigation and Enhancement Measures

Once the significance of an impact has been characterized, the next step is to evaluate what mitigation and enhancement measures are defensible. These are commonly incorporated into the project as commitments. Mitigation is aimed at preventing, minimizing or managing significant negative impacts to as low as reasonably practicable and optimizing and maximizing any potential benefits of the project, where applicable.

The priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated project activities) and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude.

1.10.2.4.4 Residual Impact Evaluation

Once mitigation and enhancement measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation and enhancement measures.

1.10.2.5 Environmental Management Plan (EMP) and Environmental Monitoring Plan

Put more attention to parameters producing negative impact and identify the mitigating measures to be incorporated in the planning and implementing stages of the project (EMP) to eliminate, reduce and offset negative impacts and thereby enhance net positive impact, i.e. benefit of the project. Plan a monitoring program to ensure the implementation of mitigating measures. The management and monitoring plans have been discussed in a chapter of EIA report in detail.

Requirement and details of the control measures have been suggested in the EMP for implementation by contractor and client during construction and operation phases of the Project. The EMP comprises of the following aspects based on the impacts assessed for the Project:

- Introduction to the purpose of the EMP;
- Institutional mechanism - roles and responsibilities for EMP implementation;
- Summary of significant adverse impacts and potential hazards;
- Mitigation measures and control technologies, safeguards etc. to minimize adverse impacts on air, water, soil and biological and socioeconomic environment, measures to minimize associated hazards and control the emergency situation; and
- Project monitoring programme for effective implementation of the mitigation measures and ascertain the efficacy of the environmental management and hazard control systems in place.

1.10.2.6 Consultation, Disclosure and Grievance Redress

EQMS has assisted sponsors in coordinating the EIA with relevant stakeholders and facilitate consultation with communities, local NGOs, and other stakeholders on the environmental aspects of the proposed project. These groups have been consulted at least twice: in meetings held during scoping of the study and when a draft EIA is available. Specialized surveys, discussions, or focus groups were utilized as well to inform the preparation of the EIA.

1.11 EIA Team

EQMS Consulting Limited is a specialist consultancy firm contracted by Orion Power Unit-2 Dhaka Limited to prepare and deliver the EIA report for the said Project. EQMS Consulting Limited has utilized a multi-disciplinary team comprising of environmental and social experts. The team members have extensive professional experience working in the fields of environmental impact assessment and social impact assessment in Bangladesh and abroad. The composition of the study team can be seen below in **Table 1-11**.

Table 1-11: Team Composition for EIA Study

Name	Position
Kazi Farhed Iqubal	EIA Expert/ Team Leader
Md. Sirajul Islam	Electrical Engineer
Md. Zahidul Islam	Environment Expert
Tauhidul Hasan	Environment Expert and Air Quality Modelling Expert
Sk. Salahuddin Ahammad	Noise Modelling and QRA Expert
Md. Saifur Rahman	Water Resource Expert
Sadman Khaled Monsur	Waste Management Expert/Health and Safety Expert
Md. Mahfuzur Rahman	Social/RAP/LRP Expert
Farhan Hassin	Jr. Social Expert
Nourin Ahosan Habib	Ecologist/Biodiversity Expert
A.B.M. Ashraful Hoque	Wildlife Expert
Bipul Kumar Paul	GIS Expert

1.12 Report Format

The report fulfils the requirements of EIA study under ECR, 2023 and has been prepared in accordance with the ToR approved by the DoE. The EIA has been prepared in two volumes which are Volume-I (Main EIA Report) and Volume-II (Appendix). The main EIA report consists of a total of 14 chapters. The chapter details are outlined below:

Executive Summary

Chapter 1 describes the introduction containing background, the purpose of the project, Need for and Importance of the project, Scope of the study and list of the members of the EIA study team;

Chapter 2 is on policy, legal and administrative framework describing the relevant policy and legal frameworks for the EIA process of the power plant project;

Chapter 3 describes the project description, project layout, resources required and their quality, and utilities demand, Sources of primary fuel and transportation of primary fuel, technology selection and process description, description of major systems, waste management system etc. of the proposed power plant;

Chapter 4 describes the environmental and social baseline conditions with detail on the physical environment, water resources, land resources, agricultural resources, fisheries, ecosystem and socio-economic condition

Chapter 5 presents all the predicted impacts of the project during pre-construction, construction and operation phases and evaluates all the predicted impacts;

Chapter 6 evaluated all the identified impacts based on the significance of the predicted impacts;

Chapter 7 identifies mitigation measures for the identified impacts;

Chapter 8 Presents an analysis of various alternatives options for project component such as no project scenario, site alternatives, fuel type, technology selection, etc.

Chapter 9 describes the EMP with mitigation measures for minimizing the effect of the negative impacts and enhancement measures for increasing the benefits of the positive impacts during pre-construction, construction, and operation stages. The tentative budget for EMP is described in this chapter.

Chapter 10 describes the environmental monitoring plan, implementation of the monitoring plan, performance indicators, and reporting and feedback mechanism.

Chapter 11 depicted the possible work plan for the project as per the feasibility report

Chapter 12 presents the results of public consultation and information disclosure including consultation with expert and representatives of institutions and selected focus group discussions.

Chapter 13 outlines all possible disaster, hazards and risks associated with the proposed thermal power plant, and also suggest safety requirements;

Chapter 14 is the concluding chapter of the EIA report with conclusion and recommendations;

CHAPTER 2

Administrative and Legal Framework

2 ADMINISTRATIVE AND LEGAL FRAMEWORK

2.1 Overview

The Orion Power Unit-2 Dhaka Limited (OPDL-2) has proposed to establish 635 MW thermal power plant in Matarbari, which is expected to curtail the national generation shortfall apart from expediting the industrialization process. To do so the respective authority required conducting Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) as it is obligatory under the national law of Bangladesh. According to the Environment Conservation Act, 1995, no industrial unit or project will be established or undertaken without obtaining an Environmental Clearance Certificate from the Department of Environment.

Along with the environmental assessment, relevant legal provisions, policies, strategies and institutional issues of planned projects/industries are very important for any project proponent or developer before they actually execute a program or plan. The proponent must be well aware of these requirements and comply with the provisions as applicable and necessary. Before initiating any development project, it is hence required to obtain environmental clearance from the Department of Environment. The activities of the proposed coal-based thermal power plant project fall under the 'red' category according to the Bangladesh Environment Conservation Rules; 2023 and therefore need to conduct EIA study to obtain site/location and environmental clearance from the Department of Environment.

In respect of legal obligations and policy guidelines under the EIA study of the coal-based power plant in Matarbari the following activities have been carried out:

- Identification of national legal obligations in relation to the interventions which will be required to review under the EIA study of the proposed thermal power plant.
- Exploration of the national legislative provisions and policy guidelines on environmental sectors.
- Identification of the international legal obligations and relevant provisions of multilateral environmental agreements related to the proposed project interventions.
- Exploration of national and international legal provisions on coal and power plant development sector; and
- Identification of the standard guidelines at a regional and international level related to the thermal power plant setup.

National laws, by-laws and official resolutions relevant to coal-based thermal power plant installation, operation and maintenance and associated activities have been identified under this study. Under the national legal framework, the proposed intervention needs to comply with the environmental legislation of the country and needs to fulfil the requirements to obtain the required permissions to implement these activities.

Department of Environment (DoE) approved a ToR for preparing an Environmental Impact Assessment study. This EIA report follows the approved ToR to comply with the national laws and regulations.

2.2 Applicable National Legal Requirements

All legal provisions relevant to environmental protection applicable to the planning, construction, and operation of coal-based power plant project are identified and summarized in **Table 2-1** along with their applicability.

Table 2-1: National Legal Provisions Applicable to the Proposed Project for Ensuring Environmental Protection

Act/Rules/ Law/Ordinance	Responsible Agency- Ministry/Authority	Key Features/Remarks	Applicability
The Bangladesh Environment Conservation Act (BECA), 1995 (as amended in 2000, 2002 and 2010)	Ministry of Environment, Forest, and Climate Change	• Powers of the DG to enforce various provisions of the Act including setting rules and regulations for environmental conservation and protection. (Section 4) • Powers given to the DG to seek the assistance of other enforcement authority (or authorities) in its enforcement. Done indirectly by way of disconnecting power, gas, or water supply to the user. (Section 4 A) • Allows the DG to seek compensation in cases of damage to the ecosystem or injury to person(s), whether directly or indirectly caused by a person or persons. He may also require that corrective or remedial action be taken to mitigate or ameliorate the situation. (Section 7) • Allows any person affected or likely to be affected as a result of pollution or degradation of the environment to apply to the DG for remedy of the damage or apprehended damage. (Section 8) • DG can require person responsible and the person in charge of the place of occurrence of an accidental pollution take measures to control or mitigate the environmental pollution. (Section 9) • Section 12, Requires that an Environmental Clearance Certificate be obtained before an industrial unit or project can be established or undertaken. • Section 13, Formulate and publish environmental guidelines relating to the control and mitigation of environmental pollution, conservation and improvement of the environment. • Section 20, Power to make rules for various purposes including the setting of EIA procedures. • Section 12, requiring an Environmental Clearance Certificate, is effectively enforced by way of The Environmental Conservation Rules, 2023, which is made pursuant to the powers provided under Section 20 of the BECA.	Applicable - According to the Act "no industrial unit or project shall be established or undertaken without obtaining an ECC from the DoE". Therefore, the provisions of the act apply to all the project intervention phases during the project life cycle.

Act/Rules/ Law/Ordinance	Responsible Agency- Ministry/Authority	Key Features/Remarks	Applicability
Environment Conservation Rules, 2023	Ministry of Environment, Forest, and Climate Change	(a) Rule 3, Outlines procedures for any person affected or likely to be affected because of pollution or degradation of the environment to apply to the DG for remedy of the damage or apprehended damage. (b) Rule 5, Classification of industrial units and projects for purpose of issuance of into four categories: - (i) Green; ii) Yellow; (iii) Orange; and (iv) Red. (c) Rule 7, Outlines procedures for obtaining an Environmental Clearance Certificate (ECC). (d) Rule 14, method of obtaining site clearance for Red category projects (e) Rule 15, Procedure of Environmental Impact Assessment Study (f) Rule 16, Public consultation meeting requirement for Red category project (g) Rule 17, Procedure of EIA report evaluation (h) Rule 18, Procedure of EIA report approval (i) Rule 19, Procedure of ECC approval (j) Rule 7(5), Prescribed form for application of SCC or ECC. (k) Rule 20, Indicates period of validity of site clearance and ECC for Green projects (5 year), Yellow (2 years), Orange and Red (1 year). (l) Rule 21, Renewal is to be made at least 30 days before expiry of certificate for site clearance certificate. (m) Rule 22, Procedure for renewal of Environmental Clearance Certificate (n) Rule 23, Action for the industries running without obtaining site clearance and ECC (o) Rule 27, Sets procedures for appeal against any notice, order, or directive to the Appellate Authority. (p) Rule 31 & 32, Prescribed emission, and environmental standards to be complied with are outlined in various schedules. (q) Rule 34, Schedule 13 - prescribes fees for issuance or renewal of ECC. (r) Rule 16, Outline of procedures for payment of fees.	Applicable - as the Projects falls under Red Category and require site clearance and ECC from DOE, Bangladesh. Besides, it is stipulated that environmental quality standards and other relevant requirements shall comply during the project life cycle.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		(ii) Rule 17, Require any accident that poses serious threat to the environment to be informed to the DG.	
Environment Court Act, 2010	Ministry of Environment, Forest, and Climate Change. Judiciary	• Establishment of one or more environment courts in each district and one or more special magistrate courts in each district. • Also provides the jurisdictions of environment court, the penalty for violating courts order, a trial procedure in special magistrate court, power of entry and search, a procedure for investigation, procedure and power of environment court, the authority of environment court to inspect, appeal procedure and formation of the environment appeal court.	Applicable - the court has jurisdiction, under the act's provisions, over a trial for an offense or compensation under environmental law, imposing penalties for violation, etc.
Air Pollution Control Rules 2022	Ministry of Environment, Forest, and Climate Change	• The Air Pollution Control Rules 2022 has been prepared with the objective of preventing, controlling and reducing air pollution to protect the environment and public health in the country. • This rule sets the standard for ambient air quality, emission standards for motor vehicles and mechanical vessels, odor level, Standards for Gaseous Emission from Industries or Projects, Standard for Construction Dust Control • According to the Air Pollution (Control) Rules-2022, any person or organisation will get two years' imprisonment and Tk 2 lakh fine on charge of emitting harmful substances into the air. • As per the Rules, the DoE will formulate a National Air Quality Management Plan, which would be prepared considering the existing sources, socio-economic conditions, topographical features, meteorological seasonal variations, and other important parameters that influence the air quality of a region. • The National Executive Council (NEC) committee will be empowered to oversee, advise, and recommend the other bodies concerned to control air pollution and to implement the plan. This committee will also oversee the progress and effectiveness of the air quality management strategies/activities, and the air quality plan. • As per the Rules, the Department of Environment (DoE) can take steps against industries and activities which are extremely harmful to the environment and public health. The Rules direct the Bangladesh Road Transport Corporation (BRTC), Bangladesh Road Transport	Applicable - the project will create air pollution within the project boundary and surroundings. Air pollution can impact human and terrestrial faunal species. Therefore, it requires complying with these rules.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		Authority (BRTA) and other authorities concerned to provide the necessary support to DoE in this regard. • The role of the local government institutions has also been included in the Rules. The DoE will provide technical support and training to the local government institutions for management of air quality standard and control of air pollution. • According to the 'Air Pollution (Control) Rules, 2022', the DoE DG will declare a place 'Degraded Air Shed' if the place continuously shows its air quality over permissible limits. The DoE will prepare a time-based Air Quality Improvement Plan in consultation with the local stakeholders to improve the air quality of the 'Degraded Air Shed'. • The DoE DG and any other assigned official can publish a list of events or activities that would be considered detrimental to the environment, health, society and economy of a place. The DoE will issue directives to control the activities. • According to the Rules, the government organisations involved with the construction activities, especially the local government organisations, are also directed to oblige by the norms of air quality management around the sites of construction/repairing/rebuilding.	
Noise Pollution (Control) Rules, 2006	Ministry of Environment, Forest, and Climate Change	• The Rules have been established to manage noise-generating activities, which have the potential to impact the health & wellbeing of workers and the surrounding communities. • According to the Rules, motor honking within a 100-meter radius of a hospital, school and office is prohibited. The rules also do not allow use of brick crushers and cement mixers within 500-meter radius of a residential area. • An area up to a radius of 100 meters around hospitals, educational institutions, offices, or similar types of institutions is designated as silent areas. The acceptable sound limit in the silent areas is 50 dB(A) for daytime and 40 dB(A) for nighttime. • The residential areas are primarily occupied by dwellings. The acceptable sound limit in the residential areas is 55 dB(A) for daytime and 45 dB(A) for nighttime.	Applicable - the project will create noise within the project boundary and surroundings. Incremental noise can impact human and terrestrial faunal species. Therefore, it requires complying with these rules.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		• Mixed areas with a mix of residential, commercial & industrial land use. The acceptable sound limit in the mixed areas is 60 dB(A) for daytime and 50 dB(A) for nighttime. • Commercial areas are primarily occupied by businesses and officers. The acceptable sound limit in the commercial areas is 70 dB(A) for daytime and 60 dB(A) for nighttime. • Industrial areas are used for industry or manufacturing. The acceptable sound limit in the industrial areas is 75 dB(A) for daytime and 70 dB(A) for nighttime. • The guidelines say exceeding the maximum noise level in certain areas is a punishable offense. • Besides, prior permission is mandatory for using loudspeakers or megaphones. The rules stipulate safety and precautionary measures in workplaces, designated authorities for allowing noise generating appliances.	
Ecologically Critical Areas (ECAs) Management Rules, 2016	Ministry of Environment, Forest, and Climate Change	• The ECA Management Rule, 2016 has enabled the government to form a "National Committee" headed by the Secretary of MoEFCC. • To implement the decision of the Directorate, District and Upazila committee may be formed. For the conservation and development of the ecologically critical area, one or more teams may be formed. The responsibility of the team would be to implement the decision and planning of the Government to improve the Environment for Ecology. • The Rule also prohibited many activities and processes which are detrimental to the natural condition of habitat, tranquility, biodiversity, etc.	Not Applicable - the proposed project is located more than 10 km away from the nearest ECA (Sonadia Island & Cox's Bazar-Teknaf Peninsula).
Biodiversity Act, 2017	Ministry of Environment, Forest, and Climate Change	• The Act has enabled the government to form a "National Committee on Biodiversity". The functions of the committee are to conserve biodiversity, genetic biodiversity, identification of biodiversity-related important areas, heritage, etc. • The government is empowered to declare, in consultation with local communities and bodies and coordination with concerned ministries or departments, any place or area significant for its biological heritage as "Biodiversity Heritage Sites".	Applicable - The project will be established at Matarbari Union under Moheshkhali Upazila. During construction and operation, the project will impact the surrounding

Act/Rules/ Law/Ordinance	Responsible Agency- Ministry/Authority	Key Features/Remarks	Applicability
		• Prohibiting the taking of activities that may have an adverse effect on endangered animals or organisms, etc. No person shall take any such activity, viz (a) adversely affect, or may effect on endanger species; (b) adversely affect or may affect the environmental characteristics of the endangered ecological community; or (c) In accordance with the Ramsar Convention, the wetland may adversely affect or affect the environment and environmental characteristics of the declared area.	environment. Therefore, this act is applicable.
Forests Act, 1927 and its amendment in 1982, 1989, 2000 and 2018	Ministry of Environment, Forest, and Climate Change	• The government can prohibit certain activities in the declared Reserved Forest area, causes any damage by negligence in felling any tree or cutting or dragging any timber, etc. • The act makes various provision for the conservation of forests. • It defines the procedure to be followed for declaring an area to be a Reserved Forest, a Protected Forest, or a Village Forest. • It defines what a forest offense is, what are the acts prohibited inside an RF, and penalties leviable on violation of the provisions of the act. • Act gives the government power to make any relevant rules to protect forest. • Guidelines for social forestry practice; and • Control and collection of timber and other forest-produces, and duties on those.	Not Applicable- there is no forest area within the project site.
Wildlife (Conservation and Security) Act, 2012	Ministry of Environment, Forest, and Climate Change	• The act has been formulated for the conservation and safety of wildlife to manage the protected areas. The act depicts 10 new types of protected areas. The bill with many other provisions proposed stern action for violation of the law. It proposed one-year imprisonment and Taka 50,000 fine for such a violation. The law also proposed at least two years and highest seven years of imprisonment and minimum Taka one lakh and maximum Taka 10 lakh fine for killing a tiger or elephant. According to the Act, 2012, in Chapter-4, Section-16, Sub-section 2(e), there is a restriction for the detrimental activities to environment within the 2 km from the border of the sanctuary area.	Not Applicable - As there are no protected areas are found within the project site and 10 km radius.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		• Prohibition is related to capturing, killing, shooting, or trapping wildlife. No person shall hunt any wild animal without a license. • Determination of threatened flora and fauna in four (4) schedules. • Prohibitions, entry, and declaration procedure of protected areas (sanctuary, national park, community conservation area, safari park, eco-park, botanical garden, wild animal breeding center, landscape zone or corridor, buffer zone, core zone, special biodiversity conservation area, national heritage, memorial tree, sacred tree, and kunjaban, etc.). • No person, institution, or company shall establish or operate any industrial factory or brickfield within 2 (two) kilometers from the boundary of a sanctuary.	
Protected Area Management Rules, 2017	Ministry of Environment, Forest, and Climate Change	• The legal basis for the management and co-management of forest protected areas. • Structures, functions, and obligations of management of some of the protected areas, but excluding safari-park, zoo, botanical garden, private park, wildlife fertility center from their application. • The Rules have 33 sections and provide for a model for participatory co-management, consisted of forest-dependent communities, forest department, civil administration, and civil society organizations. • The rules provide for financial benefits and income incentives to shareholders through participatory social forestry programs to be planted in buffer and landscape areas, and eco-tourism.	Not Applicable - As there are no protected areas are found within the project site and 10 km radius from the project boundary. The nearest protected area is Chunati Wildlife Sanctuary, which is approx. 25 km away from the project site.
Bangladesh Water Act, 2013	Ministry of Water Resources	• Any infrastructure or landfilling activities over any natural watercourses, stop the natural flow or create obstacles or divert or attempt to divert the direction is strictly prohibited. • According to the provision of section-43, all the costs may be incurred for the removal of infrastructure or landfilling materials from the person liable for making infrastructure or carrying on landfilling activities. • Any area or any part or any land connected with water resources can be declared as Water Stress Area. • Ensuring safe abstraction of water from aquifers & executive authority may subject to the lowest safe yield of surface and groundwater.	Applicable – as the project will use both surface and ground water.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		• Any infrastructure shall not be established in the immediate premises of the flood control embankment and ensure the sustainability and protection of the control structure. • No person shall not store, preserve, or divert the water of any water source in any natural or artificial reservoir.	
Bangladesh Water Rules, 2018	Ministry of Water Resources	• Provision of No Objection Certificate for the establishment of projects related to flood control and management project; surface water extraction, supply and use related project and part of the project; irrigation project using surface water; construction of hydraulic structures; water conservation project; flood-affected plain land and wetland development project; groundwater for industrial use; riverbank protection and river control; river excavation and dredging project; canal excavation and re-excavation project; fisheries development in surface water project; groundwater extraction, supply, & use related project & part of the project; and others project; • According to the Clause-16 of the rules, a NOC should be taken from DG of WARPO, District Committee/DC, Upazila Committee/UNO, and Union Committee/Chairman based on the total investment of the specific project.	Applicable –The proposed 635 MW coal fired power plant will use the ground water during construction and surface water from the Kutubdia channel for power plant operation. As a result, No Objection Certificate (NOC) will be required from the Union Integrated Water Resources Management Committee for ground water use and surface water collection, distribution and use in the proposed project.
National River Protection Commission Act, 2013	Ministry of Water Resources	• An act to establish a Commission for preventing illegal occupation of rivers, pollution of water and environment, pollution of rivers caused by industrial factories, illegal constructions and various irregularities and ensuring multidimensional use of rivers for socio-economic development including restoration of the normal flow of rivers, proper maintenance thereof and making them navigable.	Applicable - The proposed project is located near to Matamuhuri & Kohelia river and Kutubdia Channel which may impact the water quality during construction and operation phase.
Protection and Conservation of Fish Act, 1950 and its	Ministry of Fisheries and Livestock	• The act was enacted to provide for the protection and conservation of fish. Under the Act, the Protection and Conservation of Fish Rules were adopted in 1985. • This Act covers all types of aquatic species including fish, prawn, shrimp, amphibians, tortoises, turtles, crustaceans, molluscs,	Applicable - There are some rivers such as Kohelia, Matamuhuri and Kutubdia channel which is also known for

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
amendment in 1982 and Rules, 1985		echinoderms and frogs at all stages in their life cycle and all types of water bodies. • These are the use of appropriate fishing gear (net, cage, trap, explosives) and building water management structures (dams, weirs, bunds and embankments). • It also specifies the fishing and non-fishing seasons and the size of the fish below which any prohibited species cannot be killed or sold. This Act is revised and included the banning of 'jatka' of hilsa and use of gill net (current jal) in 2011. • No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow, and arrow in inland waters or within coastal waters. During the Project intervention, it should be noted that if waste effluent is not treated then it may cause significant damage to the local fishery and thus violate the provision of the law. • No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters; and • Protection and conservation of fish in government-owned water bodies.	fishing closed to the project site and physical intervention may occur in the river by this project.
Electricity Act, 2018	Ministry of Power, Energy, and Mineral Resources	• If the land acquisition is required for the establishment of a power generation plant or sub-station, it shall be deemed to have been necessary for public interest and the existing laws and regulations on an acquisition of land shall have to be followed. • If any private company holding license requires any land for constructing any connection line with the power station. sub-station or grid substation the licensee may purchase or acquire such land from the concerned landowner in accordance with the existing laws and regulations regarding land acquisition. • No licensee shall harm or obstruct or interfere with railways, highways, airports, waterways, canals, docks, wharves and jetties and pipes, during power generation, transmission, supply, or distribution. • The licensee shall take all logical precautions during the construction of power supply lines and doing civil works so as not to have any	Applicable - as the project will subject to the act of generating electricity and supply through a transmission line.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		harmful effect on the communication system of the telegraph, telephone, or electromagnetic signal emitting lines by way of induction or any other means.	
Bangladesh Energy Regulatory Commission Act, 2003	Ministry of Power, Energy, and Mineral Resources	• To determine efficiency and standard of the machinery and appliances of the institutions using energy. • To ensure efficient use, quality services, determine tariff and safety enhancement of electricity generation. • If anybody obstructs any license or his authorized representative in the works of installation or repair of electricity line or gas pipeline or the construction or repair of associated equipment, installations, he shall be liable to sentenced with imprisonment.	Applicable - as the subject project is related to primary energy.
Imports and Exports (Control) Act, 1950	Ministry of Finance	• No goods of the specified description shall be imported or exported except following the conditions of a license to be issued by the Chief Controller or any other officer authorized on this behalf by the Government.	Applicable - as the machinery and equipment for the proposed project will be imported.
Acquisition and Requisition of Immovable Property Act (ARIPA), 2017	Ministry of Land	• Current GoB Act, relating to acquisition and requisition of land. • According to the law, the affected person will get an additional 200% of assessed value for land and an additional 100% for structures, trees, crops, and other assets. • This law deals with social and economic impacts because of land acquisition.	Not Applicable since the proposed land is already acquired by government and now owned by CPGCBL. OPDL-2 will lease the land from CPGCBL.
Boiler Act, 1923	Ministry of Industries	• Prohibition of use of unregistered or uncertificated boiler. • Renewal of boiler certificate upon the expiry, accidents, moved, structural alteration, or any dangerous condition. • Regulating the inspection & examination of boilers and steampipes. • Prescribing the duties of the owner at an examination, and production and transfer of certificates. • Exclusion of any specified area from the boiler operation. • Impose local limits and power of an authorized person to oversee the limit.	Applicable - as the proposed project will use boiler.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		• Prescribing the maximum pressure at which a boiler may be used and describing the method of determining the maximum pressure. • Revocation of certificate or provisional order if the certificate is fraudulently obtained or boiler is not in good condition. • Restriction on alterations and renewals of any registered boilers without written sanction of such alteration, addition, or renewal. • Reporting of accidents to boilers or steampipe must be made by the owner within twenty-four hours of the accident in written form. • Registration number allotted to the boiler must be marked on the boiler otherwise penalties apply. Any kind of invisibility of register number by remove, alter or deface is also punishable; and • Prescribed penalties for illegal use of a boiler or use the boiler at a higher speed than the allowed limit.	
Fatal Accidents Act, 1855	Ministry of Law, Justice, and Parliamentary Affairs	• Provide compensation to families for loss occasioned by the death of a person caused by actionable wrong. It is mentioned in s.1, whenever the death of a person shall be caused by a wrongful act, neglect or default, and the act, neglect or default is such as would (if death had not ensued) have entitled the party injured to maintain an action and recover damages in respect thereof, the party who would have been liable if death had not ensued shall be liable to an action or suit for damages, notwithstanding the death of the person injured, and although the death shall have been caused under such circumstances as an amount in law to a felony or other crime.	Applicable - as the proposed project has a provision of unlikely and accidental event and may cause fatal accidents.
The Penal Code, 1860	Ministry of Law, Justice, and Parliamentary Affairs	• Valid provisions related to pollution management, environment protection, and protection of health and safety. Chapter XIV of the Penal Code provides offenses effective public health, safety, convenience, decency, and morals: • Section 277: Falling Water or Public Spring or Reservoir. • Section 278: Making Atmosphere Noxious to Health. • Section 284: Negligent Conduct with respect to Poisonous Substance. • Section 285: Negligent Conduct with respect to Fire or Combustible Matter; and	Applicable - as the proposed project has a provision of pollution impact on the surrounding environment.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		• Section 286: Negligent Conduct with respect to Explosive Substance.	
Fire Prevention & Extinguish Act, 2003 and Rules, 2014	Ministry of Home Affairs	• Regulatory enactments regarding the prevention, the successful extinguishing of fire, and reduction of damages and consequences of fire. • States to obtain a license from the Director-General of Fire Service and Civil Defense in case of any warehouse.	Applicable - proposed project will store large quantities of fuel and may cause a fire accident.
The Factories Act, 1965 and the Factories Rules, 1979 Bangladesh Labor Act, 2006 and amendment 2009, 2010, 2013 and 2018 Bangladesh Labor Rules, 2015	Department of Labor/Department for Inspection of Factories and Establishment/ Ministry of Labor and Employment	• Pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions. • Provides health, safety, and well-being of the workforce during the project life cycle. • Children under 18 years are not allowed to be employed during the project life cycle. • Safety precaution regarding explosive or inflammable dust/gas, protection of eyes, protection against fire, work with cranes and other lifting machinery, lifting of excessive weight. • Safety measures like appliances of first aid, maintenance of safety record books, rooms for children, housing facilities, medical care, group insurance, etc. • No building, wall, chimney, bridge, tunnel, road, gallery, stairway, ramp, floor, platform, staging, or other structure, whether a permanent or temporary character, shall be constructed, situated, or maintained in any factory in such a manner as to cause risk of bodily injury (Rule 38) of factory rules 1979, etc.	Applicable - as provides health, safety, and wellbeing of the workforce during the project life cycle. Besides, it also stipulated that child under 18 years are not allowed to be employed during the project life cycle and therefore, this law requires to be complied with.
National 3R Strategy for Waste Management, 2010	Department of Environment	• The concept of this strategy is minimizing waste impacts in terms of quantity or ill-effects, by reducing the quantity of waste products with simple treatments and recycling the wastes by using it as resources to produce the same or modified products. The principle of "3R" is stated as reducing waste, reusing, and recycling resources and products. • Reducing means choosing to use with items with care to reduce the amount of waste generated.	Applicable - This strategy is applicable for the management of waste to minimize/ reduce the environmental, social, and economic problems.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		• Reusing involves the repeated use of items or parts of items which still have usable aspects. • Recycling means the use of waste itself, as resources. • It suggests ISO 14001 or any other EMS structure which is significant for the development of strategies relevant for the industry and its social and environmental setting. ISO 14001 is increasingly important in international trade.	
Solid Waste Management Rules 2021	Department of Environment	• When recovering resources from waste, the principles of management that consider the waste hierarchy, such as the 3Rs, segregation, and reduction, must be followed at all stages from waste generation to final disposal. • Responsibilities of waste generators, consumers, and users: Dispose of waste in accordance with the regulations of authorities including local government; Dispose of waste separately; Do not dump, store, or burn waste outdoors. • Responsibilities of manufacturers (*not defined) and importers of products: Collect non-biodegradable products such as glass, plastic, polyethylene, multi-layered packaging, bottles, and cans from consumers and recycle or dispose of them if appropriate; Determine work plans and implementation procedures for recycling and disposal; Ensure that Extended Producer Responsibility (EPR) is properly implemented; Submit an annual report to the Department of Environment (DOE) on the amount of plastic recycled; Raise public awareness of proper waste management. Any violation of the above provisions shall be subject to imprisonment for not more than two years or a fine not exceeding 200,000 Taka (BDT), or both. The Regulations also include provisions for the treatment of solid waste such as composting and energy recovery.	Applicable - This rule is applicable for the management of waste (i.e., solid wastes) to minimize/ reduce the environmental, social, and economic problems.
Antiquities Act, 1968 and Antiquities Preservation Rules, 1986	Department of Archaeology, Ministry of Cultural Affairs	• No person shall deal in antiquities except under and in accordance with a license granted by the Director. • No person shall remove any object of the immovable protected antiquity.	Not Applicable - There are no archaeological and cultural sites in the project site.

Act/Rules/ Law/Ordinance	Responsible Agency- Ministry/Authority	Key Features/Remarks	Applicability
		• No person shall damage, alter, deface, or imperil immovable protected antiquity. • Any person preserving or storing any kind of movable antiquity without a license shall produce it to the Director on demand for verification of the source of its possession.	
Ports Act, 1908	Ministry of Shipping	The Ports Act 1908 was adopted to consolidate the enactments relating to Ports and port charges. Subject to this Act, a Conservator Shall be appointed into the port. Specific environmental management provisions of the Act are given under s.21 (1) which prohibits the discharge of ballast, rubbish and oil into any port or adjacent areas. Under s.31 of the Act, the movement of vessels of 200 tons or more cannot enter, leave or be moved within any port without having a pilot on board. In addition, no vessel of more than 100 tones is to enter, leave or be moved within any port without having a pilot, unless authority to do so has been given in writing. The lawful use of infrastructure such as piers and moorings and ensuring navigable waters are not obstructed is detailed under s.10, whereas s.21 prohibits interference with buoys, beacons and moorings. Unless permission has been granted by the Conservator, any action that causes or may cause injury to the bank or shore is prohibited under s.30 (1).	Applicable
The Dangerous Cargoes Act, 1953	Ministry of Shipping	The Dangerous Cargoes Act, 1953 was enacted to provide provisions related to the safety of ports in respect of the transit, working and storage of dangerous cargoes. Relevant provisions include s.3 (which deals with explosives and fires on vessels), s.6 (safety of vessels imports) and s.9 (enforcement). The concerned authority is the Deputy Conservator of the Port, Board of Trade or the Ministry of Communication and the Chief of Naval Staff.	Applicable
The Fire Services Ordinance 1959	-	The Fire Services Ordinance 1959 also states that the owner needs to obtain a license under the ordinance before using premises as a warehouse. In addition, under this Ordinance the Government by order	Applicable

Act/Rules/ Law/Ordinance	Responsible Agency- Ministry/Authority	Key Features/Remarks	Applicability
		no. HSLG/SVII/1R-1/60/295 dated 3rd June 1960 declared that any stock of coal exceeding four tones shall be considered to be a fire risk.	
The Explosives Act, 1884	-	The Government may for any part of Bangladesh, make rules consistent with this Act to regulate or prohibit, except under and in accordance with the conditions of a license granted as provided by those rules, the manufacture, possession, use, sale, transport and importation of explosives or any specified class of explosives. Any person manufacturing, possessing, using, selling, transporting or importing an explosive in contravention of a notification issued shall be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine which may extend to fifty thousand Taka, in default of which with a further imprisonment for a term which may extend to one year, and in the case of importation by water or land, the owner and master of the vessel or carriage in which the explosive is imported shall, in the absence of reasonable excuse, each be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine with a further imprisonment for a term which may extend to one year.	Applicable

Source: Different Laws and Regulations of GoB

2.3 Applicable Policies in Bangladesh

Other relevant policies in Bangladesh and their key features and applicability to the subject project are detailed in following **Table 2-2.**

Table 2-2: Policies and Plans Relevant to the Project

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
National Environment Policy, 2018	Ministry of Environment, Forest, and Climate Change	• Ensuring sustainable development through reducing human pressure on nature and natural resources • Considering environment protection as integral part of the development programs planned to meet the need of the present and future generation. • Making natural resources extraction, use, environmental conservation etc. to be based on science. • Considering environmental impacts and risks in extracting and using natural resources • Evaluating economic contribution of ecosystem services simultaneously to that of natural resources • Giving priority to poor and under privileged group of people in order to ensure their participation, equity, justice, accessibility to the use of natural resources and getting ecosystem services on which, they are dependent. • Taking initiatives to prevent misuse and ensure optimum of water, land, natural gas and other natural resources in the production process as well as day-to-day purposes. • Encouraging sustainable use of new and renewable resources • Enhancing long term poverty alleviation and food security through conserving biological diversity • Realizing compensation from persons and institutes those who are liable to environmental pollution through applying polluter pay principle • Including environmental conservation and preservation in all national policies and ensuring implementation of the environment policy at both government and nongovernment level	Applicable - as the proposed project has the likeliness of having an impact on the surrounding environment

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
		• Giving priority to preventive measures over curative measures in environmental conservation • Including adaptation and mitigation program in all development projects in order to address adverse impacts of climate change. • Ensure sustainable utilization of ecosystem goods and services. • Implementation of 3R principle in utilization of resources • Strengthening institutional and legal capacity of institution (Government, local, private, and technical) relevant to the enforcing and implementation of rules and regulation relating to environment policy and environment conservation • Ensuring considerations of climate change and challenges of calamities in all kinds of infrastructure projects • Reducing of all SLCP (Short-Lived climate pollutants) which are harmful to health and environment. • Taking development programs considering sustainable production and consumption as integral part of environmental conservation to meet the need of present and future generation. • Allocating necessary funds to all areas of environmental conservation, preservation, and control • Taking up programs in favor of flourishing environment friendly economy • Including environmental and ecological conservation particularly to introduce the environment and ecological concept in the environmental academic curriculum and textbooks of schools and colleges	
Bangladesh Climate Change Strategy and Action Plan, 2009	Ministry of Environment, Forest, and Climate Change	• Food security, social protection, and health. • Comprehensive disaster management. • Infrastructure. • Research and Knowledge management. • Mitigation and low carbon development. • Capacity building and institutional strengthening.	Applicable - As the project has the potential to generate pollutants in the air.

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
National Forest Policy, 2016	Bangladesh Forest Department/ Ministry of Environment, Forest, and Climate Change	• Manage all existing forests, wildlife, and other forestry resources, adhering to the principles of sustainable management and climate resilience. • Enrich degraded forest areas and enhance land areas under forest/ tree cover. • Produce a wide array of goods and ecosystem services for the benefit of Bangladesh's present and future generations.	Not Applicable- there is no forest land
National Water Policy, 1999	Ministry of Water Resources	• Protection and prevention of the natural environment for ensuring sustainable development. • Minimize disruption to the natural aquatic environment in streams and water channels. • Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding. • Water development projects should cause minimal disruption to navigation and, where necessary, adequate mitigation measures should be taken. • Full consideration to environmental protection, restoration, and enhancement measures consistent with NEMAP and the NWMP. • Ensure adequate upland flow in water channels to preserve the coastal estuary ecosystem threatened by the intrusion of salinity from the sea.	Applicable – The project proponent should minimize the water pollution, minimize disruption of aquatic environment and navigation system in the adjacent water bodies.
National Fisheries Policy, 1999	Ministry of Fisheries and Livestock	• Provide provisions for the protection and conservation of fish in freshwater and brackish water bodies. • Preservation, management, and exploitation of fisheries resources in inland open water. • Fish cultivation and management in inland closed water. • Prawn and fish cultivation in coastal areas. • Preservation, management, and exploitation of sea fishery resource. • Conserve fish breeding grounds and habitats; and	Applicable - There are some rivers such as Kohelia, Matamuhuri and Kutubdia channel which is also known for fishing closed to the project site and physical intervention may occur in the river by this project.

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
		• promote fisheries development and conservation in all water bodies.	
National Agriculture Policy, 2018	Ministry of Agriculture	• Ensure food security and socio-economic development through the productivity of crops, boosting production and raising farmers' income, diversifying crops, producing safe foods, and developing a marketing system, profitable agriculture & use of natural resources. • Increasing food availability, rights, and purchasing power by increasing crop productiveness and production. • Discourage the use of agricultural land for non-agricultural work to ensure sustainable food security. • Soil, water, flora, fauna and overall environmental conservation and effective use initiative adoption;	Not Applicable - the project is going to be established in the low land which is used for salt pan and fish culture. There is no impact on agricultural land and productivity due to the implementation of the proposed project.
National Land Use Policy, 2001	Ministry of Land	• Resisting the current trend of alarmingly declining the total amount of agricultural land used to produce adequate food for a growing population for a variety of reasons. • To prevent arbitrary use of land. • To formulate guidelines for the maximum use of land according to the natural differences in different parts of the country. • In the case of land acquisition for urbanization and development projects or any other purpose, to ensure its best use by acquiring the least amount of land and to avoid the acquisition of excess land as required. • Arranging for the preservation of such lands, especially government Khas lands, which may be required in the future for various development activities. • To ensure that the use of land is compatible with the natural environment. • Making the best use of land to alleviate poverty and increase employment; and • To play a helpful role in preventing the increase in the number of landless.	Applicable - As the proposed project is going to be established in the leased land from the government authority. Following the National Land Use Policy 2001, required land will be used for development purpose and will be established in less productive land. In that case the project contribution to the national economy will be higher than the current productivity of that land.

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
National Energy Policy, 1995	Ministry of Power, Energy, and Mineral Resources	• Utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy sources & environmentally sound sustainable energy development programs. • It highlights the importance of protecting the environment. • EIA should be made mandatory and should constitute an integral part of any new energy development project. • Use of economically viable environment-friendly technology. • Public awareness regarding environmental conservation; and • Ensure environmentally sound sustainable energy development programs causing minimum damage to the environment.	Applicable - As the proposed project is a coal-based power plant project.
Power Policy, 1995	Ministry of Power, Energy, and Mineral Resources	• Policy statement on demand forecast, long term planning and project implementation, investment terms, fuels and technologies, load management, institutional issues, private sector participation, technology transfer, and research program, environmental policy, and legal issues.	Applicable - As the proposed project is a coal-based power plant project.
Power System Master Plan, 2016	Ministry of Power, Energy, and Mineral Resources	• The power sector was heavily dependent on gas. Even two/three years back almost 90% of the electricity used to be generated from the natural gas of the country and rest by hydroelectricity and coal. • Stressed on diversification of the fuel such as natural gas, coal, furnace oil, diesel, etc. as well as renewable energy sources. • The target composition of power supply as of 2030 is set at 50% for domestic and imported coal, 25% for domestic and imported (in the form of LNG) natural gas, and 25% for other sources such as oil, nuclear power, and renewable energy.	Applicable - the proposed project will use coal for electricity generation.
National Industry Policy, 2016	Ministry of Industries	• The policy emphasized green productivity and the use of green technology thereby to protect the environment, setting up of ETP, CETPs would be encouraged by the government. • Advocates for setting up the Clean Development Mechanism or CDM in the industries. • Adoption of the 3R principle (Reduce, Reuse, Recycle) strategy would be encouraged for all industries; and	Applicable - the project will use coal for electricity production as well as maintain a good environment.

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
		• Discourages activities that use agricultural land for industrial purposes.	
National Occupational Health and Safety Policy, 2013	Department for Inspection of Factories and Establishment/ Ministry of Labor and Employment	• Necessary measures to ensure workplace safety and health protection in light of international Conventions/Declarations/ Recommendations/ Instruments. • Review and updating of all laws relating to Occupational Health and Safety (OHS); • Inclusion of OHS issues in the policies and programs of all related Ministries and agencies. • Establish labor courts in the industrial zone as the workers and trade unions can have easy access to the courts for implementing the mandatory provisions of OHS. • Impose mandatory terms and conditions upon construction agencies to follow the OHS policies during govt. run construction works; and • To ensure maximum safety standards during construction and implement all standards and regulations on an internal safety environment.	Applicable - as the policy pertains to the occupational rights and safety of workers and has the provision of a comfortable work environment and reasonable working conditions for all employees.

2.4 Other Policies in Bangladesh

2.4.1 National Environnemental Management Action Plan (NEMAP), 1995

NEMAP was developed to address issues and management requirements related to the environment; it also sets out the framework within which the recommendations of the NCS are to be implemented. NEMAP was developed to achieve the following broad objectives:

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

To attain the above-mentioned objectives, the plan groups all the relevant necessary actions under four headings, namely: institutional, sectoral, location- specific and long-term issues.

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

2.4.2 The EIA Guidelines for Industry, 2021

In Bangladesh, Initial Environmental Examination (IEE) and EIA study has been made regulatory need under certain categories of projects as specified in Environment Conservation Rule, 1997 for obtaining Environmental Clearance Certificate which is mandatory for any industrial and other development projects. Since IEE and EIA are mainly used as decision making tools, they must have to be linked to the project planning process and their findings and measures are integrated throughout entire project cycle –inception, feasibility, technical design, cost estimation, preparation of portfolio and various phases of project implementation. In Bangladesh, it has, in fact, not been the case. There has been gap between IEE and EIA process and project planning. However, this drawback has recently been removed through issuance of government notification that has provided detailed directives in this regard. Now the challenge remains is to create enabling condition and capacity in which good and desired quality EIA studies and professional practices are cultured and flourished in the country. In fulfilling this requirement, the publication of this EIA guidelines obviously put an important milestone.

Right after promulgation of the ECR, 1997, DoE published the EIA Guidelines for Industries in 1997 outlining simpler procedure to be followed for preparing EIA and their review. Now DoE has revised that book of guidelines by considering the present environmental status as well as the need for rapid economic development of Bangladesh. These considerations have essentially been kept in view while revising the handbook of general EIA Guidelines for Industries 2021.

2.4.3 National Conservation Strategy (NCS), 1992

NCS 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. 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.

2.4.4 Draft Coal Policy, 2010

The Draft Coal Policy (version 1) was published on 1st December 2005 by the Energy and Mineral Resources Division of Ministry of the Power, Energy and Mineral Resources. After that, it was revised several times. The latest one is the Bangladesh Draft Coal Policy, 2010.

The latest Draft Coal Policy (2010) outlines gas shortage, power generation, coal development, investment for coal sector, import coal, environment etc. in Bangladesh. Therefore, this policy will become useful data in relating the domestic coal supply. This policy states that coal will be used for power generation instead of gas as an alternative fuel to maintain national energy stability.

2.4.5 National Land Transport Policy, 2004

The government approved the NLTP in April 2004, which introduced the concept of long-term network planning and integration of transport policy, planning and appraisal across land transport modes. Each sub-sector undertakes physical and institutional improvement in line with its long-term policy provided in the NLTP with each sub-sector master plan. Major issues by sub-sector include (i) maintenance financing, quality, safety, and overloading in major roads; (ii) better planning in rural roads; (iii) restructuring Bangladesh Railways into a commercially oriented organization in conjunction with substantial investment in infrastructure, rolling stocks and wagons, equipment and technical modernization; (iv) efficient dredging and tariff regulation in inland waterways; and (v) operation efficiency improvements in ports. As indicated in the NLTP, environmental adaptation needs to be taken into account in project assessment, which will help mitigate climate change.

2.4.6 National Water Management Plan, 2001 (approved in 2004)

The National Water Resources Council approved on March 31, 2004, a 25-year National Water Management Plan. The plan provides a framework within which all concerned with the development, management, and use of water resources water services in Bangladesh can plan and implement their own activities in a coordinated and integrated manner. The planned activity programs have been presented in the eight sub-sectoral clusters: i) Institutional Development, ii) Enabling Environment, iii) Main River, iv) Towns and Rural Areas, v) Major Cities; vi) Disaster Management; vii) Agriculture and Water Management, and viii) Environment and Aquatic Resources. Each cluster comprises of a number of individual programs. WARPO was assigned to monitor the NWMP.

2.4.7 National Policy for Safe Water Supply & Sanitation (NPSWSS) 1998

This policy was promulgated to improve the standard of public health and to ensure improved environment, particularly by facilitating access of all citizens to basic level of services in water supply and sanitation, bringing about behavioral changes regarding use of water and sanitation; reducing incidence of water borne diseases; building capacity in local governments and communities to be effectively with problems relating to water supply and sanitation; promoting sustainable water and sanitation services; ensuring proper storage, management and use of surface water and preventing its contamination, among others. The Department of Public Health Engineering is the national lead agency responsible exclusively for water supply and sanitation facilities along with advisory service to GoB in framing policy and action plans. The Department has a Water Quality Monitoring and Surveillance Circle.

2.4.8 Coastal Zone Policy, 2005

Coastal zone policy initiated as a harmonized policy that transcends beyond sectoral perspectives. The policy provides general guidance so that the coastal people can pursue their livelihoods under secured conditions in a sustainable manner without impairing the integrity of the natural environment. The policy framework underscores sustainable management of natural resources like inland fisheries & shrimp, marine fisheries, marine fisheries, mangrove and other forests, land, livestock, salt, minerals, sources of renewable energy like tide, wind, and solar energy. It also emphasis on conservation and enhancement of critical ecosystem- necessary measures will be taken to conserve and develop aquatic and terrestrial including all the ecosystems of importance identified by the Bangladesh National Conservation Strategy (Mangrove, coral reef, tidal wetland, sea grass bed, Barrier Island, estuary, closed water body etc.).

2.4.9 Open Space Protection

The Urban Open-fields, Garden and Natural Water Bodies Protection Act (Jaladhar Ayne) 2000 is intended to preserve areas of open space from encroachment or conversion to other uses. With proper implementation of the law, the respective authorities can protect the open spaces natural water bodies including the flood plains of the urban areas from filing up for the sake of urbanization and development.

2.4.10 Coastal Development Strategy, 2006

Coastal Development Strategy has been approved by the Inter-Ministerial Steering Committee on ICZMP project on February 13, 2006. The strategy is based on the Coastal Zone Policy and takes into account the emerging trends: increasing urbanization, changing pattern of land use, declining land and water resources, unemployment and visible climate change impacts. The strategy has 9 strategic priorities and the following 3 are relevant priorities with proposed type of interventions:

- Safety from man-made and natural hazards.
- Sustainable management of natural resources.
- Environmental conservation.

2.4.11 Disaster Management Act, 2012

This Act is the legal basis for coordinating activities about disaster management, setting policies and formulation of rules and to build up infrastructure of effective disaster management to fight all types of disaster. It also described the national disaster management principles and planning by reducing the overall vulnerability from different impacts of disaster through risk reduction activities; conduct of humanitarian assistance programs efficiently to enhance the capacity of poor and disadvantaged as well as strengthening and coordinating programs undertaken by various government and NGOs related to disaster risk reduction and emergency response. The Department of Disaster Management (DDM) is responsible for the Disaster Management Act and to mandate the implement of the objectives.

2.4.12 Road Transport Act, 2018

The Road Transport Act 2018 set-forth requirements for road/traffic safety and prevention of motor vehicle accidents. The Bangladesh Road Transport Authority (BRTA) is a regulatory body to control, manage and ensure discipline in the road transport sector, as well as to maintain road safety. It works under the Ministry of Communication to carry out the purposes set out for it under the Motor Vehicle Ordinance.

2.4.13 The Embankment and Drainage Act, 1952

The East Bangle Act No. 1, 1953 was amended in 1953 which has been adapted by the People Republic of Bangladesh, by the Bangladesh Order (adaptation of Existing Laws), 1972 (President's Order No. 48 of 1972). The Act consolidates the laws relating to embankments and drainage providing provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion or other damage by water.

The specific Sections and Articles relevant to the project are mentioned below:

- **Section 4 (1)** of the Act states that the embankment, watercourse, and tow-path, earth, pathways, gates, berms and hedges of the embankments shall vest in the Government of the Authority (BWDB).
- **Section 56 (1)** states that, person will be subject to penalty (500 taka or imprisonment… if he erects, or causes of willfully permits to be erected, any new embankment, or any existing embankment, or obstructs of diverts, or causes or willfully permits to be obstructed or diverted, any water course).
- **Section 15** allows for the engineer (engineer in charge of Divisional level BWDB) for constructing new embankment or enlarging, lengthening, or repairing existing embankments.
- The other sections of the Act give powers and access to the Government or Authority or Engineers to commence necessary project activities, for land acquisition (through the DC), and site clearing activities including removal of trees or houses (if necessary).

2.4.14 Bangladesh Climate Change Strategy and Action Plan, 2009

The GOB also prepared the BCCSAP in 2008 and revised in 2009. This is a comprehensive strategy to address CC challenges in Bangladesh. BCCSAP built on and expanded the NAPA. It is built around the following six themes:

- **Food security, social protection, and health** to ensure that the poorest and most vulnerable in society, including women and children, are protected from CC and that all programs focus on the needs of this group for food security, safe housing, employment and access to basic services, including health.
- **Comprehensive disaster management** to further strengthen the country's already proven disaster management systems to deal with increasingly frequent and severe natural calamities.
- **Infrastructure** to ensure that existing assets (e.g., coastal and river embankments) are well maintained and fit for purpose and that urgently needed infrastructure (cyclone shelters and urban drainage) is put in place to deal with the likely impacts of climate change.
- **Research and Knowledge management** to predict that the likely scale and timing of CC impacts on different sectors of economy and socio-economic groups; to underpin future investment strategies; and to ensure that Bangladesh is networked into the latest global thinking on climate change.
- **Mitigation and low carbon development** to evolve low carbon development options and implement these as the country's economy grows over the coming decades.
- **Capacity building and Institutional strengthening** to enhance the capacity govt. ministries, civil society, and private sector to meet the challenge of CC.

2.5 Administrative Setup related to Environment in Bangladesh

The Ministry of Environment, Forest and Climate Change (MoEFCC) is responsible for overseeing all environmental matters relating to national environmental policy and regulatory issues in the country. The MoEFCC oversees the activities of the following technical/implementing agencies:

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

2.5.1 Department of Environment (DOE)

The DoE has been placed under the MoEFCC as its technical wing and is statutorily responsible for the implementation of the ECA, 1995. The department was created in 1989, to ensure sustainable development and to conserve and manage the environment of Bangladesh. The principal activities of the DoE are:

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

2.5.2 Procedure for obtaining Environmental Clearance from DoE, Bangladesh

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

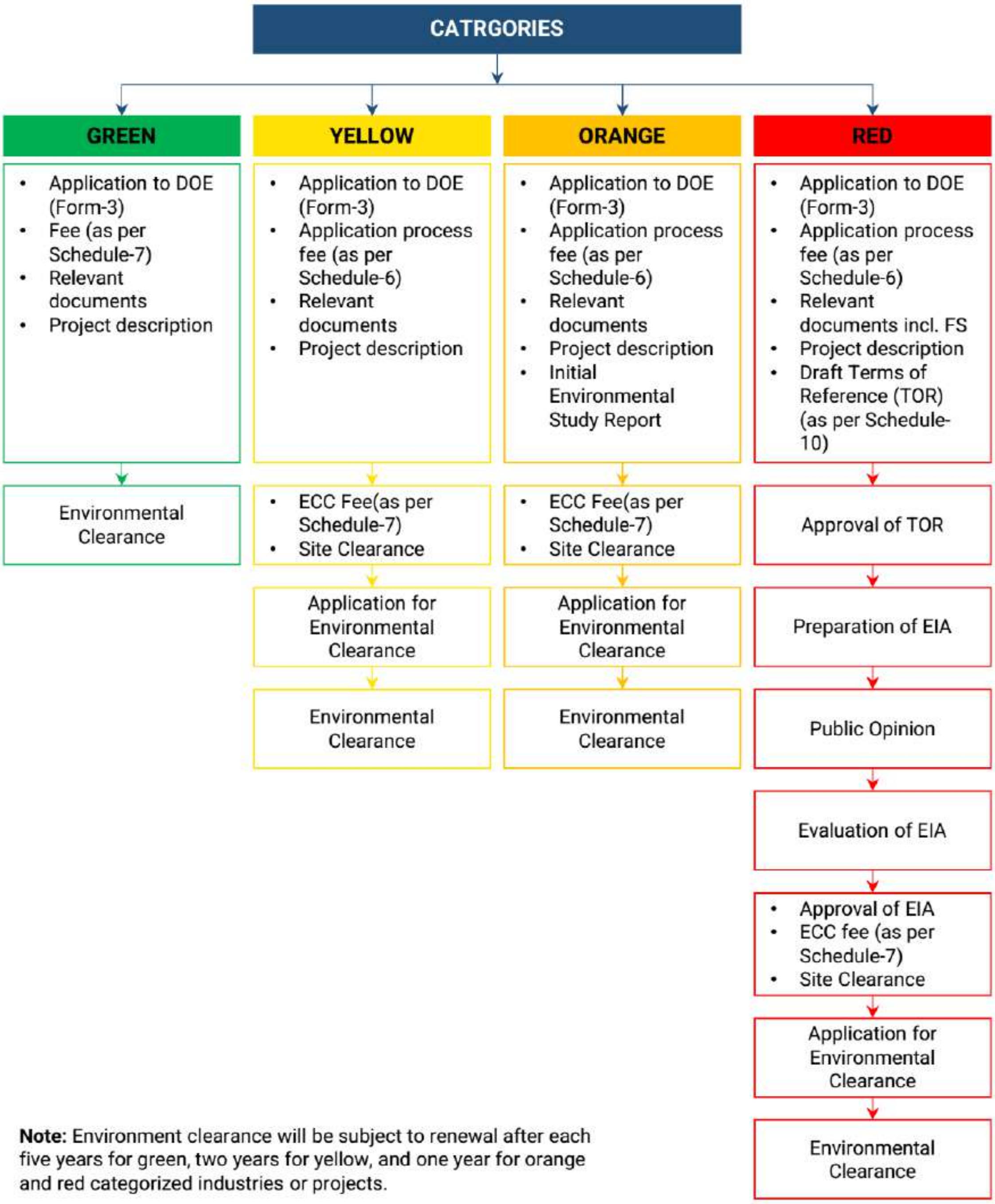
- Projects categorized as Green do not require IEE or EIA for environmental clearance however, the proponent must submit an application in a prescribed format along with specified documents.
- Projects categorized as Yellow require IEE for site clearance and environmental clearance.
- Projects categorized as Orange require an IEE to be submitted to the DOE along with an application in a prescribed format and other specified documents for obtaining site clearance certificate. If Environmental clearance committee feels any project will harm to environment significantly then they may recommend for EIA study and
- Red category projects require ToR approval and EIA. An EIA is required for the location clearance and the environmental clearance.

As per the ECR 2023, Power Plant project fall under the "RED" category as referred below:

- **Item 3: Power Plant**

Procedure for obtaining environmental clearance from DoE for different categories project is presented in **Figure 2-1**.

Figure 2-1: Procedure for Obtaining Environmental Clearance for Different Categories Project



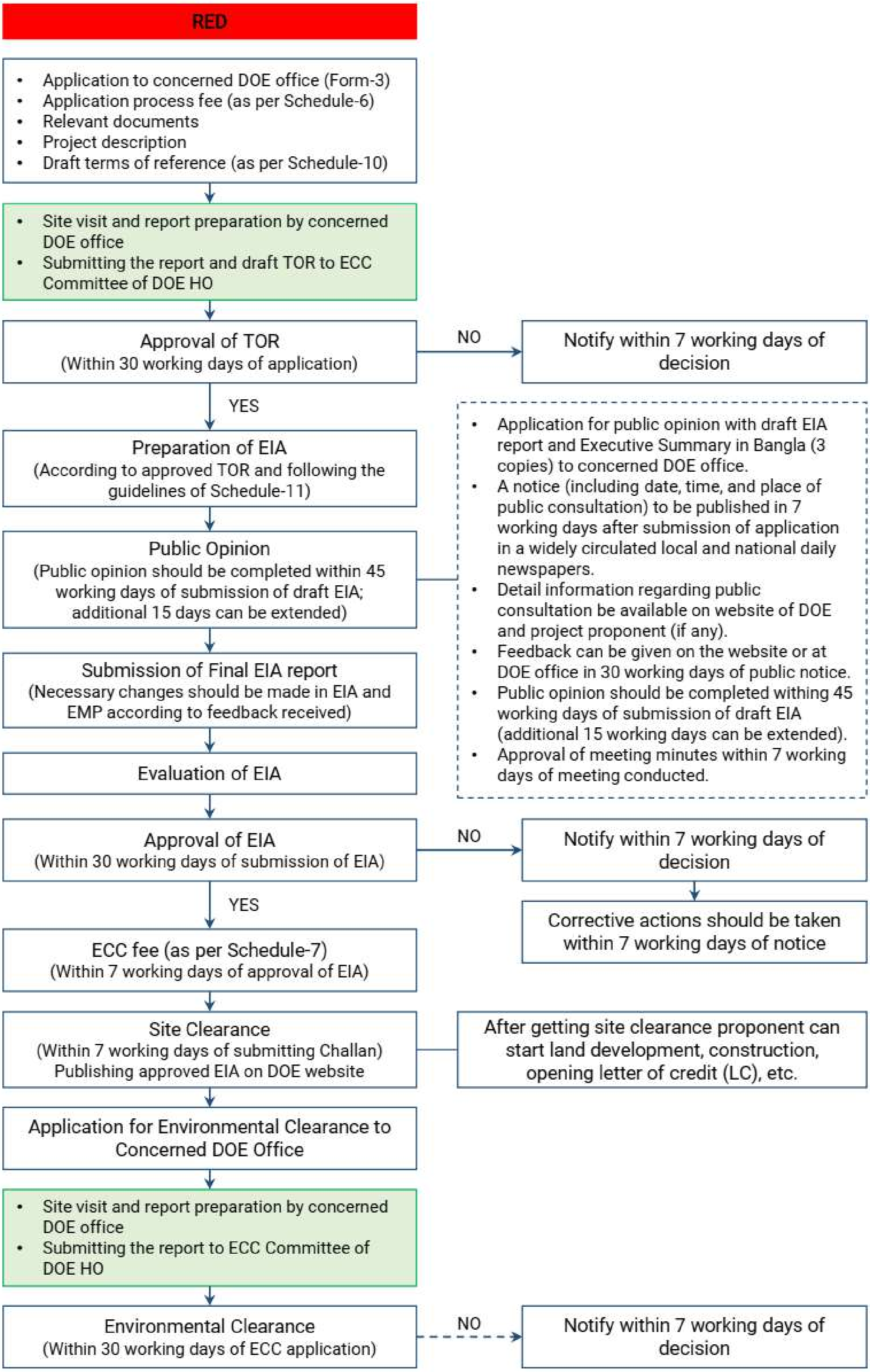
Procedure of Environmental Clearance for Red Category Project

The process for obtaining an Environmental Clearance Certificate for the proposed project is outlined in the following.

- Proponent must submit the application following the form attached in schedule 6 along with process fee, project related documents, detail, draft terms of reference as per schedule 10 and applicable instruction mentioned in schedule 9;
- Environmental clearance committee will scrutiny all documents and forward to DG for approval;
- DG will approve the terms of reference within 30 days;
- According to the terms of reference, EIA report should be prepared by authorized consultant by DoE;
- The report shall be submitted to the respective DoE office;
- A public consultation meeting should be conducted as per the instruction of Rule 16 of ECR 2023;
- Respective DoE office will forward the report to ECC committee for review;
- Report shall be disclosed in the company website;
- The EIA report will be disclosed in DoE website for 30 days to obtain the public opinion;
- Environmental clearance committee will scrutiny the EIA report and may call for presentation;
- After satisfactory explanation, committee will forward the report to DG for approval;
- DG will approve the report within 30 days after completion of report disclosure;
- Proponent will be notified within 7 days after report approval from DG to submit fee as per schedule 7;
- Respective DoE office will provide site clearance certificate within 7 days after confirmation of fee deposition;
- Project authority can do land development, infrastructure construction and open LC for the project;
- Approved EIA report shall be disclosed in the company website for public notification;
- Project authority shall apply for environmental clearance to operate of the industry;
- DoE officers will visit the industry/project to verify the SCC condition then application and a report will be forwarded to the ECC committee;
- ECC committee will forward the report to DG for ECC approval;
- Respective DoE office will issue ECC after approval from DG; and
- ECC will be issued by DoE within 30 days after receiving application.

The process of ECC approval for red category project is presented in **Figure 2-2**.

Figure 2-2: Procedure of Obtaining Environmental Clearance for Red Category Project



2.6 International Maritime Conventions, Protocols and Agreements applicable for coal transportation

Bangladesh is signatory of the International Maritime Organization (IMO). Therefore, all activities relating to shipment of coal through the Port shall have to be done strictly in compliance with the standards set by the IMO, particularly the conventions, protocols, and agreements. The following Conventions/ Protocols of IMO have been agreed by the GoB.

1. IMO Convention 1948
2. IMO amendments 1991
3. IMO amendments 1993
4. SOLAS Convention 1974
5. SOLAS Protocol 1988
6. LOAD LINES Convention 1966
7. LOAD LINES Protocol1988
8. TONNAGE Convention1969
9. COLREG Convention1972
10. STCW Convention 1978
11. SAR Convention 1979
12. STP Agreement 1971
13. STP Protocol 1973
14. IMSO Convention 1976
15. INMARSAT OA 1976
16. FACILITATION Convention 1965
17. MARPOL 1973/1978 (Annex I/II)
18. MARPOL 1973/1978 (Annex III)
19. MARPOL 1973/1978 (Annex IV)
20. MARPOL 1973/1978 (Annex V)
21. MARPOL Protocol 1997 (Annex VI)
22. INTERVENTION Convention 1969
23. SUA Convention 88
24. SUA Protocol 1988
25. OPRC Convention 1990

Some of the Conventions/Protocols acceded by GoB are highlighted following **Table 2-3**:

Table 2-3: International Maritime Conventions, Protocols, and Agreements of different issues

Issues	International Maritime Conventions, Protocols and Agreements	Remarks
International Maritime	IMO Convention, 1948	The Convention establishing the IMO was adopted in 1948 but the Organization started life as the Inter-Governmental Maritime Consultative Organization (IMCO) until it was changed to the IMO in 1982. The Aims of the IMO include a range of objectives: • To provide machinery for co-operation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade, and to encourage the general adoption of the highest practicable standards in matters concerning maritime safety and efficiency of navigation. • To provide for the consideration by the organization of any matters concerning shipping that may be referred to it by any organ or specialized agency of the United Nations.

Issues	International Maritime Conventions, Protocols and Agreements	Remarks
		• To provide for the exchange of information among Governments on matters under consideration by the organization. There have been a series of amendments to the convention which are 1975 amendments, 1977 amendments, 1991 amendments. This Convention came into force in Bangladesh on May 27, 1976. The amendment 1993 acceded on November 7, 2002.
Maritime safety	SOLAS Convention, 1974	The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant Ships. The 1974 version includes the tacit acceptance procedure-which provides that an amendment shall enter into force on a specified date unless, before that date, objections to the amendment are received from an agreed number of Parties. The Convention came into force on May 25, 1980, and acceded by GoB on February 6, 1982. The 1988 Protocol of SOLAS 1974 was acceded by Bangladesh on November 4, 2002.
Measurement of ships	Load Lines Convention, 1966	It has long been recognized that limitations on the draught to which a ship may be loaded make a significant contribution to her safety. These limits are given in the form of freeboards, which constitute, besides external weather tight and watertight integrity, the main objective of the Convention. The Convention acceded by GoB on August 10, 1978. The Protocol of the load Line Convention acceded by GoB on November 4, 2002.
Preventing collisions at sea	Convention on International Regulations for Preventing Collisions at Sea (COLREG), 1972	The 1972 Convention was designed to update and replace the Collision Regulations of 1960 which were adopted at the same time as the 1960 SOLAS Convention. One of the most important innovations in the 1972 COLREGs was the recognition given to traffic separation schemes-Rule 10 gives guidance in determining safe speed, the risk of collision and the conduct of vessels operating in or near traffic separation schemes. The Convention was acceded by Bangladesh on May 10, 1978.
International Maritime Satellite	System Convention on International Maritime Satellite Organization (INMARSAT), 1976	IMO recognized the potential for satellite communications to assist in distress situations at sea soon after the launch of the world's first telecommunications satellite, Telstar, in 1962. In February 1966, IMO's Maritime Safety Committee (MSC) decided to study the operational requirements

Issues	International Maritime Conventions, Protocols and Agreements	Remarks
		for a satellite communications system devoted to maritime purposes. In 1973, IMO decided to convene a conference with the object of establishing a new maritime communications System based on satellite technology. The Convention came into force by GoB on July 16, 1979.
Prevention of Pollution from Ships	International Convention for the Prevention of Pollution from Ships (MARPOL)	The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and includes the protocol of 1997 (Annex VI). It has been updated by amendments through the years. MARPOL 73/78 (Annex-I, II, III, IV, V and VI) was acceded by GoB on November 4, 2002.
	Convention on Facilitation of International Maritime Traffic (facilitation), London, 1965	The Convention's main objectives are to prevent unnecessary delays in maritime traffic, to aid cooperation between Governments, and to secure the highest practicable degree of uniformity in formalities and other procedures. In particular, the Convention reduces the number of declarations which can be required by public authorities. The Convention came into force in Bangladesh on October 28, 2000.
Safety of maritime navigation	Convention for the Suppression of Unlawful Acts of Violence against the Safety of Maritime Navigation (SUA convention), 1988	The main purpose of the convention is to ensure that appropriate action is taken against persons committing unlawful acts against ships. These include: a. The seizure of ships by force. b. Acts of violence against persons on board ships; and c. The placing of devices on board a ship which are likely to destroy or damage it. The convention obliges Contracting Governments either to extradite or prosecute alleged offenders. The Convention came into force in Bangladesh on September 7, 2005.

2.7 International Legal Obligations

Bangladesh is signatory to a number of MEAs and also some bilateral instruments. Some of them are very important in the context of environmental protection. The legal obligations and provisions of MEAs related to the proposed project interventions will be reviewed; (Convention on Biological Diversity; Convention on Wetlands of International Importance Especially as Waterfowl Habitat; United Nations Convention on the Law of the Sea; Convention Concerning the Protection of the World Cultural and Natural Heritage) Bangladesh has already had accessed to, ratified or signed a number of important

MEAs related to environment protection and conservation of natural resources which shall have to be complied with during implementation of the project. The pertinent ones of these are highlighted below:

2.7.1 Rio Declaration

The 1992 UNCED adopted the global action program for sustainable development called 'Rio Declaration 'and 'Agenda 21'. Principle 4 of the Rio Declaration, 1992, to which Bangladesh is a signatory along with a total of 178 countries, states, "In order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it".

2.7.2 Convention on Biological Diversity, 1992

The Convention on Biological Diversity, Rio de Janeiro, 1992 was adopted on 5 June 1992 and entered into force on 29 December 1993. Bangladesh ratified the Convention on 20 March 1994. The Contracting Parties of the Convention have committed to:

- Introducing appropriate procedures requiring environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biodiversity, with a view to avoiding or minimizing such effects, and where appropriate allow for public participation in such procedures; and
- Introducing appropriate arrangements to ensure that environmental consequences of its programs and policies, that are likely to have significant adverse impacts on biodiversity, are duly taken into account.

Obligation has been placed on State parties to provide for environmental impact assessments of projects that are likely to have significant adverse effects on biological diversity (art. 4).

2.7.3 Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, 1971

This convention is also known as the Ramsar Convention. It was adopted 2 February 1971 and entered into force on 21 December 1975. Bangladesh has ratified the Convention 20 April 2002. This provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are 127 Parties with 1085 wetland sites designated as Wetlands of International Importance.

This is an intergovernmental treaty, which provides the framework for international cooperation for the conservation of wetlands habitats. Obligations for Contracting Parties include the designation of wetlands to the "List of Wetlands of International Importance", the provision of wetland considerations within their national land use planning, and the creation of Natural Reserves.

2.7.4 United Nations Convention on the Law of the Sea, Montego Bay, 1982

This Convention was adopted on 10 December 1982 at Montego Bay, Jamaica. Bangladesh has ratified this Convention. Main objectives of the convention are:

- To set up a comprehensive new legal regime for the sea and oceans, as far as Environmental provisions are concerned, to establish material rules concerning environmental standards as well as enforcement provisions dealing with pollution of the marine environment; and
- To establish basic environmental protection principals and rules on global and regional cooperation, technical assistance, monitoring, and environmental assessment, and adoption and enforcement of international rules and standards and national legislation with respect to alt sources of marine pollution.

2.7.5 UNESCO World Heritage Convention

Convention concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972: This convention has been ratified by 175 states. This defines and conserves the world's heritage by drawing up a list of natural and cultural sites whose outstanding values should be preserved for all humanity. Of the 730 total sites, there are currently 144 natural, 23 mixed and 563 cultural sites that have been inscribed on the World Heritage List (distributed in 125 State parties). These are the "Jewels in the Crown" of conservation.

2.8 International Safeguard Requirements

As mentioned by the project proponents, financing sources and financial support for the Project may be sought from multi-lateral financial, such as the IFC, the ADB, the EPFIs, and the AIIB as well as from the export credit agencies of the countries where major pieces of equipment for the Project will be sourced. This support from the multi-lateral financial institutions/ export credit agencies also linked with the adherence of international best practices and environmental and social safeguard requirements of the lenders. The following subsections outline the key environmental and social requirements of the IFC, and EPFIs guidelines for Environmental and Social consideration applicable to the Project.

2.8.1 IFC Performance Standards

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

A brief description of the Performance standards is provided in **Table 2-4**.

Table 2-4: IFC Performance Standards

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

Source: IFC Performance Standards, January 2012

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

The following sub-sections try to provide the requirements of the specific PS, so as to set up the context for matching the requirements of these PS during the various stages of the life cycle of the Project.

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

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

- A Social and Environmental Assessment to understand the social and environmental impacts and risks;
- A Management Programme for mitigating the impacts and minimizing the risks identified in the assessment;
- Establishing and ensuring organizational capacity and requisite trainings to the staff to implement the Management Programme;
- Identification and engagement with range of stakeholders that may be interested in their actions;
- Development and implementation of Stakeholder Engagement Plan that is scaled to the project risks and impacts and development stage and tailored to the characteristics and interests of the Affected Communities;
- Engagement and consultation with the affected communities, subject to identified risks and adverse impacts from a project;
- Informed Consultation and Participation ("ICP") process for projects with potentially significant adverse impacts on affected communities;
- For projects with adverse impacts to Indigenous Peoples, requirement to engage them in a process of ICP and in certain circumstances requirement to obtain their Free, Prior, and Informed Consent (FPIC);
- Implementation and maintenance of procedure for external communications to receive and register external communications from the public, and their Redressal;
- Adequate monitoring and reporting systems to measure and report the effectiveness of the Management Programmes.

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

PS 2: Labour and Working Conditions

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

- Establishment of a sound worker-management relationship;
- Encouraging equal opportunity and fair treatment of workers;
- Promoting compliance with national labour and employment laws;
- Management of accommodation services with provision of basic services;
- Promoting healthy and safe working conditions for workers; and
- Analysis of alternatives for retrenchment prior to implementing any collective dismissals.

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

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

PS 3: Resource Efficiency and Pollution Prevention

PS 3 outline a project level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices with objectives to:

- Avoid or minimise adverse impacts on human health and the environment by avoiding or minimizing pollution from activities;
- Promote more sustainable use of resources, including energy and water; and
- Reduce project-related greenhouse gas ("GHG") emissions.

Key requirements of PS3 are to consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid or where avoidance is not possible, minimise adverse impacts on human health and the environment during the entire project life-cycle. In addition, a project needs to follow good international industry practice ("GIIP"), as reflected in various internationally recognized sources including the World Bank Group Environmental, Health and Safety Guidelines.

PS 4: Community, Health, Safety and Security

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

A project needs to evaluate the risks and impacts to the health and safety of the Affected Communities during the project life-cycle and require establishing preventive and controlling measures consistent with good international industry practice ("GIIP"), such as in the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) or other internationally recognized sources.

PS 4 recognises that project activities, equipment, and infrastructure often bring benefits to communities including employment, ecosystem services, and opportunities for economic development. However, projects can also increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failures, and releases of hazardous materials.

The performance standard details out project proponents responsibility to avoid or minimise the possible risks and impacts to community health, safety and security that may arise from project activities.

PS 5: Land Acquisition and Involuntary Resettlement

The objectives of this PS are to:

- Avoid, and when avoidance is not possible, minimise displacement by exploring alternative project designs;
- Avoid forced eviction;
- Anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost, and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation and the informed participation of those affected;
- Improve, or restore, the livelihoods and standards of living of displaced persons;
- Improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.

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

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

- Land rights or land use rights acquired through expropriation or other compulsory procedures in accordance with the legal system of the host country;
- Land rights or land use rights acquired through negotiated settlements with property owners or those with legal rights to the land if failure to reach settlement would have resulted in expropriation or other compulsory procedures;
- Project situations where involuntary restrictions on land use and access to natural resources cause a community or groups within a community to lose access to resource usage where they have traditional or recognizable usage rights;
- Certain project situations requiring evictions of people occupying land without formal, traditional, or recognizable usage rights;8 or
- Restriction on access to land or use of other resources including communal property and natural resources such as marine and aquatic resources, timber and non-timber forest products, freshwater, medicinal plants, hunting and gathering grounds and grazing and cropping areas.

This PS does not apply to resettlement resulting from voluntary land transactions (i.e., market transactions in which the seller is not obliged to sell, and the buyer cannot resort to expropriation or other compulsory procedures sanctioned by the legal system of the host country if negotiations fail). It also does not apply to impacts on livelihoods where the project is not changing the land use of the affected groups or communities.

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

PS 6 aims at protecting and conserving biodiversity, maintaining ecosystem services, the variety of life in all its forms, including genetic, species and ecosystem diversity and its ability to change and evolve, is fundamental to sustainable development. The objectives of this PS are to:

- Protect and conserve biodiversity;
- Maintain the benefits from ecosystem services; and
- Promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

The components of biodiversity, as defined in the Convention on Biological Diversity, include ecosystems and habitats, species and communities, and genes and genomes, all of which have social, economic, cultural and scientific importance. This PS addresses how clients can avoid or mitigate threats to biodiversity arising from their operations as well as incorporate sustainable management of renewable natural resources[1].

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

For the purposes of implementation of this PS, habitats are divided into modified, natural and critical. Critical habitats are a subset of modified or natural habitats. For the protection and conservation of biodiversity, the mitigation hierarchy includes biodiversity offsets, which may be considered only after appropriate avoidance, minimization, and restoration measures have been applied. A biodiversity offset

1 Given the complexity in predicting project impacts on biodiversity and ecosystem services over the long term, the client should adopt a practice of adaptive management in which the implementation of mitigation and management measures are responsive to changing conditions and the results of monitoring throughout the project's lifecycle.

should be designed and implemented to achieve measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity; however, a net gain is required in critical habitats. The design of a biodiversity offset must adhere to the "like-for-like or better" principle and must be carried out in alignment with best available information and current practices.

PS 7: Indigenous Peoples

PS 7 acknowledges the possibility of vulnerability of indigenous people[2] owing to their culture, beliefs, institutions and living standards, and that it may further get compromised by one or other project activity throughout the life cycle of the project. The PS underlines the requirement of avoiding / minimizing adverse impacts on indigenous people in a project area, respecting the local culture and customs, fostering good relationship and ensuring that development benefits are provided to improve their standard of living and livelihoods.

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

PS 8: Cultural Heritage

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

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

Protect cultural heritage from the adverse impacts of project activities and support its preservation; and

Promote the equitable sharing of benefits from the use of cultural heritage in business activities.

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

The requirements of this Performance Standard do not apply to the proposed project as the land and natural resource footprints do not impact any cultural heritage sites of local, national or international significance and protection.

2.8.1.1 IFC Project Categorization

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

- Category A Projects: Projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented;

2 There is no universally accepted definition of "Indigenous Peoples." Indigenous Peoples may be referred to in different countries by such terms as "Indigenous ethnic minorities," "aboriginals," "hill tribes," "minority nationalities," "scheduled tribes," "first nations," or "tribal groups." This Performance Standard applies to communities or groups of Indigenous Peoples who maintain a collective attachment, i.e., whose identity as a group or community is linked, to distinct habitats or ancestral territories and the natural resources therein. It may also apply to communities or groups that have lost collective attachment to distinct habitats or ancestral territories in the project area, occurring within the concerned group members' lifetime, because of forced severance, conflict, government resettlement programmes, dispossession of their lands, natural disasters, or incorporation of such territories into an urban area.

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

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

2.8.1.2 IFC EHS Guidelines

The Environmental, Health, and Safety (EHS) General Guidelines[3] (April 30, 2007) will be applicable for this Project. In addition to that, IFC's Sector specific EHS Guidelines for Thermal Power Plants[4] (December 19, 2008) and EHS Guidelines for Electrical Power Transmission and Distribution[5] (April 30, 2007) will also apply.

2.9 Equator Principles IV

The Equator Principles IV (June 2020) are a set of ten (10) voluntary standards adopted by financial institutions as a framework for environmental and social risk management for project finance transactions.

The subsequent **Table 2-5** summarises the key EP requirements and their applicability for the proposed project:

[3]http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_GeneralEHS/$FILE/Final+-+General+EHS+Guidelines.pdf

[4]http://www1.ifc.org/wps/wcm/connect/dfb6a60048855a21852cd76a6515bb18/FINAL_Thermal%2BPower.pdf?MOD=AJPERES&id=1323162579734

[5]http://www.ifc.org/wps/wcm/connect/66b56e00488657eeb36af36a6515bb18/Final%2B-%2BElectric%2BTransmission%2Band%2BDistribution.pdf?MOD=AJPERES&id=1323162154847

Table 2-5: Equator Principles and their Applicability for the Project

Principles	Outline	Details
Principle 1: Review and Categorization of the Project	Equator Principles Financial Institutions (EFPIs) are required to categorize projects based on the magnitude of its potential environmental and social risks based on the environmental and social screening criteria of IFC.	Projects are designated as Category A, B or C when it represents, respectively, a high, medium or low level of risk as per the following understanding: Category A – Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented; Category B – Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and Category C – Projects with minimal or no adverse environmental and social risks and/or impacts.
Principle 2: Environmental and Social Assessment	For projects categorized as A or B, the borrower has to conduct an ESA to appropriately address all social and environmental impacts and risks.	The assessment should also propose mitigation and management measures. The principle requires ESIA study to assess social and environmental impacts and risks due to the Category A project. A Climate Change Risk Assessment is required for all Category A and, as appropriate, Category B Projects
Principle 3: Applicable Environmental and Social Standards	For projects located in non-OECD countries, and those located in OECD countries not designed as high-income, as defined by the World Bank Development indicator database, the assessment will refer to the then applicable IFC Performance Standards and applicable industry specific EHS guidelines.	The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues.
Principle 4: Environmental and Social Management System and Equator Principles Action Plan	For all Category A and Category B Projects, the borrower has to develop or maintain an Environmental and Social Management System (ESMS).	Further, an Environmental and Social Management Plan (ESMP) will be prepared by the borrower to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the borrower and the EPFI will agree an Equator Principles Action Plan (EPAP). The Equator Principles

Principles	Outline	Details
		AP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.
Principle 5: Stakeholder Engagement	For all Category A and Category B Projects, the EPFI will require the borrower to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, other stakeholders	For Projects with potentially significant adverse impacts on Affected Communities, the borrower will conduct an informed consultation and participation process. The borrower will tailor its consultation process to the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups. This process should be free from external manipulation, interference, coercion and intimidation. To facilitate Stakeholder Engagement, the client will, commensurate with the Project's risks and impacts, make the appropriate Assessment Documentation readily available to the Affected Communities, and where relevant Other Stakeholders, in the local language and in a culturally appropriate manner. Disclosure of environmental or social risks and adverse impacts should occur early in the Assessment process, in any event before the Project construction commences, and on an ongoing basis.
Principle 6: Grievance Mechanism	For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish effective grievance mechanisms which are designed for use by Affected Communities and Workers, as appropriate, to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance.	The grievance mechanism is required to be scaled to the risks and impacts of the Project and have Affected Communities as its primary user. It will seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The mechanism will have to be informed to the affected Communities in the course of the Stakeholder Engagement process.
Principle 7: Independent Review	For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of	The Independent Environmental and Social Consultant will also propose or opine on a suitable EPAP capable of bringing the Project into compliance with the Equator Principles or indicate where there is a justified deviation from the applicable standards. The Independent Environmental and Social Consultant must be able to demonstrate

Principles	Outline	Details
	the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.	expertise in evaluating the types of environmental and social risks and impacts relevant to the Project. For Category B projects, any due diligence performed by a multilateral or bilateral financial institution, or an OECD Export Credit Agency may be taken into account to determine whether an Independent Review is required.
Principle 8: Covenants	It is important to incorporate covenants linked to compliance.	For all category A and B projects, the borrower will covenant in financing documentation a) to comply with all host country laws; b) to comply with Equator Principles; c) to comply with the ESMPs and EPAP during the construction and operation of the project in all material respects d) to provide periodic reports to the EPFIs and e) to de-commission the facilities in accordance with a decommissioning plan.
Principle 9: Independent Monitoring and Reporting	To ensure ongoing monitoring and reporting over the life of the loan.	The EPFI will, for all category A projects, and as appropriate category B projects, require an independent environmental and /or social expert, or require that the borrower retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFIs.
Principle 10: Reporting and Transparency	For all category A and category B projects as appropriate, the borrower will commit that at a minimum, a summary of the ESIA is accessible and available online.	The client will ensure that, at a minimum, a summary of the ESIA is accessible and available online and that it includes a summary of Human Rights and climate change risks and impacts when relevant. The client will report publicly, on an annual basis, GHG emission levels (combined Scope 1 and Scope 2 Emissions, and, if appropriate, the GHG efficiency ratio) during the operational phase for Projects emitting over 100,000 tonnes of CO_2 equivalent annually. The EPFI will report publicly, at least annually, on transactions that have reached Financial Close and on its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations.

2.10 Applicable Environmental Standards

The relevant environmental standards (national as well as international) for thermal power plants as applicable to the proposed Project are presented in the following sections.

2.10.1 Flue Gas Emission Standard

Flue gas emission standard as per Air Pollution Control Rules 2022 and IFC/WB EHS guidelines (2008) for thermal power plant is given in the **Table 2-6** below.

Table 2-6: Flue Gas Emission (Stack Emission) Standards from the Proposed Plant

Criteria Pollutant	Unit	Applicable Emission Standard in Bangladesh [1]	IFC/WB EHS Guidelines (Thermal Power Plant, 2008) [2]	Proposed Emission Standard for the Plant
NOx	mg/Nm^3	200	510	350
PM	mg/Nm^3	50	50	40
SO_2	mg/Nm^3	200	850	200

Note:

[1] Schedule-5 (Standards for Gaseous Emissions from Industries or Projects), Air Pollution Control Rules 2022.

[2] Emission guidelines for Boiler using solid fuels with plant size more than 600 MWth in non-degraded air-shed.

It is evident from the above table that National Air Pollution Control Rules are more stringent than the WB/IFC guidelines. Hence, it is recommended that the Project should meet stringent standards, as per applicability. Only the NOx emission standard has been adjusted considering the economic and financial viability.

2.10.2 Ambient Air Quality Standard

Ambient air quality standard as per Air Pollution Control Rules (Schedule-1) is given in the **Table 2-7** along with WHO Ambient Air Quality Guideline Values (2021).

Table 2-7: Ambient Air Quality Standards/ Guidelines

Parameters	Unit	Duration	Bangladesh*	WHO**	Suggested Criteria for the Project
PM10	$\mu g/m^3$	24-hr	150	150 (interim target – 1) 100 (interim target – 2) 75 (interim target – 3) 50 (interim target – 4) 45 (guideline)	150 (interim target – 1 & Bangladesh)
	$\mu g/m^3$	Annual	50	70 (interim target – 1) 50 (interim target – 2) 30 (interim target – 3) 20 (interim target – 4) 15 (guideline)	50 (interim target – 2 & Bangladesh)
$PM_{2.5}$	$\mu g/m^3$	24-hr	65	75 (interim target – 1) 50 (interim target – 2) 37.5 (interim target – 3) 25 (interim target – 4) 15 (guideline)	65 (Bangladesh)

Parameters	Unit	Duration	Bangladesh*	WHO**	Suggested Criteria for the Project
	µg/m^3	Annual	35	35 (interim target – 1) 25 (interim target – 2) 15 (interim target – 3) 10 (interim target – 4) 5 (guideline)	35 (interim target – 1 & Bangladesh)
SO_2	µg/m^3	1-hr	250	-	250 (Bangladesh)
	µg/m^3	24-hr	80	125 (Interim Target – 1) 50 (Interim Target – 2) 40 (guideline)	80 (Bangladesh)
NO_2	µg/m^3	24-hr	80	120 (Interim Target – 1) 50 (Interim Target – 2) 25 (guideline)	80 (Bangladesh)
	µg/m^3	Annual	40	40 (Interim Target – 1) 30 (Interim Target – 2) 20 (Interim Target – 3) 10 (guideline)	40 (Interim Target – 1 & Bangladesh)
CO*	µg/m^3	1-hr	20,000	-	20,000 (Bangladesh)
	µg/m^3	8-hr	5,000	-	5,000 (Bangladesh
	µg/m^3	24-hr		7000 (Interim Target – 1) 4000 (guideline)	4000 (guideline)

Note:

* The Bangladesh National Ambient Air Quality Standards have been taken from the Air Pollution Control Rules 2022.

** WHO Ambient Air Quality Guideline Values (2021)

Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

Represents the standard values that should be applicable to the Project based on comparison of National Standard and WHO guidelines.

2.10.3 Noise Level Standard

Noise quality standard as per Noise Pollution (Control) Rules 2006 is given in the **Table 2-8** below along with IFC Noise level guidelines (2007).

Table 2-8: Noise Level Standards/ Guidelines

Category of Area/ Receptor	Bangladesh*		IFC-WHO**	
	Day (dB(A))	Night (dB(A))	Day (dB(A))	Night (dB(A))
Silent Zone	45	35	-	-
Residential Area	55	45	55	45
Mixed Area	60	50	-	-
Commercial Area	70	60	70	70
Industrial Area	75	70	70	70

Note:

* The Bangladesh National Ambient Noise Standards have been taken from Noise Pollution Control Rules 2006.

** Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

***As per IFC EHS noise level guidelines, Noise impacts should not exceed the levels presented in the above table or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Represents the standard values applicable to the Project.

2.10.4 Effluent Standard

Effluent discharge standard as per ECR, 2023 schedule 4 is given in the **Table 2-9** below for Thermal Power Plants.

Table 2-9: Effluent Standards

S/N	Parameter	Unit	Guideline Values		
			National Standards		
			Place 1[6]	Place 2[7]	Place 3[8]
1	Ammoniacal Nitrogen (as elementary N)	mg/L	50	50	50
2	Ammonia (as free ammonia)	mg/L	5	5	5
3	Arsenic (as As)	mg/L	0.2	0.2	0.2
4	BOD_5 at 20ºC	mg/L	30	250	100
5	Boron (B)	mg/L	2.0	2.0	4.0
6	Cadmium (as Cd)	mg/L	2.0	1.0	2.0
7	Chloride (Cl^-)	mg/L	600	600	-
8	Chromium (as total Cr)	mg/L	0.5	1.0	1.0
9	COD	mg/L	200	400	250
10	Chromium (as hexavalent Cr)	mg/L	0.1	2.0	1.0
11	Copper (as Cu)	mg/L	3.0	3.0	3.0
14	Fluoride (as F)	mg/L	2	15	10
15	Sulfide (as S)	mg/L	1	-	5
16	Iron (as Fe)	mg/L	3	3	3
17	Iron	mg/L	-	-	-
18	Total Kjeldahl Nitrogen (as N)	mg/L	100	-	100
19	Total Nitrogen	mg/L	-	-	-
20	Lead (as Pb)	mg/L	0.1	1.0	2.0
21	Manganese (as Mn)	mg/L	2.0	2.0	2.0
22	Mercury (as Hg)	mg/L	0.01	0.01	0.01
23	Nickel (as Ni)	mg/L	1.0	2.0	5.0
24	Nitrate (as elementary N)	mg/L	10.0	-	20.0

[6] Inland surface water.
[7] Public sewerage system connected to treatment at second stage.
[8] Coastal areas.

S/N	Parameter	Unit	Guideline Values		
			National Standards		
			Place 1[6]	Place 2[7]	Place 3[8]
25	Oil and Grease	mg/L	10	20	20
26	Phenolic Compounds (as C_6H_5OH)	mg/L	1.0	5.0	5.0
27	Dissolved Phosphorus (as P)	mg/L	5.0	-	-
28	Total Phosphorus	mg/L	-	-	-
29	Radioactive substance a. Alpha particle radiation b. Beta particle adiation	µCi/L	To be specified by Bangladesh Atomic Energy Commission		
30	pH	-	6-9	6-9	6-9
31	Selenium (as Se)	mg/L	0.05	0.05	0.05
32	Zinc (as Zn)	mg/L	5	15	15
34	Temperature	°C	Not more than 5°C of waterbody temperature	-	Not more than 5°C of waterbody temperature
36	Suspended Solids (SS)	mg/L	100	500	100
37	Cyanide (as Cn)	mg/L	0.1	2.0	0.2
38	Cyanide (free)	mg/L	-	-	-
39	Cyanide (total)	mg/L	-	-	-
40	Total Residual Chlorine	mg/L	1.0	-	1.2
41	Bioassay test[9]	-	90% of fisheries can survive in treated wastewater even after 96 hours		

Note: Discharge to Inland water is applicable for this project.

2.10.5 Sewage Discharge Standard

Sewage discharge standard as per ECR, 2023 Schedule 3 (Standards for Sewage Discharge) is given in the **Table 2-10** below along with IFC EHS Guideline values for Treated Sanitary Sewage Discharge, 2007.

Table 2-10: Standards for Sewage Discharge

Parameter	Unit	Standard Limit (Bangladesh)*	WB Guideline Values
BOD	mg/l	30	30
Nitrate	mg/l	50	-
Phosphate	mg/l	15	-
Suspended Solid	mg/l	100	50
Temperature	°C	30	-

[9] Only applicable for pesticide and pharmaceutical industries.

Parameter	Unit	Standard Limit (Bangladesh)*	WB Guideline Values
Coliform	No./100 ml	1000	400
pH		6-9	6-9
COD	mg/l	125	125
Oil & Grease	mg/l	10	10
Total Nitrogen	mg/l	-	10
Total Phosphorous	mg/l	-	2

Notes:

* Schedule 3 (Standards for Sewage Discharge) of the Environmental Conservation Rules, 2023

Represents the standard values applicable to the Project.

It is evident from the above tables that in most cases, the WB/IFC guidelines are more stringent than the local standards. Hence, it is recommended that the Project should meet stringent standards, as per applicability. Other applicable standards are given in **Appendix-B**.

2.10.6 Stack Height

According to the air pollution control rules 2022 (schedule 5), the lowest height of stack for 500 MW or above capacity coal based power plant located 15 km beyond the environmentally sensitive area boundary (ECA, national park, wildlife sanctuary, protected forest or other government declared sensitive areas) will be 220 meter whereas the lowest stack height is applicable as 275 meter for the power plant located within 15 km from the environmentally sensitive area boundary. This standard has been established based on dispersion of SO_2 considering that the stack will emit the pollutants above the inversion layer of the air.

Capacity of the Power Plant	Lowest height of stack (meter)
Power plant located 15 km beyond the environmentally sensitive area	
500 Megawatt or above	220
200 to 500 Megawatt	150
Less than 200 Megawatt	100
Power plant located within 15 km from the environmentally sensitive area boundary	
500 Megawatt or above	275
200 to 500 Megawatt	220
Less than 200 Megawatt	150

As no environmentally sensitive area is located within 15 km of the project boundary therefore, 220-meter minimum stack heigh is applicable for the proposed 635 MW coal based thermal power plant at Matarbari project. Under the Manual of Aerodrome Standard, 2005 of Civil Aviation of Bangladesh, height of any structure within seven nautical miles of airport is restricted up to 500 ft. The proposed site is located 18.14 nautical miles north-west of the Cox's Bazar Airport. A height clearance permission needs to be taken from Civil Aviation Authority of Bangladesh (CAAB).

CHAPTER 3

Project Description

3 PROJECT DESCRIPTION

3.1 Project Overview

The proposed project is a 1x635MW sub-bituminous coal based thermal power Plant. The plant will consist of one ultra-supercritical pulverized coal fired boiler with built in dry low NOx burners suitable for outdoor installation with a stack of 220-meter high and a tandem-compound, multi cylinder design condensing type steam turbine. The plant will have an Electrostatic Precipitator (ESP) to arrest dust and Flue Gas Desulfurization (FGD) system for reduction of sulfur di-oxide. The proposed plant will comprise of an opposed wall fired Benson once through two pass radiant- type super critical boiler with a super heater steam system and a single reheats steam system and will be able to operate in sliding pressure mode. The project will be adopted once through cooling water system. The generated power will be evacuated through the Maheshkhali-Modunaghat-Vulta 400 kV double circuit transmission line connecting to the Maheshkhali 400 kV switchyard. The key project information is presented in **Table 3-1**.

Table 3-1: Key Project Information

Plant Configuration	Ultra-supercritical PC (Pulverized Coal)
Carbon capture	Nil
Gross power output	700 MW
Net power output	635 MW
Plant Load Factor	85 %
Primary fuel (type)	Bituminous and Sub-bituminous Coal having GCV of 26,050 KJ/Kg (after mixing) and Sulfur content (0.9%)
Source of fuel	Coal will be imported from Australia and Indonesia
Coal Consumption	168.4 tones/hour (at 85% plant load factor)
Land Area	Total 225 acres (Plant area- 204.64 acres, Connecting road- 1.73 acres, Coal corridor- 18.63 acres)
Stack height	220 m
Water Intake (Make up water)	81513 m^3/hr
Water discharge after treatment	81259 m^3/hr
Water consumed	254 m^3/hr

Source: OPDL-2

3.2 Project Objectives

Due to the industrialization, the power demand is growing in Bangladesh. In Bangladesh, more than 50% power plants are running with natural gas. In recent day, natural gas and oil availability is an immense crisis due to supply and demand gap as well as Russia-Ukraine war. Most of the generation is dependent on natural gas. In the future, there is the risk that natural gas supplies will be insufficient for power generation because it is needed not only for power generation but also for the residential/commercial sector. Sole dependence on natural gas to achieve a stable power supply is a dangerous proposition.

The coal-based power plants were decreasing day by day due to the environmental issues worldwide. But, recent days for the acute crisis of oil and gas due to the effect of Russia-Ukraine war, many developed countries are changing their strategies of generating electricity to avoid dependency on Russian Oil & Gas and diverted to re-open coal-based power plant as well as to generate least cost electricity. Bangladesh also facing fuel crisis and the electricity supply demand gap is increasing. As a result, the government has given permission to Orion Power Dhaka Unit-2 Limited to set up a 635 MW (net) coal-based power plant in the Maheshkhali area. The main objective of the project is to develop cheaper power and ensure supply of electricity.

3.3 Project Layout

The detailed layout of the proposed project will encompass all structures, road network, drainage network, different pollution abatement measures, water, wastewater, and effluent treatment facilities. A temporary jetty for construction material and secondary fuel unloading has been proposed along the west boundary of the plot. The coal yard has been proposed in the close proximity of the river in the north-south direction considering the predominant wind direction and the distance from settlements. The milling house is located next to the boiler plant. ESP and FGD provision have been kept for flue gas treatment. Fuel oil pump house, fuel oil tank and dirty oil pond at the west side of the plant. A comprehensive water pump station, service water and firefighting water tank, raw water treatment plan and raw water reservoir are placed north of the main power building. The ash yard is located at the north-west side of the boundary. Adequate space has been kept in the layout plan for lay-down and pre-assembling activities of open stores, contractor's offices and stores etc. workshop & warehouse, fire station, administrative building, mosque, tennis-volleyball and badminton ground, dormitory building and canteen are located north-east side of the plant. There are sufficient spaces for greenery. The following major components have been included in the layout plan:

- Industrial (plant area)
- Main power plant (boiler, turbine, Generator, Workshop Store, etc.)
- Electrostatic Precipitator, Flue Gas Desulfurization (FGD) as required, and Chimney.
- Once through cooling system
- Greenbelt and open space
- Open air sub-station and network control room
- Coal yard & coal conveyer belt
- Ash handling control room, ash silo, ash disposal area

The layout of the proposed power plant is shown in **Figure 3-1**.

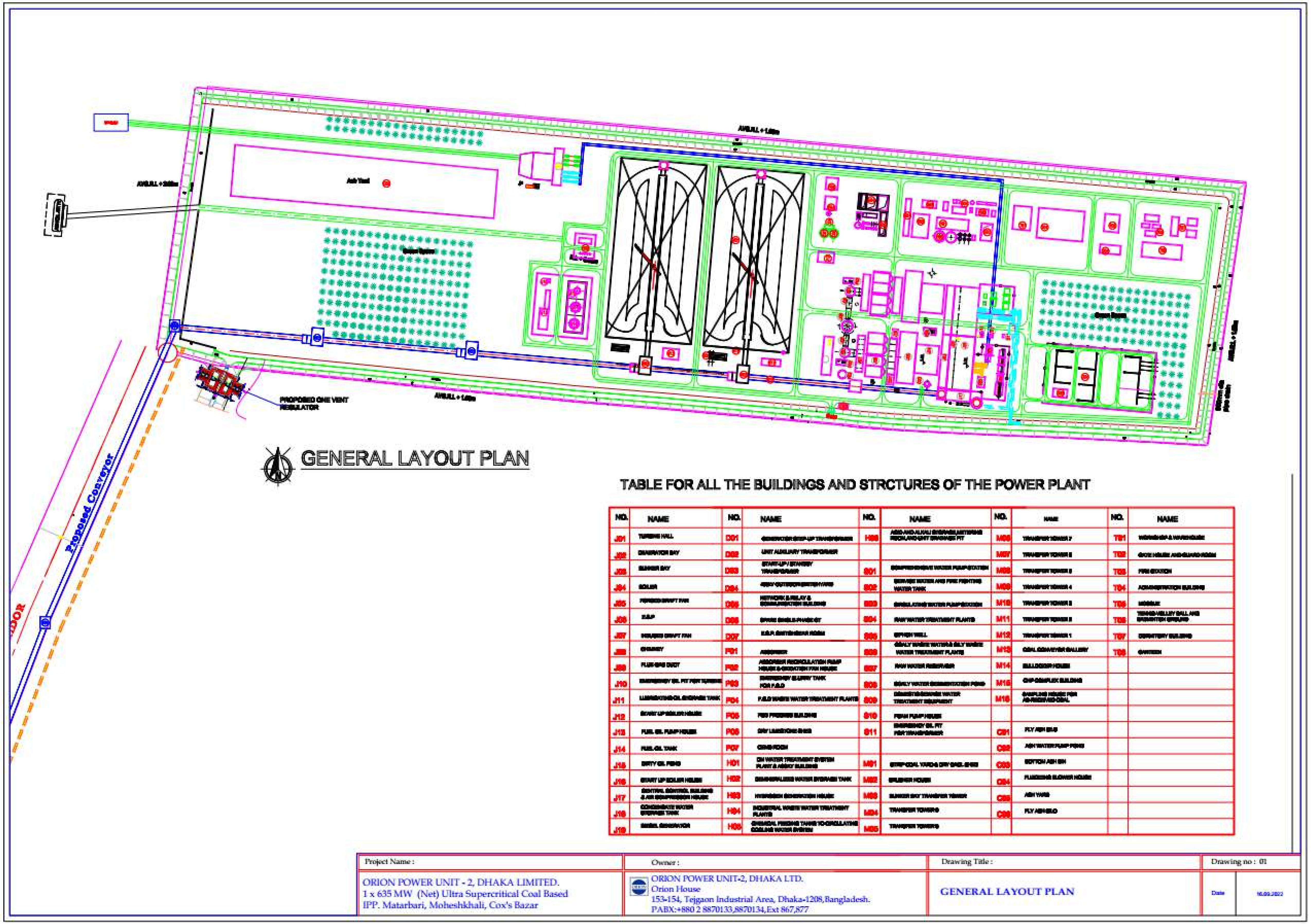
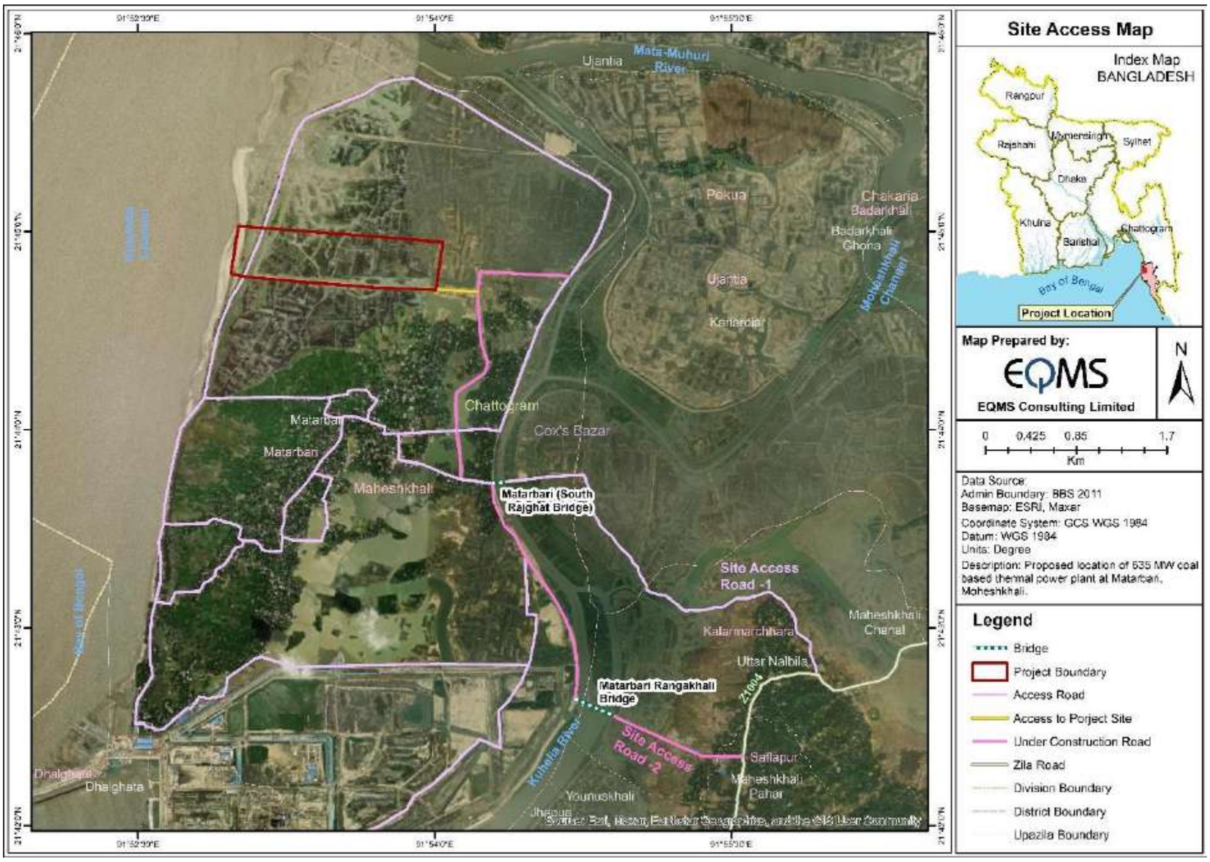


Figure 3-1: Layout of the Proposed Power Plant

3.4 Access to the Site

Matarbari Island can be accessed from Cox's Bazar or Chittagong through the Dhaka-Chittagong-Cox's Bazar highway (N1). The project site accessible from both Chattogram and Cox's Bazar. The distance from Cox's Bazar and Chattogram to the project site is approximately 76.4 km and 123.7 km. The Site can be accessed from Chakaria on highway (approximately 47.8 km from Cox's Bazar), following Road No 172 (Chakaria to Uttar Nalbila) up to Uttar Nalbila. From Uttar Nalbila, Matarbari Road is connected to Matarbari Island. Matabari Road is a one lane road, and the approximate width is 3.0 m. The Uttar Nalbila-Matarbari Road is not good in condition. The upgradation of the road is underway. Still there is no direct connection to the project site. A road is being constructed from the Matarbari Rangakhali bridge (under construction) to nearby the project site. Approximately 350 meters approach road needs to be constructed from the under-construction road to the project site. After completion of the road and Matarbari Rangakhali bridge, the project site will be accessible from Uttar Nalbila though two ways (Uttar Nalbila-Matarbari road-Project site and Uttar Nalbila-Matarbari Rangakhali bridge-Project site). The distance from the Uttar Nalbila-Matarbari road-project site is 6.96 km whereas Uttar Nalbila-Matarbari Rangakhali bridge-project site is 7.79 km. The site is also accessible via waterways of river. The nearest airport is Cox's Bazar, approximately 81.6 km away via N1. Chittagong Airport is 134 km from Matarbari via N1. The nearest seaport is Chittagong, approximately 123 km from Matarbari. The site accessibility map is presented in **Figure 3-2**.

Figure 3-2: Access to the Site Map



3.5 Resources and Utility Demand

3.5.1 Land Requirement

A total of 225 acres land will be required to set up the proposed power plant of which 201.64 acres for power plant, 1.73 acres for access road and 18.63 acres for coal corridor. The proposed land is already acquired by the government and owned by Coal Power Generation Company Bangladesh Limited

(CPGCBL). OPDL-2 has leased the land from CPGCBL to build the proposed power plant. Currently the proposed project site is being used for shrimp cultivation in monsoon season and salt pan during dry period. There will be a main power block, ash yard, ash disposal area, administrative building and accommodation building etc. within the power plant boundary. the land use breakdown of the proposed project is shown in **Table 3-2**.

Table 3-2: Land use Breakdown of the Proposed Power Plant

Sl.	Name of the Item	Area (acre)	Percentage (%)
1	Main power plant area	54.10	24.05
2	Coal Handling System	30.18	13.42
3	Ash Pond	14.18	6.30
4	Greenery	22.99	10.22
5	Coal conveyor belt/ corridor	18.63	8.28
6	Construction lay-down area, fabrication yard, temporary site office and worker camps etc. during the construction period. In future it will be converted to storage yard plus green belt.	56.21	24.98
7	Dyke and internal roads	26.97	11.99
8	Connecting Road	1.73	0.77
	Total	**225.00**	**100.00**

Source: OPDL-2

3.5.2 Fuel Requirement

3.5.2.1 During Construction Stage

During construction stage, diesel will be required for operating construction equipment. It is estimated that 4000-5000 litre/day diesel will be required during construction stage. The required fuel will be sourced from the local market.

3.5.2.2 During Operation Stage

3.5.2.2.1 Coal Requirement

The plant load factor is considered 80%. The coal requirement for the project has been estimated as follows:

- Consumption, per hour: 168.4 Tonnes/hour
- Consumption, per day: 4,042 Tonnes/day
- Consumption, per year: 14,75,445 Tonnes/year

The coal for the proposed project will be sourced from Australia and Indonesia. The specifications of the coal have been provided in **Table 3-3**.

Table 3-3: Coal Specifications

Sl.	Parameter	Unit	Design Coal	Coal Range
1.	Calorific Value	KJ/kg	26050	24800 – 30150
2.	Carbon, C Fixed (proximate)	%	42.0	40 – 65
3.	Carbon, C Fixed (ultimate)	%	61.1	59 – 70
4.	Volatile Matter	%	34.0	22 – 40

Sl.	Parameter	Unit	Design Coal	Coal Range
5.	Ash Content	%	9.0	4.7-14.7
6.	Moisture Content	%	15	8.7-15
7.	Hydrogen	%	4.6	4.2 – 4.9
8.	Sulphur	%	0.9	0.34-0.9
9.	Oxygen	%	8.0	6.23-13.53
10.	Nitrogen	%	1.4	1.31-1.7
11.	Ash Composition			
a.	Silica (SiO_2)	wt%	57.92	48.2-57.9
b.	Alumina (Al_2O_3)	wt%	30.0	23.5-31.6
c.	Iron Oxide (Fe_2O_3)	wt%	3.84	3.5-9.5
d.	Calcium Oxide (CaO)	wt%	2.70	3.1-4.3
e.	Magnesia (MgO)	wt%	1.57	1.5-2.7
f.	Titania (TiO_2)	wt%	1.80	0.90-1.7
g.	Sodium Oxide (Na_2O)	wt%	1.05	0.2-1.2
h.	Potassium Oxide (K_2O)	wt%	0.50	0.4-2.1
i.	Sulphuric Anhydride (SO_3)	wt%	0.50	0.5-4.6
j.	Phosphoric Anhydride (P_2O_5)	wt%	0.04	0.04-1.4
k.	Manganese (Mn_3O_4)	wt%	0.04	-
l.	Other Metallic Oxide	wt%	0.04	-
m.	Initial Deformation Temperature	°C	1150-1395	1150-1400
n.	Hemispherical Fusion Temperature	°C	1295-1482	1295-1500

Source: OPDL-2

3.5.2.2.2 Other Fuel Requirement

Besides the coal, the system deals with two types of fuel oil, one is Light Diesel Oil (LDO) and the other is Heavy Fuel Oil (HFO). The HFO is used for warm start-up of the boiler and during low load up to 35 % Boiler Maximum Continuous Rating (BMCR). Further HFO is used for flame stabilization during low load with coal up to 35 % BMCR. Alternatively, only LDO can be used for startup, coal flame stabilization and low load operation including cold start-up.

Cold start up requires approx. 250 KL (LDO- 60 KL and HFO- 190 KL) and Hot Start up requires approx. 100 KL (LDO- 25 KL and HFO- 75 KL). Approximately, 5000 KL per annum LDO and HFO will be required. The specification of HFO and LDO are presented in **Table 3-4** and **Table 3-5**.

Both the HFO and LDO will be delivered by barge to the plant storage tanks. Two identical tanks will be provided for HFO, the capacity of the HFO tanks will be 2 x 1500 m^3, and one tank is provided for LDO, the capacity of the LDO tank will be 1 x 500 m^3.

Each HFO tank will be designed to incorporate heater coils for heating the oil as it is withdrawn from the tank. The heater coils shall be able to maintain an oil temperature of minimum 50℃.

Table 3-4: Specification of Heavy Fuel Oil (HFO)

Sl.	Particulars	Unit	Min	Max
1.	Density @ 15°C	kg/m^3	-	991
2.	Viscosity @ 50°C	Cst	-	180
3.	Water	% Vol	-	0.5
4.	Sulphur	% mass	-	3.5
5.	Ash	% mass	-	0.1
6.	Total Sediment Potential	% mass	-	0.1
7.	Hydrogen Sulfide	mg/kg	-	2
8.	Vanadium	mg/kg	-	250
9.	Sodium	mg/kg	-	30
10.	Aluminium + Silicon with max 30 ppm of Aluminium	mg/kg	-	60
11.	Alphaltenes	% mass	-	13
12.	Carbon Residue	-	-	22
13.	Pour Point	°C	-	24
14.	Flash Point (PMCC)	°C	60	-
15.	Net Specific Energy (LHV)	MJ/kg	39.5	-
16.	Used Lubricating Oils (ULO)	mg/kg	-	Calcium <30, Zinc<15 & Phosphorous <15

Source: OPDL-2

Table 3-5: Specification of Light Diesel Oil (LDO)

Sl.	Particulars	Unit	Min	Max
1.	Density @ 15°C	kg/m^3	-	1010
2.	Viscosity @ 40°C	Cst	4.0	14
3.	Injection Viscosity	Cst	2.0	24
4.	Water	% Vol	-	0.3
5.	Sulphur	% mass	-	2.0
6.	Ash	% mass	-	0.05
7.	Vanadium	mg/kg	-	100
8.	Sodium	mg/kg	-	30
9.	Aluminium + Silicon	mg/kg	-	15
10.	Alphaltenes	% mass	-	14
11.	Pour Point	°C	-	6
12.	Flash Point (PMCC)	°C	60	-

Source: OPDL-2

3.5.3 Earth Filling and Building Material Requirement

The average existing elevation of the plant site is +1.25 m. Plant area to be filled by dredge sand in project inside up to 10.0 m height with sand having min. F.M. 0.8 in 250 mm in layers including levelling, watering, and compaction each layer up to finished level. Required dredged sand material will be sourced from authorized vendor.

Different construction materials will be required for power plant construction. Only basic construction materials are available in Bangladesh such as reinforcing steel, slabs, sand, cement and bricks and other materials including steel products. Other material required for construction will be imported from neighbouring countries.

3.5.4 Water Requirement

3.5.4.1 Water Requirement during Construction

The water demand for the construction works will be about 40 m^3/hour to 100 m^3/hour during normal and peak demand respectively and will be sourced from 'underground' after obtaining due approval from Water Resource Planning Organization (WARPO). The potable water requirement will be range from 90 KLD – 180 KLD and will also be sourced from the underground. Suitable treatment will be provided for drinking water. The wastewater generated will be treated in a temporary sewage treatment system and discharged to Bay of Bengal in compliance with the discharge norms.

3.5.4.2 Water Requirement during Operation

About 81,513 m^3/hr of surface water will be sourced from Bay of Bengal for the proposed project. The major water demand for the proposed power plant is cooling water system and it has been estimated as 81,259 m^3/hr. A once through cooling water system is proposed, which will involve extraction of water from the river and discharge of the heated cooling water back to the Kutubdia Channel. A total of 81,259 m^3/hr water will be discharged to the Kutubdia channel. The circulation cooling water temperature will be rising maximum 5˚C from the inlet water temperature. About 254 m^3/hr water will be consumed for power cycle makeup water, ash handling system, greenbelt development, plant washing and water sprinkling for dust suppression and domestic consumption. The breakup of the water requirement is presented in **Table 3-6**. The water balance for the proposed plant is presented in **Figure 3-3**.

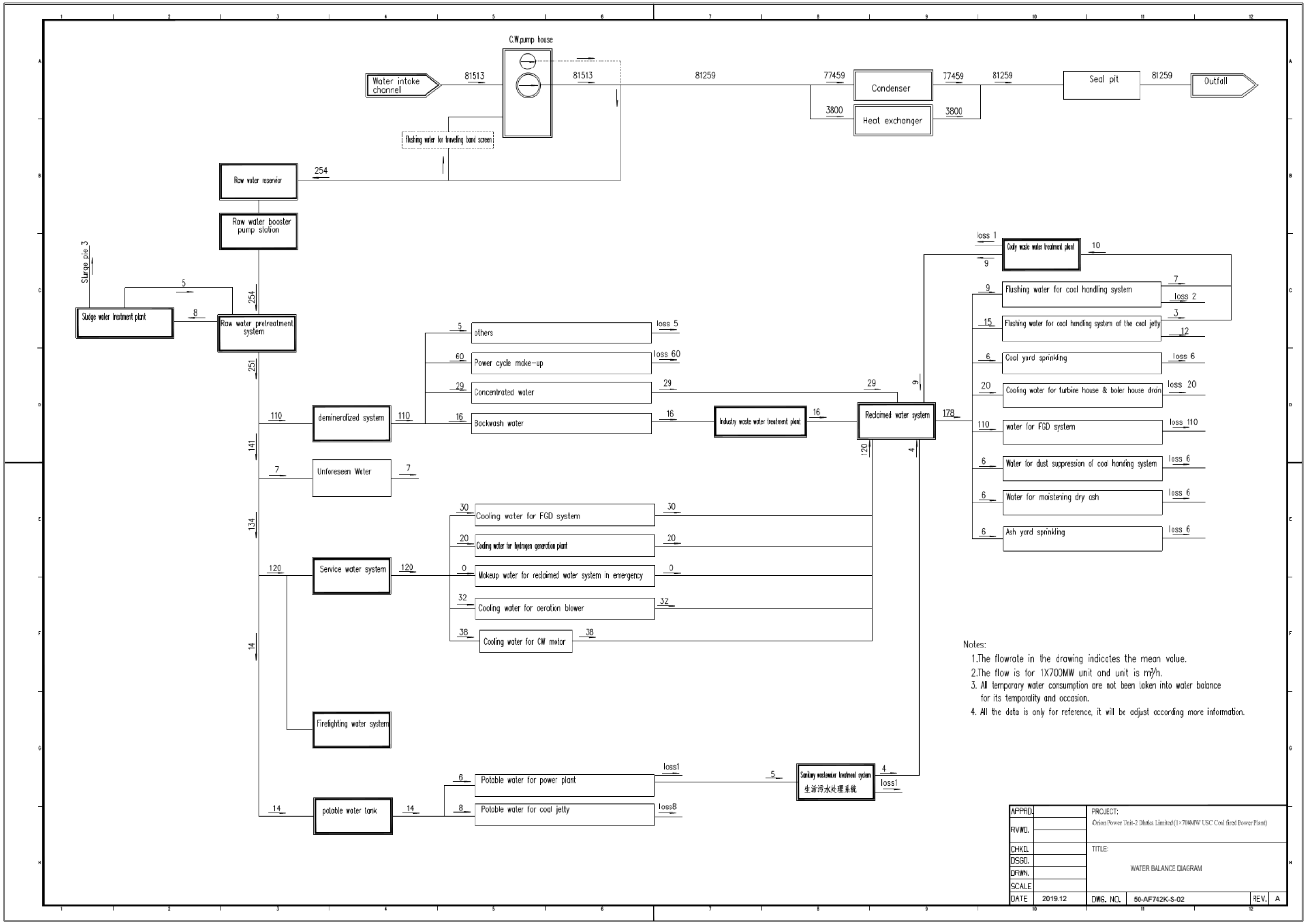
Table 3-6: Water Requirement during Plant Operation

Sl.	Activity	Water Requirement (m^3/hr)
1.	**Cooling Water**	**81259**
i.	Condensers	77459
ii.	Heat Exchangers	3800
2.	Power Cycle Make-up	60
3.	Unforeseen water	7
4.	Sludge water treatment	3
5.	Potable Water for power plant & jetty	9
6.	Sanitary wastewater treatment system	1
7.	Others	5
8.	Flushing water for coal handling system	2
9.	Flushing water for coal handling system of the coal jetty	12
10.	Coal yard sprinkling	6
11.	Cooling water for turbine house and boiler house drain	20

Sl.	Activity	Water Requirement (m^3/hr)
12.	Water for FGD system	110
13.	Water for dust suppression of coal handling system	6
14.	Water for moistening dry ash	6
15.	Ash yard Sprinkling	6
16.	Coaly wastewater treatment plant	1
Total Water Requirement		**81513**

Source: OPDL-2

Figure 3-3: Water Balance for the Proposed Power Plant



Source: OPDL-2

3.5.5 Manpower Requirement

3.5.5.1 During Construction

During construction phase, the labour requirement will range from 1000–1500 during normal operations and 2500-3000 workers for peak construction activities. There will be a significant influx of labour during the construction phase, and it is expected that during the peak construction activities, about 1000-2000 migrant workers will be accommodated in labour camps.

3.5.5.2 During Operation

The advanced computerized distributed control system and international management model will be adopted during the operation stage. During the operation stage, total 135 no. of employees will be required of which 28 manager and 107 staff.

3.6 Technology Selection and Process Description

3.6.1 Technology Selection

The proposed plant will be using ultra super-critical technology. The proposed 635 MW Coal based power plant is based on Pulverised Coal (PC) combustion and a water-steam thermodynamic cycle. The thermal efficiency of the power plant can be improved by using the steam at super critical condition. The improvement in overall efficiency of the plant compared to sub critical parameters will be at least 2%. The "efficiency" of the thermodynamic process of a coal-fired power describes how much of the energy that is fed into the cycle is converted into electrical energy. The greater the output of electrical energy for a given amount of energy input, the higher the efficiency. A thermal power plant based on supercritical technology is more efficient than a subcritical plant, producing more power from less coal and with lower emissions.

The critical condition of water: Critical pressure = 221bar Critical temperature = 374º C At most elevated condition the steam is supercritical. Thus, if water is at a supercritical pressure and is heated the temperature will increase continuously. At a particular value the water will flash instantaneously into steam and super heating will commence. There is no change of specific volume from the liquid to the dry steam state.

Benefits of Ultra Supercritical Thermal Cycle Technology:

The benefit of Ultra Super-critical Technology is listed as below:

- Reduced fuel consumption due to improved plant efficiency.
- Significant reduction in CO_2 emissions.
- Excellent availability, comparable with that of an existing sub-critical plant.
- Low Coal consumption results to low NOx, SO_2 and particulate emissions compare to subcritical plant.
- Overall reduction in Auxiliary Power Consumption.
- Reduction in requirement of ash dyke land and consumptive water.
- Sliding pressure operation due to once through system.
- Uniform distribution of heat due to spiral wall arrangement leading to less boiler tube failure, thereby improving system continuity and availability of the station.
- Less start up time of the boiler.

In summary, a highly efficient plant with best available pollution control technology will reduce existing pollution levels by burning less coal per megawatt-hour produced.

3.6.2 Process Description

In a thermal power plant, the chemical energy of the fuel (coal) is first converted into thermal energy (during combustion), which is then converted into mechanical energy (through a turbine) and finally into electrical energy (through a generator).

The coal is transferred from the coal handling plant by conveyor belt to the coal bunkers, from where it is fed to the pulverizing mills, which grind it to fine powder. The finely powdered coal, mixed with air is then blown into the boiler by a fan where it burns. The process of combustion releases thermal energy from coal.

The boiler walls are lined with boiler tubes containing high quality demineralized water (known as boiler feed water). The combustion heat is absorbed by the boiler tubes and the heat converts the boiler feed water into steam at high pressure and temperature.

The steam will then be piped to the high-pressure turbine, the first of a three-stage turbine process. The steam will be exhausted from the High Pressure (HP) turbine and reduced in both pressure and temperature. The reheated steam will then be passed to the Intermediate Pressure (IP) turbine, and from there passed directly to the Low Pressure (LP) turbine set. The steam exhaust from the LP-turbine part will be cooled down in a condenser by means of cooling water. The absorbed heat in the cooling water will be released to the Sea by means of a once through cooling water system.

Rotation of generator produces electricity, which is passed to the step-up transformer to increase its voltage so that it can be transmitted efficiently. The power will be evacuated via switchyard through a Transmission System.

During combustion, the non-combustible part of coal is converted into ash. A small part of ash (about 20%) binds together to form lumps, which fall into the ash pits at the bottom of the furnace. This part of ash, known as bottom ash, is water quenched ground and then conveyed to pits for subsequent disposal to ash disposal area or sale.

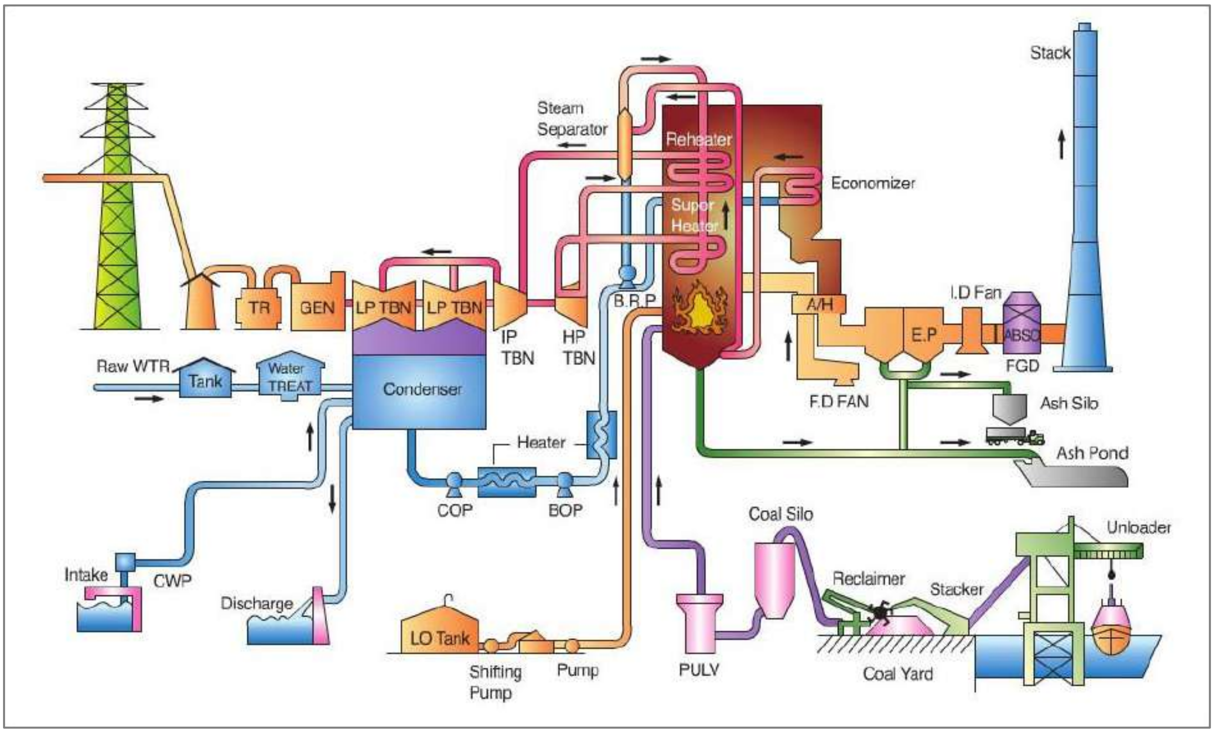
Major part of the ash (about 80%) is in fine powder form, known as Fly Ash, and is carried out of the boiler along with the flue gas. The flue gas, after heat recovery, is passed through the electrostatic precipitators, where the ash is trapped by electrodes charged with high voltage electricity.

The flue gases exiting from the Electrostatic Precipitators (ESPs) are discharged through a tall chimney for wider dispersal of remaining ash particles and gases.

The ash collected in the ESP hoppers is extracted in dry form and conveyed to dry ash storage silos from where it is supplied to user industries. Unused parts of fly ash shall be taken to ash ponds for disposal.

The configuration of a typical once through ultra-supercritical boiler has been shown in simplified form in **Figure 3-4**.

Figure 3-4: Schematic Diagram of Coal based Thermal Power Plant



Source: KEPCO E&C

3.7 Description of Major Systems

3.7.1 Coal Systems

The proposed power plant will require 4042 tonnes coal per day and 1.47 million tonnes per annum. The required coal will be sourced from Australia and Indonesia by waterway. There will be a coal unloading jetty at Matabari deep seaport. The main benefit of the site is that here inland transportation of coal is not required. Here, mother vessels like Panamax/ Supramax with 60,000- 70,000 DWT can directly approach to coal unloading jetty. The navigation channel is 350 meters (1,150 ft) length with a maximum permissible draught of 16 meters (52 ft). Ships with the capacity of 70,000 DWT is able to dock here.

The unloading facility will comprise of barge unloaders. The wharf will be provided with 6 shore cranes of 25tonne capacity each fitted with 8 tonne grabs. Coal will be transported from port to power plant through 4.7 km long conveyor belt.

To avoid impurities in the coal, which may damage the belt conveyor system, a magnetic separator and crusher will be installed. The coal yard will have a minimum capacity of 320,000 tonnes, which is equivalent to 59 days plant operation at full load and 73 days at 0.8 plant load factor. Coal will be collected by dozers and conveyed from coal yard to silos.

The coal yard will be covered against rainfall and appropriate drainage shall be provided. The coal yard will be provided with a runoff pit with drains around the coal yard. During monsoon, the rainwater from the coal pile will be collected in drains and led to the coal pile run off pit. The runoff pit will be equipped to separate out the coal particles from the runoff and this coal will be dumped in coal yard.

Automatic dust detectors will be provided in the coal yard. The coal yard will have a dust suppression system and spray heads of swivelling spray units located at a distance of minimum 40 meters around the coal yard will be provided.

As no inland transportation is involved in this project in new location, there is also no dependency on river dredging by BIWTA as well as no uncertainty of coal transportation during rough weather. Besides this, environmental impact due to inland transportation, ship to ship loading / unloading etc. are also eliminated from project scope. Detail coal handling system has been described in section 3.7.7.

3.7.2 Fuel Oil Systems

The system deals with two types of fuel oil, one is light diesel oil (LDO) and the other is heavy fuel oil (HFO). The fuel oil handling and storage system will include unloading, storage and transfer of fuels to the oil tanks. Light diesel oil (LDO) will be used for the cold start of boiler load up to 7.5 % Boiler Maximum Continuous Rating (BMCR) and for auxiliary steam boiler. Heavy fuel oil (HFO) will be used for start-up of the boiler and during low load up to 35% BMCR. HFO will also be used for flame stabilization during low load.

Both the HFO and LDO will be delivered by barge to the plant storage tanks. Two identical tanks will be provided for HFO, the capacity of the HFO tanks should be 2 x 1500 m^3, and one tank will be provided for LDO, the capacity of the LDO tank should be 1 x 500 m^3. All HFO and LDO tanks will be provided by owner. Fuels will be distributed to the required area through an oil pumping house and pipes up to the end users.

Each HFO tank shall be designed to incorporate heater coils for heating of the oil as it is withdrawn from the tank. The heater coils shall be able to maintain an oil temperature of minimum 50°C. Heating media should be steam.

The Oil barges shall be equipped with oil transfer pumps used for HFO and LDO unloading from barges to oil tanks. 2×100% LDO oil unloading pump units with piping and valves for LDO unloading from barges to oil tanks.

The HFO will be unloaded from jetty to HFO oil tanks via unloading pump on jetty. 3 × 50% LDO oil forwarding pump units with piping and valves for supply LDO oil from oil tanks to oil firing system of boiler. 3 × 50% HFO oil forwarding pump units with piping and valves for supply HFO oil from oil tanks to oil firing system of boiler.

Necessary drain system and waste oil collecting facilities will be designed. All HFO pipes shall have steam heat tracing and be insulated. All pumps will be designed according to the requirements from the systems and have strainer in the suction line.

3.7.3 Boiler

The proposed plant will comprise of an opposed wall fired Benson once through two pass radiant type super critical boiler with a super heater steam system and a single reheat steam system and will be able to operate in sliding pressure mode. The superheat steam temperature will be controlled by means of water injection whereas the reheat steam temperature will primarily be controlled by means of flue gas recirculation over the load range. Attemperating water injection for reheat steam temperature control will be minimized and only used as secondary system.

The rated steam conditions at Boiler Maximum Continuous Rating (BMCR) will be as follows:

1.	High pressure superheat steam outlet pressure:	250 bar
2.	High pressure superheat steam outlet temperature	580˚C
3.	High pressure superheat steam flow outlet boiler	538.9 kg/sec
4.	Cold reheat steam pressure, outlet HP turbine	60.3 bar
5.	Cold reheat steam temperature	362˚C
6.	Hot reheat steam pressure, inlet IP turbine	56.60 bar
7.	Hot reheat steam temperature	595 ˚C

8.	Hot reheat steam flow outlet boiler	452.5 kg/sec
9.	Feed water final temperature inlet boiler	310 ˚C

Source: OPDL-2

3.7.3.1 Air – Flue Gas System

The air intake will be as per the ambient design condition (i.e., Temperature – 7 to 42˚C, Relative Humidity – 40-70%) and pressure of 1013 mbar. The flue gas inlet temperature to the Electrostatic Precipitator will be 120˚C. Two forced draft (FD) fans will be provided to supply secondary air to the furnace to assist in combustion.

3.7.3.2 Combustion System

The system will be equipped with coal mills and coal silos, so that the boiler can operate at full load, BMCR. Each coal silo will have a storage capacity for 12 hours operation at BMCR.

The coal silo will have a normal outlet to the coal feeder and an emergency outlet to make it possible to empty the silo down on floor level in trucks in case of error to the silo system. The mills will be equipped with rotating classifiers and meet the design coal specifications. The boiler will be equipped with low NOx burners to reduce primary NOx.

3.7.4 Steam Turbine Unit

The steam turbine will receive steam from the boiler unit and will run at a speed of 3000 revolutions per minute (RPM). The turbine will be directly coupled to a synchronous generator to generate power. The steam turbine will be provided with necessary number of regenerative extraction/bleed points. After expansion in the HP turbine, part of the HP exhaust will be taken to the HP heater for feed water pre-heating and remaining part will be directed to the reheater for reheating and then to IP and LP sections of the turbine for further expansion.

The main parameters of steam turbine are as follows:

Type	Ultra-super critical, reheat, tandem compound four cylinders, four flow exhausts, Condensing turbine
Turbine Nominal Load (TMCR)	700,000 kW
Rotating Speed	3,000 rpm
Direction of Rotation	Counterclockwise (viewed from the turbine front)
Number of Extraction	Eight (8)
Last Stage Blade Length	909 mm
Rotor Number	Four (4)
Casing Number	Four (4)
Type-HIP/Type-LP	Cast type/ Fabricated type
Outline (LxWxH)	37x11.5x8.2 m
Main steam flow	1991.592 t/h
Steam pressure upstream MSV	27.0 MPa(a)
Steam temperature upstream MSV	600°C
Reheat steam flow	1600.848 t/h
HP casing exhaust steam pressure	6.467 MPa(a)
HP casing exhaust steam temperature	374°C

Steam pressure upstream RSV	5.921 MPa(a)
Steam temperature upstream RSV	610°C
Heat rate at 100%TMCR	7358 kJ/kWh (guarantee value)

Source: OPDL Unit-2

The turbine unit will have the following performance conditions at Turbine Maximum Continuous Rating (TMCR).

- Preliminary gross output 700 MW at 100% TMCR
- Internal Consumption 50 MW
- Net power output (minimum) 635 MW

3.7.4.1 Condensate and Feed water Preheat Train

The turbine unit will be provided with five (5) low pressure hearer steps, one (1) de-aerator and storage tank, four (4) high pressure heater steps and one (1) high pressure de super heater.

The condensate preheater train is expected to consist of 5 preheaters, including the drain cooled. Feed water to the boiler will be de-aerated in the feed water tank to remove the dissolved oxygen up to specified levels in order to avoid water side corrosion of boiler tubes.

3.7.5 Generator

Steam turbine generator main parameters are as follows:

Rated output	730 MW
Rated voltage	24 kV
Rated current	21951.3 A
Rated power factor	0.8 (Lagging)
Speed	3000 rpm
Frequency	50 Hz
No of phase	3
Short Circuit Ratio	≥ 0.52
Efficiency	≥ 98.86%
Cooling Method	
Stator winding	Direct Water cooled
Stator core	Hydrogen cooled
Rotor winding	Direct Hydrogen cooled
Rated Hydrogen Pressure	0.45 MPa (g)
No. of Terminals	6
Insulation Class	Class F (rated for class B temperature rise)
Hydrogen Consumption	≤ 14 m^3/per day
Rotor Shaft Vibration	≤ 0.08 mm (P/P)
Noise Level	≤ 85 dB(A), at 1 m distance from the generator outline

Source: OPDL-2

3.7.6 Cooling Water Systems

The cooling water system provides the water for condenser. The main cooling water system for the proposed plant is a once through cycle (OTC). The inlet water will be drawn from Bay of Bengal. A tapping from the main cooling water system inlet part will provide auxiliary cooling water and the heated auxiliary cooling water will be discharged back to the Kutubdia Channel. The intake is located 1.87km on the southwestern side of the plant whereas outfall will be located on the western side of the plant.

The intake point for water withdrawal will comprise of the following:

- Coarse bar screen with a mechanical cleaning function to prevent entry of mechanical debris and biological species in the inlet channel.
- Fish avoidance system to prevent fish from entering the inlet channel.
- Waste disposal system from the coarse bar screen

The cooling water system will be designed basing on the following design data:

- Design cooling water temperature, inlet: 28.5 °C
- Cooling water temperature rise, from inlet to outlet: 5 °C
- Design cooling water outlet temperature: 33.5 °C
- Operating range, river temperature, inlet: 15~35 °C
- Design flow velocity in the main CW supply pipe is 2.46m/s while in the branch pipe is 2.36m/s.
- Design flow velocity in the discharge box culvert is 1.79 m/s
- The flow velocity of the CW discharge gate shaft and discharge open channel is 1.43m/s.

The main cooling water system flow is: Kutubdia Channel → CW intake submerged open channel → CW intake box culvert →CW pumphouse forebay → CW pump→DN2600 Expansion joint→DN2600 Hydraulic Operated Butterfly valve→DN2600 CW pump discharge pipe→DN3600 CW main supply pipe→DN2600 condenser cooling water inlet pipe → Secondary strainer →Motor driven butterfly valve → Condenser → Motor driven butterfly valve→DN2600 condenser outlet pipe→DN3600 CW main discharge pipe → Siphon well → Discharge box culvert → CW discharge gate shaft →Discharge open channel → Kutbdia channel.

The CCW water-water heat exchanger takes cooling water from the condenser cooling water inlet pipe and discharges cooling water to the condenser discharge pipe.

The CW intake submerged open channel, CW intake box culvert, CW pumphouse forebay, CW discharge gate shaft, and discharge open channel are designed for the demand of 2×700MW units while the rests are designed for the demand of 1×700MW unit.

3.7.7 Cooling Water Intake and Outfall Structures

3.7.7.1 CW Intake submerged Open Channel

The cooling water will be taken from the Sea with submerged intake open channel, which is designed for the capacity of 2×635 MW units with designed water flow of about 50 m^3/s. The submerged open channel is trapezoidal which has a bottom elevation of -8.00m (MSL, the same below) and the bottom width is 16m. At the design low water level of -2.0m, the water depth is 6.00m with flow velocity of 0.27m/s.

3.7.7.2 CW Supply and Discharge Pipes

The CW pump outlet pipes and condenser cooling water inlet/outlet pipes are DN2600 welded steel pipes in pump house and GRP pipes underground while the main CW supply and discharge pipes are DN3600 GRP pipes. There is one main CW supply and discharge pipe for one unit. The design flow velocity in the main CW supply pipe is 2.46 m/s while in the branch pipe is 2.36 m/s.

3.7.7.3 Siphon well and CW discharge Culvert

The cooling will be discharged via the DN3600 main discharge pipe to the siphon well. The siphon well is sized as L×W = 18.0m×12.0m (internal dimensions). The siphon well has a bottom elevation of -4.00m and a weir top elevation of 3.40m.

Downstream the siphon well, a wall box culvert with orifice sectional size as 3.5m×4.0m is set to discharge the cooling water throughout the plant to the discharge gate shaft. The inner bottom elevation of the box culvert is -4.00m, while the design flow velocity in the discharge box culvert is 1.79m/s.

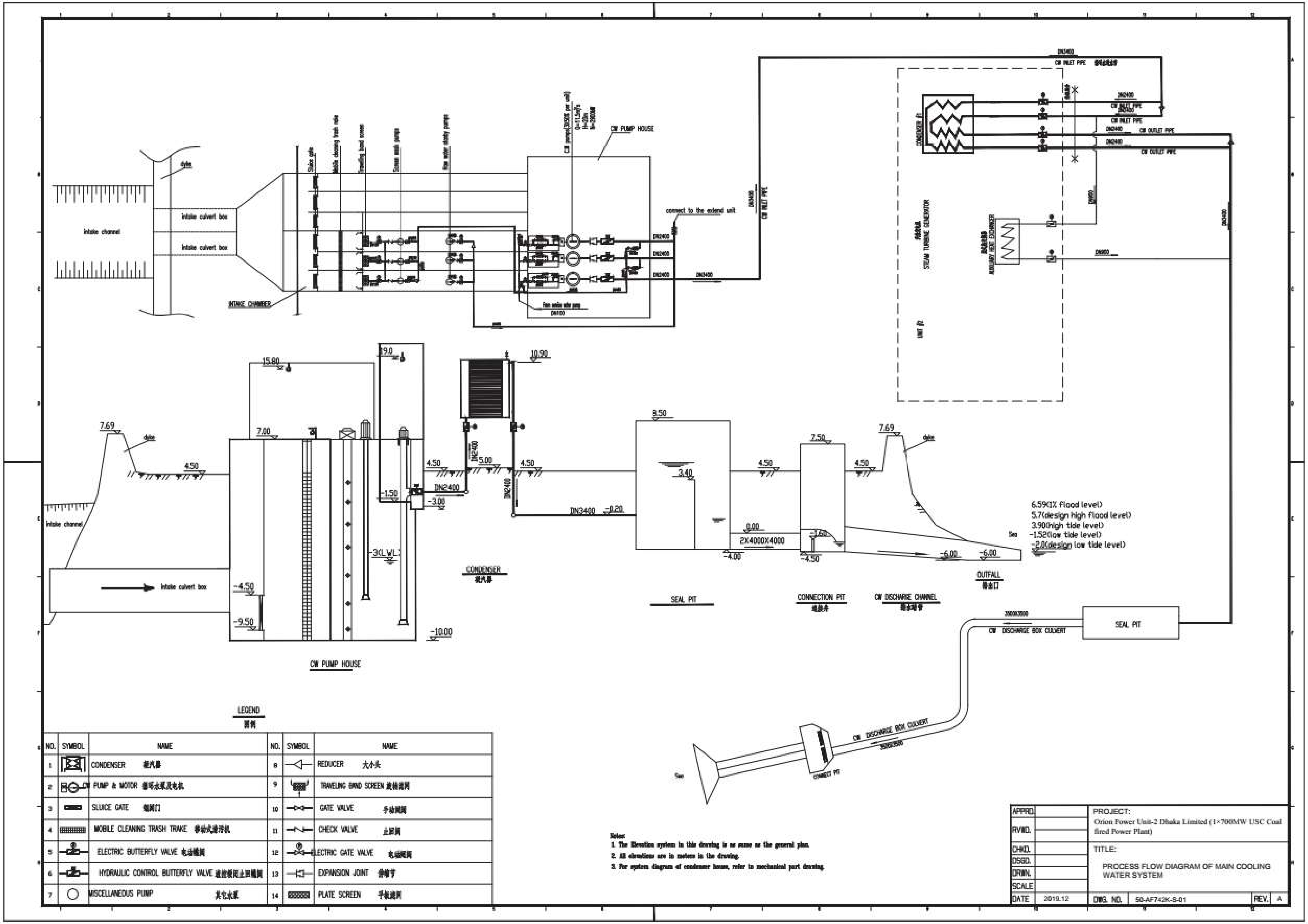
3.7.7.4 CW Discharge Gate Shaft and Discharge Open Channel

The CW discharge gate shaft is located at the west side of the plant area. For the purpose of maintenance, one gate is set in the gate shaft for each 635 MW unit.

Downstream the gate shaft, discharge open channel is used to discharge the cooling water to the Kutubdia channel. The CW discharge open channel is designed for 2×635 MW units and the open channel is rectangle which has a bottom elevation of -5.50m and the width is 10m. At the design low water level of -2.0m, the water depth is 3.50m with flow velocity of 1.43m/s.

Process flow diagram of main cooling water system is presented in **Figure 3-5**.

Figure 3-5: Process flow diagram of Main Cooling Water System



Source: OPDL-2

3.7.8 Coal Handling System

Coal handling system Coal transportation from source, Coal Unloading System, Coal Transportation system from Coal Jetty to coal Yard and Feeding System to Coal Bunkers.

3.7.8.1 Transportation of Coal from Source

The coal for the power plant will be imported from Indonesia and Australia. The annual coal consumption for the proposed power plant is 1.47 million tons. The coal will be transported by ship then be transported by belt conveyor from jetty to the plant. There will be a coal unloading jetty at Matabari deep seaport. It will be constructed on the north side of the port. The navigation channel is 350 meters (1,150 ft) length with a maximum permissible draught of 16 meters (52 ft). Ships with the capacity of 70,000 DWT (Panamax/ Supramax) is able to dock here. The coal received from the vessels shall be unloaded through rail mounted continuous bucket type barge unloaders (Grab Buckets) and shall be conveyed to the plant end by parallel double stream high capacity through conveyors via a series of transfer points.

Coal transportation: Loading at the coal source port>>>>transfer to coal unloading terminal (Matarbari deep seaport) >>>transfer to the power plant by 4.7 km long belt conveyor.

Coal loading at the source port

Coal Transportation

Coal Unloading

Coal transfer through Covered Conveyor belt

3.7.8.2 Coal Unloading and Transfer System

The coal received from the ship shall be unloaded through rail mounted continuous bucket type barge unloaders (Grab Buckets) and shall be conveyed to the plant end by parallel double stream high capacity through conveyors via a series of transfer points. The coal will be transferred from coal unloading jetty to coal yard through 4.7 km conveyer belt. The **Figure 3-6** showing the coal conveyer route from deep seaport to coal yard.

The transfer conveyor system describes the system which transports coal by Belt Conveyors through various transfer towers to the coal yard and from the coal yard to the coal bunkers at the mill house.

Coal Barge → Bridge-type grab ship unloader → Belt conveyor →Transfer Tower → Belt conveyor → Through various Transfer towers and Belt conveyors → Crusher House → Coal Yard → Coal Bunker House

Figure 3-6: Coal Conveying Route

3.7.8.2.1 Coal Yard

One full covered arch type of coal yard is designed, the front and back sides will be closed by wind barriers for dust suppression purpose.

Coal yard width is 135 m, and length 310 m, and coal pile height is 18 m. 320,000 MT of design coal can be stored and is available for 59 days plant operation at full load and 73 days at 0.8 plant load factor.

Two (2) sets of stacker-reclaimers and two (2) sets of belt conveyors are deployed for coal stacking and reclaiming. The stacking capacity is 2400 t/h which is matched with coal unloading system, and reclaiming capacity is 1200 t/h which is matched with plant coal feeding capacity.

Two (2) sets of bulldozers and One (1) set of wheel type loader are deployed for some auxiliary works such as leveling and compaction.

The dust suppression system of the coal yard shall be considered. The spray heads are of swiveling spray units located with a distance of minimum 40 meters around the coal yard. The spray range of the spray head is 45 meters.

A coal yard run off pit will be provided close to the coal yard area. The drains will be provided around the coal yard.

3.7.8.2.2 Transfer Tower

The transfer towers are used to transfer coal to the next belt. As the Coal Yard is approximately 4.7 Km away from the jetty so various transfer towers and belt conveyor will be used before the conveyor enters the crusher house and finally to the Coal Yard.

3.7.8.2.3 Belt Conveyor System

Belt conveyor system is designed as the coal handling system process diagram. The belt conveyor system has double lines, one line in operation and one line standby. And the double lines can operate simultaneously in emergency situations or other special working conditions.

Each of the belt conveyors is designed with a capacity from grab bucket of coal jetty to the coal yard and to coal bunkers of mill house as mentioned below.

Capacity design	2400 t/hr.
Belt width	1800 mm
Belt speed at rated capacity	max. 2.8 m/s

The slope of the belt conveyors will not exceed 16 degrees from jetty to coal crusher room. The slope of the belt conveyors will not exceed 18 degrees from transfer tower to the coal bunkers of the boiler.

The sloping belt conveyors have equipped non-return restriction device to prevent running back of the belt conveyor in case of the belt conveyor being stopped in load conditions. The non-return restriction device shall instantaneously engage without shock and be capable of protecting equipment and personnel. The non-return restriction devices can be integrated in the gearbox or driving pulley according to the actual requirement.

Ratio of calculated maximum working tension to rated belt tension will not exceed 0.8. The vertical weight tension device is designed for belt conveyor.

According to the requirement, all above ground conveyors (except coal yard and coal bunker bay) will be located in open-air gallery. The conveyors shall be equipped with rain cover to keep conveyors in close space, and the gallery floor is steel grate / plate type.

O&M Requirements

With regard to layout the sizes of the transfer towers, transfer points and crusher building will consider a minimum clear walkway space of 1.2 m around the equipment for each floor. The headroom shall be minimum 3.0 m and, in any case, sufficient for operation, dismantling and removal of equipment.

When a conveyor crosses a road, there will be a minimum clearance of 8 m (preliminary) below the structure.

There will be provided cross over possibilities for maximum each 100 m length. For maximum each 100m conveyor length there shall be escape possibility from conveyor to the ground.

3.7.8.2.4 Crushers & Screens

Crushers and screens are set in the coal crusher room.

The screen is designed to separate the >30 mm size of coal, muddy coal etc. The separated coal ≤30 mm size will be fed onto the corresponding belt conveyor through separate hopper/chute equipped under each screen.

The crusher is designed to crush the oversize product of the screen, to prepare the ≤30 mm size of coal.

The design parameters of the screen list as follow:

Number of screens	2 × 100%
Capacity rated	2400 t/hr.
Separate particle size	30 mm

The design parameters of the crusher list as follow:

Number of crushers	2 × 100%
Capacity rated	1500 t/hr.
Inlet particle size	≤300 mm
Outlet particle size	≤30 mm

3.7.8.2.5 Sampling Device

The coal sampling device will be designed to provide coal samples. It is possible to take samples from any of the two conveyors running at rated capacity. The normal coal size for design shall be 300 mm for coal sampling unit before coal crusher. However occasionally 400 mm lumps may also arrive. Coal size after crusher will be 30 mm. However occasionally 50 mm lumps can be in crushed coal. Two as-received coal auto sampling device will be arranged on belt conveyor before coal yard.

3.7.8.3 Magnetic Separator

The magnet separator will be designed to minimum separate M20 bolts & nuts, and 50 kg plates and bars of L/D ratio of less than 5. To achieve the requirements, four stage magnetic separators are designed in coal handling system.

The first stage magnetic separator is located in head of belt conveyor of coal jetty. And the second stage magnetic separator is arranged on the head of belt conveyor after coal yard. The third and fourth stage magnetic separators are installed at the middle part of belt conveyors before and after the coal crusher house. Different type of electromagnetic iron separator is supplied to adapt different use.

The metal detectors have sensitivity to minimum detect 25 mm aluminum sphere hidden under the coal for synthetic belting and in case of steel cord belting the sensitivity is 40 mm. The metal detector can also detect other metals, like brass, copper, stainless steel, manganese steel, bars, scraps etc. The metal detector can ignore magnetite/iron and can distinguish between metal pieces and magnetite/iron.

3.7.8.4 Dust Suppression

The design of transfer tower for equipment are all including dust suppression system or control of dust emissions from dust generation points such as transfer points, feeders, crushers etc. Dust control is achieved by dust suppression and extraction system.

The accumulated dust on the floors of the buildings (structures), such as coal conveying trestle, transfer tower, crusher room, and belt conveyor layer of coal bunker bay of boiler, take-up device room will be cleaned hydraulically.

The indoor flushing water of the coal handling system will be drained to floor drains or open trenches and then is drained into the dispersed water collection pit. The water drainage trench and collection pit will be designed to locate at the bottom floor of the coal handling system building.

Vertical type wastewater pump will be arranged in the collection pit for transferring the coal containing sewage to the sedimentation basin. Two vertical type wastewater pump per collection pit will be designed, 1 in operation and 1 standby. The start and stop of the wastewater pump will be interlocked with the water level.

The parameter of the vertical type wastewater pump is as follows:

Number of wastewater pumps	~16 (preliminary)
Rated flow	~50 m^3/hr
Rated pressure	~0.3MPa

3.7.9 Ash Handling System

3.7.9.1 Fly Ash Handling System

The fly ash content of the coal is 9%. Hence, the total fly ash generation has been estimated as 363.8 tons per day whereas 0.133 million tons per annum. Fly ash from ESP hoppers shall be collected by one pneumatic conveying system. The pneumatic conveying system shall be designed to meet the requirement of 200% capacity based on the worst coal ash of BMCR condition. Fly ash from dust collector hoppers shall be conveyed to the fly ash silos.

The capacity of fly ash handling system is preliminary 56t/h, conveying distance is about 300m. There are about 16 ESP hoppers.

Two concrete fly ash silos will be built. The total capacity of the two fly ash silos will meet 72 hours ESP fly ash production of 1×635 MW unit while burning design coal under BMCR condition. The effective volume of per silo is about 2500 m^3 and the diameter of the silo is about 14 m and height is about 30m.

The ash silo outlet shall be equipped with dry and humidified ash loading equipment, which capacity is about 100t/h. There are four discharge outlets will be equipped for each fly ash silo, two of them will be used to discharge dry fly ash and transported out by truck for recycle use, the third one will be used to discharge humidified fly ash and transported out by truck, and the fourth one will used to be discharge dry fly ash by pneumatic conveying devices. Negative pressure dusting system with bag filter or dry fog system is supplied at the unloading area to suppress the dust.

Fly ash from the economizer will be collected by one (1) pneumatic conveying system and will be conveyed to the fly ash silo. This system shall be designed to meet the requirement of 200% capacity based on the worst coal ash of BMCR condition. The fraction of ash from economizer hopper is both 5% of the total amount of ash.

A separate fly ash transportation system will be provided for another way for transportation.

The fly ash will be conveyed to one buffer ash silo which is located at the jetty by pneumatic conveying system, including 2×100% pneumatic conveying system. The capacity of each system is about 30t/h. Then the fly ash will be discharged to the ash barge by chute. The effective capacity of the buffer ash silo is about 200 m^3 which will meet 16 hours ESP fly ash production of 1×635 MW units while burning design coal under BMCR condition. Fly ash handling system process is presented in **Appendix C-5**.

A single-line belt conveyor system is supplied to transport the fly ash to ash pond:

Capacity design	400 t/hr.
Belt width	1000 mm
Belt speed at rated capacity	max. 1.6 m/s

Ash Pond- There shall be an ash disposal area for the storage of humidified bottom ash and fly ash, pyrites and gypsum. The storage shall be equipped with water spray system for dust suppression. There shall be pumping station to removed excess rainwater to water treatment system. Size of the Ash Pond will be approx. 500 M x 300 M and 12 m of height. This storage will be sized for 1.5 years production of bottom ash and fly ash, pyrites and gypsum. The ash disposal area shall be divided into 2 cells, one cell for bottom ash, fly ash and pyrites, one cell for gypsum. Dams will be laid around the ash yard area. A 5-meter windbreak forest belt will set around the ash pond. Section of Ash yard is presented in **Appendix C-6**.

3.7.9.2 Bottom Ash Handling System

The fraction of bottom ash is 20% of the total amount of ash. Hence, the total bottom ash generation has been estimated as 72.8 tons per day whereas 0.027 million tons per annum. The dry bottom ash mechanical handling system shall be designed to meet the requirement of 200% capacity based on the worst coal bottom ash of BMCR. The bottom ash shall be cooled by air. The dry bottom ash handling system shall be a mechanical dry ash removal system for bottom ash extraction and cooling. One bottom ash crusher will be provided at the discharge of the dry ash removal conveyor with 200% capacity and the 30~50mm export granularity.

It's including dry-type bottom ash conveyor (preliminary 5~20t/h), single-roll slag crusher (20t/h), bucket elevator (20t/h) and concrete bottom ash silo (effective volume is about 600m3).

The bottom ash will be crushed and fell into bottom ash silo. One steel bottom ash silo will be built with the capacity of 72 hours bottom ash production of 1×635 MW unit while burning design coal under BMCR condition. There are two discharge outlets will be equipped for bottom ash silo, one outlet will be used to discharge dry bottom ash and transported out by truck for comprehensive use, and the other outlet will be used to discharge humidified bottom ash and transported out by truck. Bottom ash handling system process is presented in **Appendix C-7**.

3.7.9.3 Ash Utilization

The dry ash is taken in dry form to storage silo near plant boundary for utilization. There are 76 cement industries in Bangladesh, and it is planned to tie up with the cement plants for sale of fly ash. 100 % utilisation of fly ash has been considered. The ash will be loaded to trucks/barge through gravity flow for transport of fly ash to cement plants. Purging with hot air will be done for dry dust free environment. In case the cement plant is located beyond 5-7 km of the plant boundary; the fly ash will be transported in covered barges. The ash will be loaded to the barge using an inclined chute with hot air.

The options for utilisation of residue ash such as use in brick manufacturing, clinker industries, cement industries, compaction purposes are also being explored. However, land development and ash dyke have been planned in case of non-utilization of ash.

3.7.10 Water Treatment System

The proposed project will require water with varied degree of treatment/processing such as clarified and treated water for service water, demineralised water for boiler, condensate polishing plant regeneration and filtered disinfected water for potable water requirements.

3.7.10.1 Raw Water Treatment

Water from Meghna River will be pumped into an open reservoir with two compartments. The raw water treatment will comprise of the following processes:

- Disinfection
- Aeration
- Clarification
- Continuous sludge removal
- Final filtration

The sludge from the treatment process will be processed in a sludge dewatering system (centrifuges/ belt press filter). The raw water treatment system has been illustrated in **Figure 3-7**.

3.7.10.2 Demineralization (DM) Plant

The Demineralisation plant will supply make-up water to the water steam cycle, condensate make up and condensate polishing regeneration. The DM plant will involve removal of mineral salts from water by ion-exchange method, consisting of cation, anion and mixed bed polisher. The regeneration effluents for the demi plant process will be discharged to neutralization pit. The pit interior surfaces and surrounding surfaces will be protected by anti-acid material lining and the pit will be equipped with means for recirculation of the contents to ensure water mixing, acid and alkali injection points and automatic pH controls and recorders. The effluent from the DM plant will be sending to wastewater treatment system. Demineralized Water Treatment System (DWTS) will be sized as following:

Sl.	Item of Usage	Calculation	m^3/h
1.	Make-up to the main steam cycle (1.5 % Make-up)	1 x 2100 x 1.5%	31.5
2.	Chemical Dosing, Demineralizer Regeneration, and Condensate Polisher Regeneration System dilution water		3.0
3.	Laboratory demineralized water use		0.5
4.	Make-up to the CCCW system (0.5 % Make-up)	1x 2000 x 0.5%	10.0

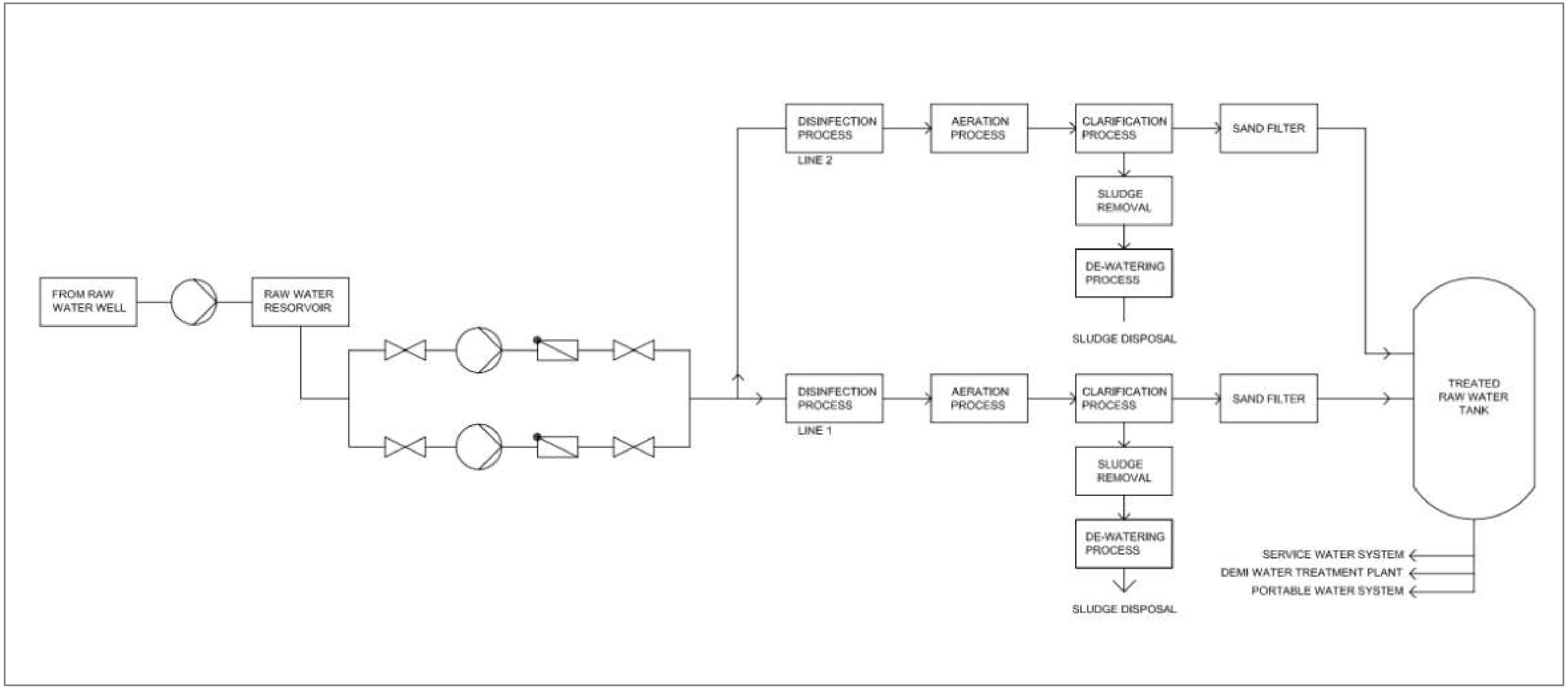
Source: OPDL-2

According to the above, the DM water requirement for the design condition is: Q=45 m^3/h. DM water treatment system should be sized as 2 x 100% with each stream of 50~60 m^3/h.

3.7.10.3 Potable Water

A potable water treatment system will be provided to supply water for domestic consumption.

Figure 3-7: Raw Water Treatment Scheme



3.7.11 Pollution Control Measures

3.7.11.1 Air Emission Control System

Adequate flue gas cleanings systems will be installed so that the emissions are well below the allowable limited as given by Schedule-5, Standards for Gaseous Emission from Industries or Projects of the Air Pollution Control Rules 2022 and International Finance Corporation's Environmental, Health and safety Guidelines for Thermal Power Plants.

Electrostatic Precipitator (ESP)

An electrostatic precipitator (ESP) will be installed to effectively remove the small particulate matter from the exhaust flue gas from the boiler and achieve high collection efficiencies (≥99.67%). The ESP sized for Particulate matter PM down to 50 mg/Nm^3 for compliance with IFC Guidelines. The ESP will be located after the boiler in the boiler axis between the air heater and ID fans. The ESP will have a number of flue gas paths and fields with gas tight housing. The ESP shall be capable of meeting the maximum particular emission requirement even with soot blowing in operation. The fly ash is collected in hoppers below the ESP and conveyed pneumatically further on to the fly ash storage.

The nitrogen oxides will be controlled through installation of low NOx burner and through other techniques such as over fire air. A controlled portion of total combustion air flow, typically 10-20 %, will be directed through over fire ports located above the highest elevation of burner. The removal of air flow from burners will result in a fuel rich primary combustion zone to limit the NOx formation. In case, the NOx emission limit is not met by means of primary measures, installation of a Selective Catalytic Reduction (SCR) high dust De-NOx plant will be considered.

Flue Gas Desulphurization

Limestone-Gypsum Wet Flue Gas Desulphurization (FGD) will be installed. So, SO_2 emission concentration will be controlled ≤200mg/Nm^3.

Stack Height: In compliance with the requirements of Air Pollution Control Rules under Schedule-5, the plant will have a stack with a height of 220 m, with facilities for online monitoring of stack emissions.

Pollution Monitoring: The chimney will also be provided with a Continuous Emission Monitoring System (CEMS).

3.7.11.2 Control Measures for Coal Handling System

One full covered arch type of coal yard is designed, the front and back sides will be closed by wind barriers for dust suppression purpose. A cover will be installed for the conveyor for coal transportation to coal yard.

Unloading of coal will be minimized (e.g., reduce the frequency of activity, etc.) during times of high-speed winds. Appropriate coal handling during stock and unloading activities will be maintained.

For the control of fugitive dust emission within and around the Coal handling plant, dust extraction and suppression systems will be provided. Dust suppression system will be installed at all the transfer points in Coal Handling Plant and at Coal stockyard. Dust extraction system would be provided in crusher house, and at Coal stockyard. Further in order to arrest the coal dust generation, conveyers will be provided with enclosed galleries. The bottom portion of all the conveyors will be provided with seal plates within the power plant area and above roads.

To control emissions of fugitive dust within and around the coal handling plant and coal stockyard, a water spray system shall be installed. Spraying water in coal yard to keep the surface wet and prevent wind from blowing coal and dust.

In addition, frequent wash downs of these areas, with plant service water, will be undertaken at appropriate locations.

Dust collection system with ventilation system having bag filters will be provided to evacuate dust and hazardous gases like Methane from the coalbunkers. Collected dust will be returned to coal bunker. The dust collector outlet emission will be restricted to 50 mg/Nm^3 to trap the dust in the bunkers.

Storage of coal would be designed in such a way that the air content in the coal pile is minimized. Dimension of the coal stack, particularly the height, is a very important parameter for making storage of coal safe and adequate care would be taken while designing the same.

Re-greening especially along boundary of plant site, surrounding coal yard with domestic plants. The coal pile area run off water during monsoon season will be led to a pond. Coal particles will settle down in the pond and clear water will be allowed to overflow to the central monitoring basin for treatment.

3.7.11.3 Control Measures for Ash Handling System

Fly ash evacuated from ESP/Economizer/Air Preheater collecting hoppers is transported in closed pipelines by pneumatic means. At the time of unloading fly ash into the silos, some ash laden air would get vented out. In order to restrict the fly ash dust particles to the limits of 50 mg/Nm^3, a vent filter will be installed on top of each of the fly ash silos.

The following pollution control measures will be installed for ash disposal:

- It is proposed to use closed trucks for fly ash transportation in order to avoid dust nuisance. To reduce the dust nuisance while loading the ash from fly ash silos, the fly ash is conditioned with water spray.
- Water sprinkling system will be commissioned in the ash disposal area to restrain flying of fine ash to wind.
- It is also proposed to dispose un-utilized fly ash to ash dyke.
- The dust nuisance in the ash disposal area will be contained by ensuring that the ash is always kept wet.
- The ash pond will be developed with dykes all round constructed with earth. The ash bund shall be designed to be suitable under all conditions to which they may be subjected to, including self-weight, vertical loads, lateral loads, water pressure, seepage and draw down, seismic effects etc. for the ultimate stage of raising of the bund. The bunds shall be of homogenous earthen construction. The design of bund shall ensure that the phreatic (seepage) line shall not meet downstream face of the embankment. To ensure this, adequate internal drainage arrangement shall be provided. The embankment shall be safe against failure due to "piping".
- Average Finished Bed level shall be maintained as even as possible. Leakage from the bottom of the ash pond will be prevented by using an impermeable layer, such as high-density polyethylene (HDPE) sheet or silt layer.
- Ash Pond Recovery System- Water recovered from ash pond will be collected into recovery water sump near Ash Pond and will be pumped back to the clarifier (located in the plant) with the help of centrifugal pumps. Necessary Chemical dosing at the inlet of clarifier will be provided to enable settling down of the particles. Clear water will flow by gravity into clear water sump.
- Wastewater will be managed and treated appropriately by neutralization and sedimentation to comply with water quality of Bangladesh regulations and IFC/WB EHS Guideline values for thermal power plants. The above measures will be taken to ensure that the impact on the water quality will be insignificant.
- Watering in ash pond as required for the dry season.
- Re-greening especially along the boundary of the plant site, surrounding ash pond with domestic plants according to local climate conditions.
- As the ash pond is filled, discarded portions of the pond will be managed to minimize the risk of air pollution due to fugitive dust emissions. Throughout the total life cycle, the ash pond will be in constant monitoring, inspection and maintenance.

3.7.11.4 Noise Control

The major noise generating sources include turbines, turbo-generators, compressors, pumps, fans, coal handling plant. The equipment will be designed to control the noise level below 90 dB. All the DG sets will have acoustic enclosures limiting the noise to a maximum of 75 dB at one meter distance. Personnel protective equipment like ear plug/ear muffler will be provided to workers engaged in high noise areas. The buffer area around the plant, boundary wall around the project will further dampen the noise level and minimise the impact on the nearby community.

3.7.11.5 Effluent Treatment System

A central effluent treatment plant with the facilitation of Central Monitoring Basin (CMB) has been planned to collect, treat and dispose all the plant effluents. The liquid effluent shall be collected and treated / recycled generally as per following design philosophy.

- A portion of CW blow down water shall be used for dust suppression system of coal stockyard and balance shall be diverted to Central Monitoring Basin.
- Ash water system shall be generally operating in re-circulation mode; blow down if any from Ash water system shall be led to the CMB.
- Other plant drains/ effluent shall be collected and pumped to central monitoring basin.
- Regeneration waste of Demineralization Plant, condensate polishing plant and boiler blow down water shall be pumped to the CMB.
- Water from plant service water system and dust suppression system shall be collected from the plant drains and will be allowed to settle for removal of suspended impurities. The treated water will be pumped to the CMB.
- Drains from coal stockyard will be drained to a set of coal settling pond for removal of coal particles.
- All the plant liquid effluents shall be mixed in CMB, and quality of the effluent shall be measured and monitored. Through a set of water effluent disposal pumps and piping, the same shall be disposed of from central monitoring basins up to the final disposal point.
- Final disposal to the Kutubdia channel will be made maintaining DoE's standard for effluent quality (Schedule 4 of ECR 2023).

Process of Industrial wastewater treatment system is presented in **Appendix C-9** and **Appendix C-10**.

<u>Process Effluents</u>

The process effluents from the proposed project will comprise of:

- **Clarifier:** Sludge from the treatment plant will be collected in a slump. Solid waste will be removed by centrifuges/ belt press filter. Clear water will be directed to the inlet of clarifier and the solid waste will be disposed by dumpers to land fill according to regulations.
- **DM plant:** The regeneration waste will be neutralized in basin near DM plant. Neutralized regeneration effluent will be pumped to the collection basin.
- **Condensate polishing unit:** The regeneration waste will be collected and neutralized in a neutralization pit. The neutralized regeneration effluent will be then pumped to the collection basin.
- **Boiler blow down and other process drains:** Collected in drain tanks and reused.
- **Service wastewater:** Will be treated by oil water separator, lamella or conventional/reactor clarifier. The treated water from clarifier will be transferred to collection basin.
- **Boiler air pre-heater washing**
- **Coal pile area run offs:** Will be channelized to settling pond and the clear overflow will be pumped to the collection basin.
- **Ash disposal area run off –** Will be channelized to the settling pond and the clear overflow will be pumped to the collection basin.

- **Fuel oil storage and handling area effluent:** Oily effluent will be pumped to oil water separator,

Domestic Wastewater

Domestic wastewater will be generated from the accommodation facility provided for the workers and staff during the operation. The wastewater generated will be treated in a package type sewage treatment plant (STP).

Runoff from process and other plant areas

Storm water runoff drainage network will be developed to direct runoff from roof drains and other areas to the collection basins or to natural drainage, as appropriate. The collection basins will be designed to contain general site drainage, neutralization basin flows, oil/water separator flows, and service water system flows, septic tank. The basin will be sized to contain minimum the 24 hours storm runoff from two most recent consecutive rainfall events and will be designed not to have a normal discharge. Offsite runoff entering the site from surrounding areas will be routed around the site area through the use of overland flow, open channel flow, and underground piping or a garland drain around the site.

3.7.11.6 Other Waste Streams

The hazardous solid waste in the form of waste oil, spent ion exchange material and water pretreatment clarifier sludge will be generated from the power plant. The waste oil will be collected in Mild Steel (MS) drums and stored on paved platforms with proper labelling. The waste will be sold to DoE approved vendors. The sludge will be dried and sent for land-filling. Spent Ion exchange material will also be sent for land-filling.

3.8 Other Plant Facilities

3.8.1 Hydrogen Generation System

The hydrogen generation system is designed for the cooling for generator of 1×635 MW unit. The medium-pressure (~3.0MPa), water electrolysis hydrogen generation device will be adopted. The hydrogen quality should meet the generator manufacture's requirements.

Capacity of Hydrogen Generation System

1) Guaranteed amount of hydrogen leakage of 1×635 MW unit per day: 18 Nm^3;
2) First hydrogen filling (Replacement and hydrogen pressure reached) amount of 1×635 MW unit: 645 Nm^3.

Total capacity of the hydrogen generation equipment shall be considered based on the sum of the normal consumption of all hydrogen cooling generators and the largest generator first hydrogen filling amount that can be accumulated within 7d. Based on this principle and information provided by DBC, the hydrogen generation equipment output calculation is as follows:

$$(645+18\times7)\ Nm^3 \div (7\times24)\ h=4.59\ Nm^3/h.$$

Considering the capacity margin and the manufactures' handbook, one (1) set of 10Nm3/h capacity medium-pressure hydrogen generation system will be selected for 1×635 MW unit.

Three (3) hydrogen storage vessels (~3.0MPa, 13.9m^3) with the total effective hydrogen storage of ~960 Nm^3 will be provided for enough hydrogen storage.

3.8.2 Fire Protection System

The fire protection installations and escape routes shall be designed according to Bangladesh regulations, standards, and directions. The system will comprise of water firefighting system, fire extinguishers, fire extinguishing water tank and fire extinguishing water pumping station.

3.8.3 Electrical and I&C (Instrumentation and Control) Systems

The steam turbine generator will be rated to deliver 635 MW net powers, with 0.8 lagging and 0.95 led Power Factor and 50 Hz frequency at the plants delivery point. The generator will be connected to the 400 KV switchyard through a Step-up transformer. The power will be evacuated from the 400 KV Switchyard through line feeders. The start-up power will be normally drawn from the grid (proposed 400 KV lines) through station transformer and Diesel Generator (DG) sets shall be provided for the black start of the plant. The size of the DG sets will be decided based on the power required for starting the plant.

3.8.4 Jetty

A coal unloading jetty will be constructed at the northern side of the Matarbari deep seaport. Coal will be transported from the coal unloading jetty to coal yard through 4.7 km conveyer belt.

A temporary jetty will also be constructed on Kutubdia channel at the western side of the powerplant for construction material, HFO and LDO unloading.

3.8.5 Transmission Capacity/Option for Linking to Grid

According to the Revisiting PSMP-2016 plan, all the power plants located in Maheshklhali, Matarbari and southern Chattogram are decided to be evacuated through the Maheshkhali-Modunaghat-Vulta 765kv transmission line (initially charged 400kv) as well as another 400 kv transmission line, One of these two lines are under construction, and another is in verse of starting the construction. Power from Orion Power Unit-2 Dhaka Ltd. will be evacuated by 400kv double circuit transmission line connecting to that Maheshkhali 400kv switchyard. The approximate distance from the proposed power plant to Maheshkhali 400kv switchyard is 13 km.

3.9 Significance of the Project

According to The Power System Master Plan (PSMP) 2016, Bangladesh aspires to become a high-income country by 2041. Therefore, the development of energy and power infrastructure pursues not only the quantity but also the quality to realize the long-term economic development and to match the objective, improvement of power quality for the forthcoming high-tech industries needs to be addressed holistically. As per revisiting PSMP 2016, GoB has a plan to generate 94,160 MW (high case) electricity of which 30,166 MW (32%) planned from coal. Accordingly, GoB approved 18 coal-based power plant. Till now, four coal based power plant in operation and three are under construction. OPDL-2 got a permission to set up a 635 MW coal-based power plant in Gazaria, Munshiganj. GoB scraped 10 coal-based power plant since construction work made no progress as well as considering environmental issue.

Still, most of the power generated from natural gas. In Bangladesh, natural gas demand is quite high rather than supply. Now a days, acute crisis of oil & gas due to the Russia-Ukraine war, many developed countries restarted the coal-based power plants to meet the electricity demand. Bangladesh also facing electricity crisis due to the demand supply gap of fuel. As a result, Government of Bangladesh has given their high emphasis on implementing of Orion Power Unit-2 Dhaka Limited at a different location which is at Moheshkhali. BPDB advised to shift the project site on a land owned by Coal Power Generation Company Bangladesh Limited (CPGCBL) to ensure best utilization of this land as well as most reliable operation of this project. The significant of the project are as follows.

- No additional land acquisition is required since the project will be set up on the already acquired land.
- No involuntary resettlement is involved.
- Matarbari port is only 4 km away and mother vessel like Panamax/ Supramax with 60,000-70,000 DWT can directly approach to coal unloading jetty. Coal will be transported from jetty to power plant through conveyer belt.

- No inland transportation is involved in this project in new location, there is also no dependency on river dredging by BIWTA as well as no uncertainty of Coal transportation during rough weather.
- Environmental impact due to inland transportation, ship to ship loading / unloading etc. are also eliminated from project scope.
- Ultra-supercritical technology with high efficiency, less emission and operation flexibility.
- The project will provide reliable electricity at low cost.

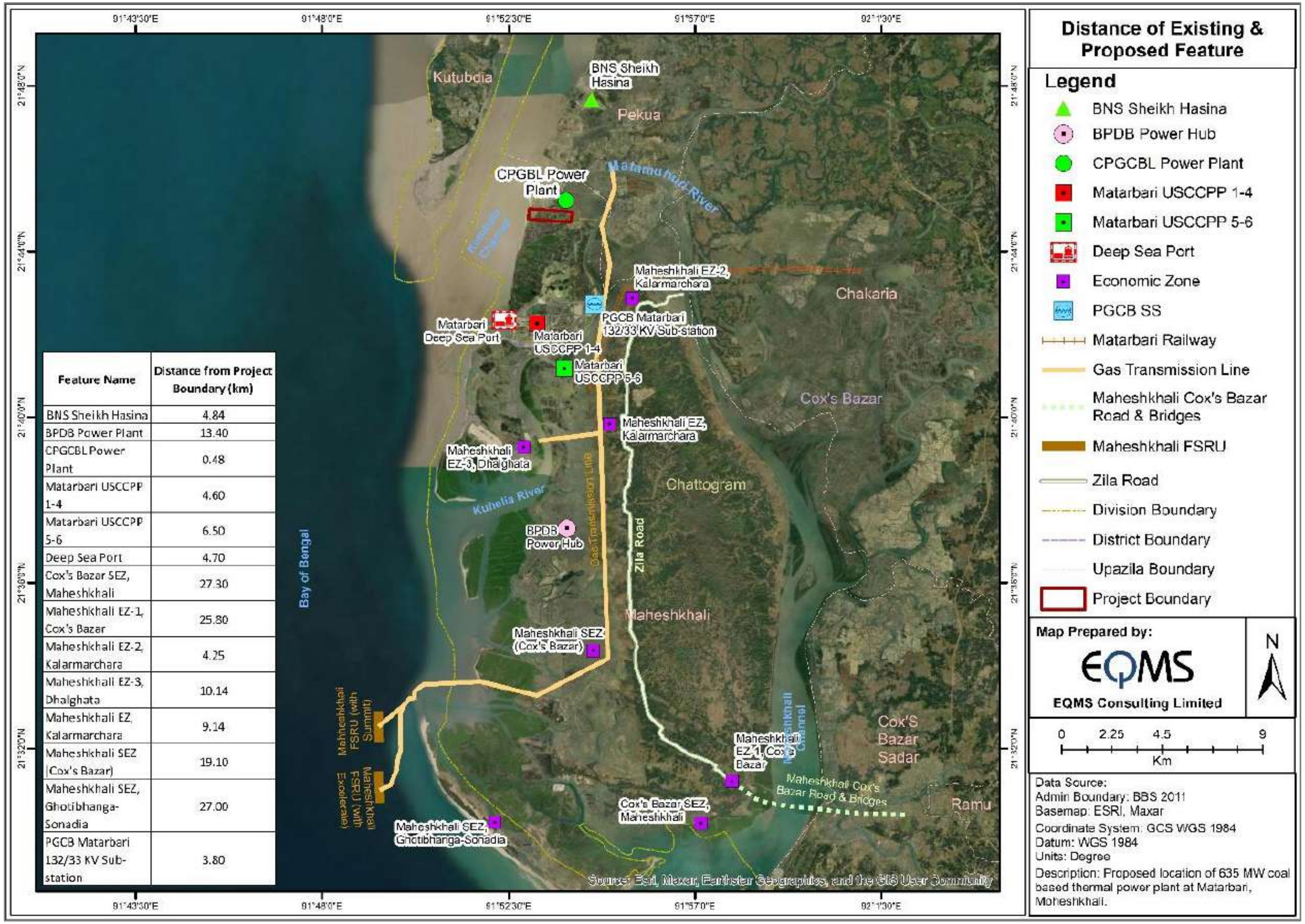
3.10 Location of Protected Area

The is no protected area within 10 km of the project location. Detail of the protected area including ecological critical area, marine protected area and import bird and biodiversity areas are describe in section 4. 6.4.

3.11 Distance to Existing Infrastructure

The government has taken a master plan for development in Matarbari and Moheshkhali Islands through different implementing agencies, with finance from JICA under the project "Moheshkhali-Matarbari Integrated Infrastructure Development Initiative" (MIDI). According to the MIDI, there will be road and rail network, power plant (Coal, LNG and solar), deep seaport, LNG terminal, 5 economic zones, SPM with double pipeline project. Among them, several development projects are under construction. The nearest village is Baniakata & Banti Shikderpara village which is approximately 150 m-250 m East and South-East direction from project boundary. The Matarbari 600X2 MW coal based thermal power plant is located 4.60 km south of the project site and BNS Sheikh Hasina Submarine base is located about 4.84 km north of the project. Coal based power plant of this region is currently being scraped by government of Bangladesh. The distance of the existing and proposed infrastructure is presented in **Figure 3-8.**

Figure 3-8: Distance of the Existing and Proposed Infrastructures



Feature Name	Distance from Project Boundary (km)
BNS Sheikh Hasina	4.84
BPDB Power Plant	13.40
CPGCBL Power Plant	0.48
Matarbari USCCPP 1-4	4.60
Matarbari USCCPP 5-6	6.50
Deep Sea Port	4.70
Cox's Bazar SEZ, Maheshkhali	27.30
Maheshkhali EZ-1, Cox's Bazar	25.80
Maheshkhali EZ-2, Kalarmarchara	4.25
Maheshkhali EZ-3, Dhalghata	10.14
Maheshkhali EZ, Kalarmarchara	9.14
Maheshkhali SEZ (Cox's Bazar)	19.10
Maheshkhali SEZ, Ghotibhanga-Sonadia	27.00
PGCB Matarbari 132/33 KV Sub-station	3.80

3.12 Project Activities- Construction Phase

The construction phase of the proposed Project will involve land survey, geotechnical investigation, component delivery; construction of access roads, foundations, erection of boiler units, plant structures boilers, generators, turbines, storage tanks, welding/cutting onsite, installation of heavy machinery, pumps and mechanical and electrical installations. The construction works will also entail site clearance, filling and levelling works along with development of material storage yards.

3.13 Project Schedule

The project completion is scheduled in about 45 months from the commencement of construction activities to plant commissioning. The work plan of implementation (Implementation Schedule) is provided in **Table 3-7**.

Table 3-7: Project Schedule

Sl.	Activity	Expected Date
1.	Commencement of construction activities	22 June, 2023
2.	Completion of construction works	9 May, 2026
3.	Trial production	3 months (10 May 2026-7 August 2026)
4.	Performance test	One month (8 August 2026 – 6 September 2026)
5.	Commercial operation	6 September 2026

3.14 Project Cost

Orion Power Unit-2 Dhaka Ltd. intends to develop a 635 MW Coal based Thermal Independent Power Producer (IPP) power plant in mouza: Matarbari, upazilla: Maheshkhali, district: Cox's Bazar, Bangladesh.

The generated power will be sold to BPDB (Bangladesh Power Development Board). The total project cost is estimated to be around 13,215.62 crore BDT based on the present market condition .

CHAPTER 4

Environmental and Social Baseline Condition

4 ENVIRONMENTAL AND SOCIAL BASELINE

4.1 Study Area

The proposed coal based thermal power plant will have both positive and negative influence over the area. Hence, a 10 km study area or Area of Influence (AoI) has been considered to analyse the existing physical, environmental, ecological and social environment. The study area/AOI comprises of two distinct zones, i.e. offshore & intertidal zone and the onshore areas. The onshore area is dominated by agricultural land, saltpans, settlements with homestead plantation, block plantation areas (coastal shelterbelts) and hilly areas of Maheshkhali etc. The offshore area includes the Bay of Bengal, which is located on the western side of project area. The 10 km study area map is shown in **Figure 4-1**.

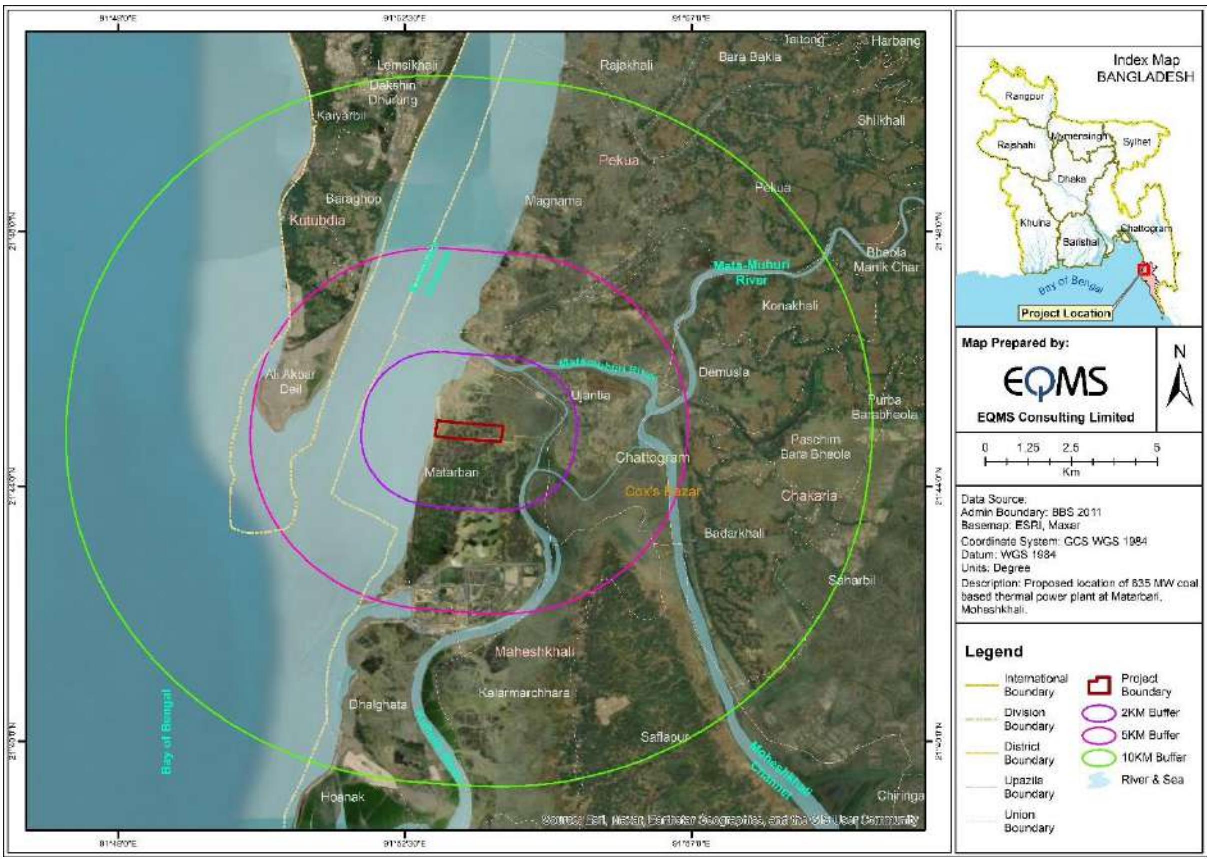
The project will be constructed at the Matarbari Union of Moheshkhali Upazila in Cox's Bazar District. The physical setting around the proposed project site is described as follows:

- **North** - Saltpan, Matamuhuri River and Ujantia village
- **East** - Saltpan, Kuhelia River, Baniakata & Banti Shikderpara village
- **South** - Uttar Shikderpara, Paschim Shikderpara, Natun Bazar & Rajghat village
- **West** - Kutubdia Channel as part of the Bay of Bengal

Land use in the immediate vicinity of the project area is mainly rural and salt pan area and the settlements near the project area are relatively low populated area.

The existing environmental and social condition analysis was completed through the use of a combination of primary and secondary data sources. To establish an understanding of the environmental and socio-economic baseline of the project area, baseline monitoring was carried out in October 2022 to January 2023.

Figure 4-1: Study Area Map



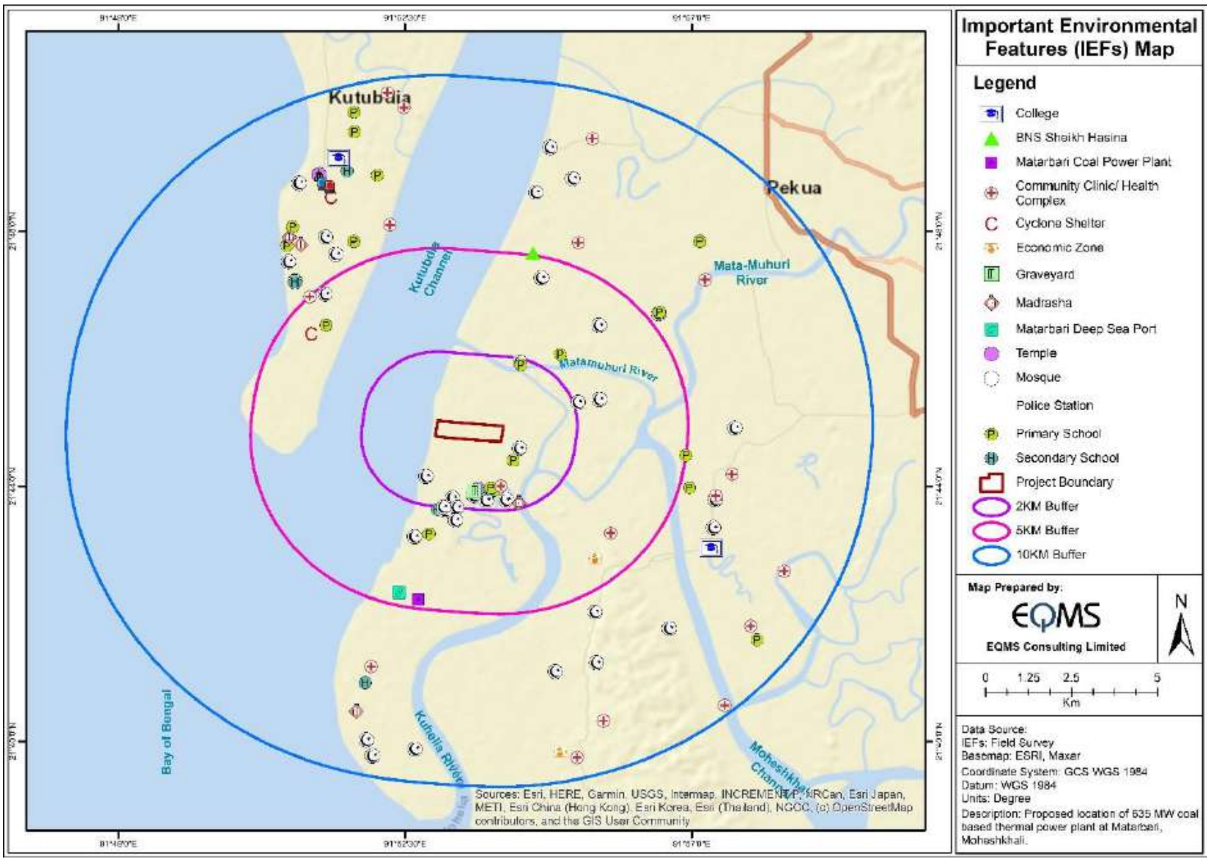
Source: EQMS, October 2022

4.2 Distance to Important Environmental Features (IEFs), Urban and Rural Communities

The proposed power plant project is located at Matarbari union under Maheshkhali Upazila of Cox's Bazar District. The nearest village is Baniakata & Banti Shikderpara village which is approximately 150 m-250 m East and South-East direction from project boundary. The proposed site is located on the south of Ujantia union (1.85 km), on the east side of Kutubdia Channel. The total land of the project is 204.64 acres which is now used for shrimp cultivation and salt pan.

Within the proposed power plant boundary, no structure (i.e., houses, mosque, school, madrasa, graveyard, market, etc.) has been observed. There are some important features around the project site. **Figure 4-2** represents the nearest features surrounding the proposed power plant site. The nearest mosque is named Banti Shikderpara Mosque located 242 m south-east side from the plant site. Uttor Shikdarpara Govt. Primary School is located at a distance of 543 m south which is the nearest school from the project boundary. Furthermore, in Notun Bazar area, some important features have been found such as the graveyard, which is 1.5 km south side from the project site, Matarbari Tample is 1.45 km south direction from project boundary. The nearest health complex is located approximately 1.26 km south direction from the site.

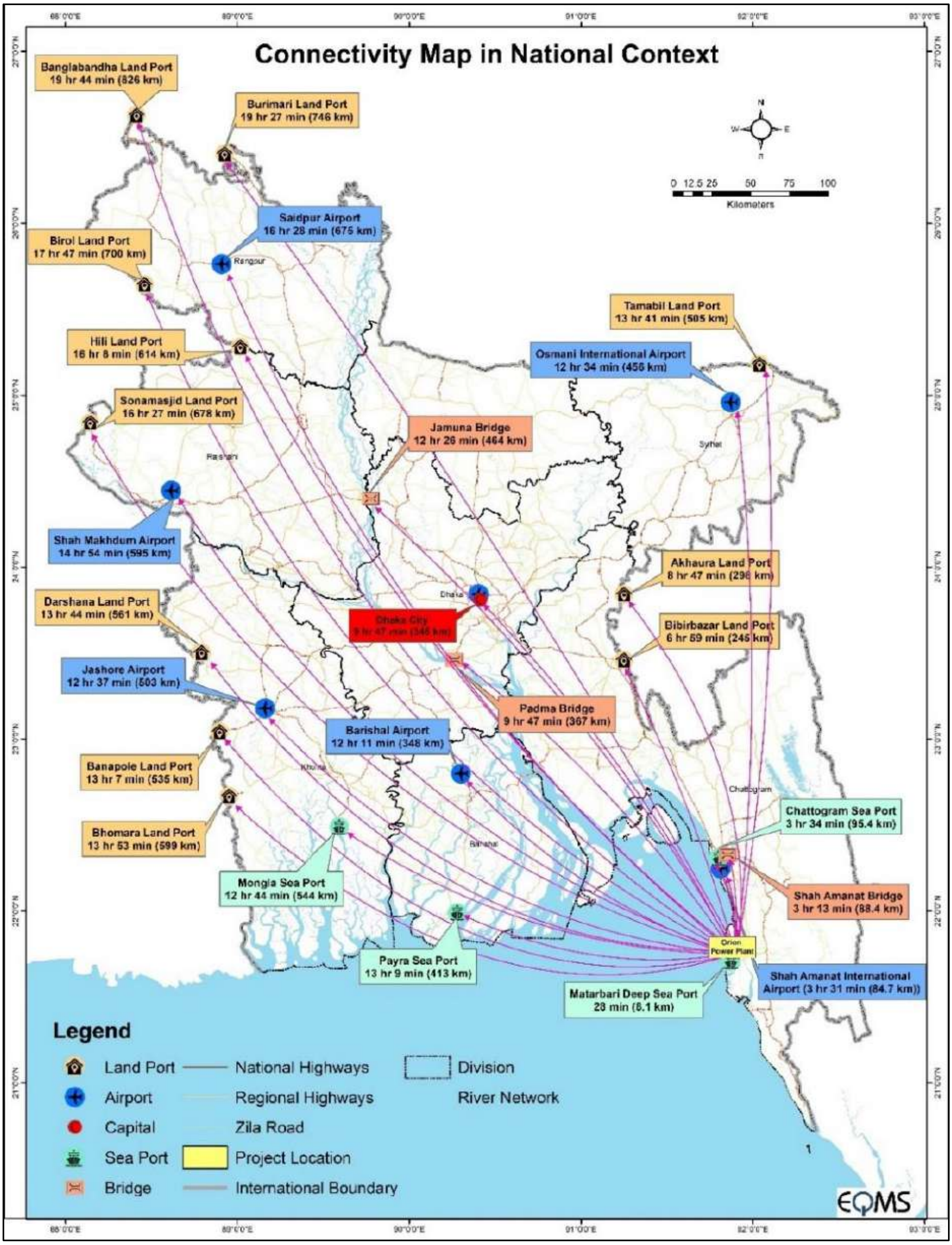
Figure 4-2: Important Environmental Features (IEFs) Map for the Proposed Project



4.3 Distance to Existing Infrastructure Such as Roads, Ports, Rail

The proposed project site is approximately 70 km south of Chattogram and 40 km north-west of Cox's Bazar. Site is at 18 km west of the National Highway (Chittagong-Cox's Bazar Highway) with Dhaka City approximately 346 km northwest direction from project location. Hazrat Shahjalal International Airport at Dhaka is located northwest of the site at a distance of 346 km. The distance of Matarbari Deep Sea Port and Chattogram Sea Port from project site is approximately 8.1 km and 95.4 km respectively. The nearest land port is Bibir Bazar Land Port which is 245 km north from the project site. The Nearest Railway station will be Cox's Bazar Railway Station which is about 70 km away from project site. The location of the proposed power plant with respect to the national and regional context is shown in **Figure 4-3**.

Figure 4-3: Connectivity Map in National Context



Source: EQMS, October 2022

4.4 Physical Environment

4.4.1 Meteorology

Bangladesh is located in the tropical monsoon region and its climate is characterized by high temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations. From the climatic point of view, four distinct seasons[10] can be recognized in Bangladesh.

- Pre-Monsoon Hot Season (March to May) – Characterized by the highest temperatures of the year–up to 36°C. Certain rainfall may occur, with tropical cyclones occasionally affecting coastal areas.
- Rainy Monsoon Season (June to September) – Period of highest rainfall (up to 80% of the annual rainfall), humidity, and cloud cover. Increased rain and cloud cover generally cause a small reduction in mean daily temperatures.
- Post-Monsoon Season (October to November) – Temperature remains hot and humid, though cloud cover decreases in this season. Limited tropical thunderstorms may still, particularly in coastal areas; and
- Cool Dry Winter Season (December to February) – Coolest time of the year with mean minimum temperatures falling below 10°C in some areas. Reduced humidity and cloud cover. Rainfall is scarce.

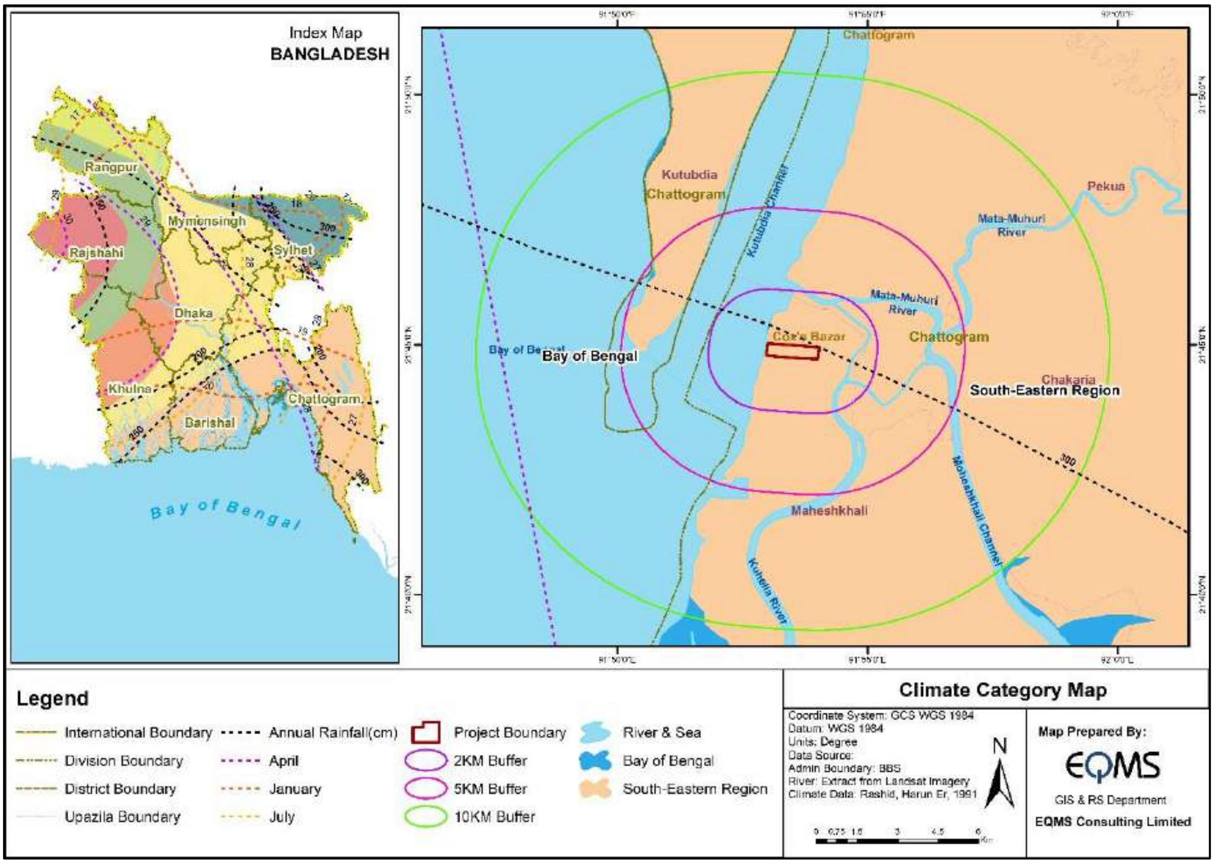
Despite the general predictability of the seasons in Bangladesh, local conditions may still vary widely across the country. As such, Bangladesh can be divided into seven climatic sub-zones based on differences in a range of factors including rainfall, temperature, evapotranspiration, and local seasonality (Rashid, 1991). According to the climatic sub-regions of Bangladesh, the proposed project area is in the South-Eastern Region. The climatic sub-regions of the study area are shown in **Figure 4-4**. The climatic data for the study area was obtained from the Bangladesh Meteorological Department (BMD)[11].

There is no meteorology station in Matarbari Union of Maheshkhali Upazila. The nearest meteorological station to the proposed project site is Kutubdia Meteorological Station, which is about 8 km from the project site. Meteorological data for the last thirty years (1991-2020) of Kutubdia Meteorological Station were analyzed.

[10] Brammer, H. (1996). *The Geography of the Soils of Bangladesh*. University Press Limited, Dhaka, Bangladesh.

[11] Bangladesh Meteorological Department is the authorized Government organization for all meteorological activities in Bangladesh. It maintains a network of surface and upper air observatories, radar and satellite stations, agro-meteorological observatories, geomagnetic and seismological observatories, and meteorological telecommunication system

Figure 4-4: Climatic Sub-regions of the Study Area

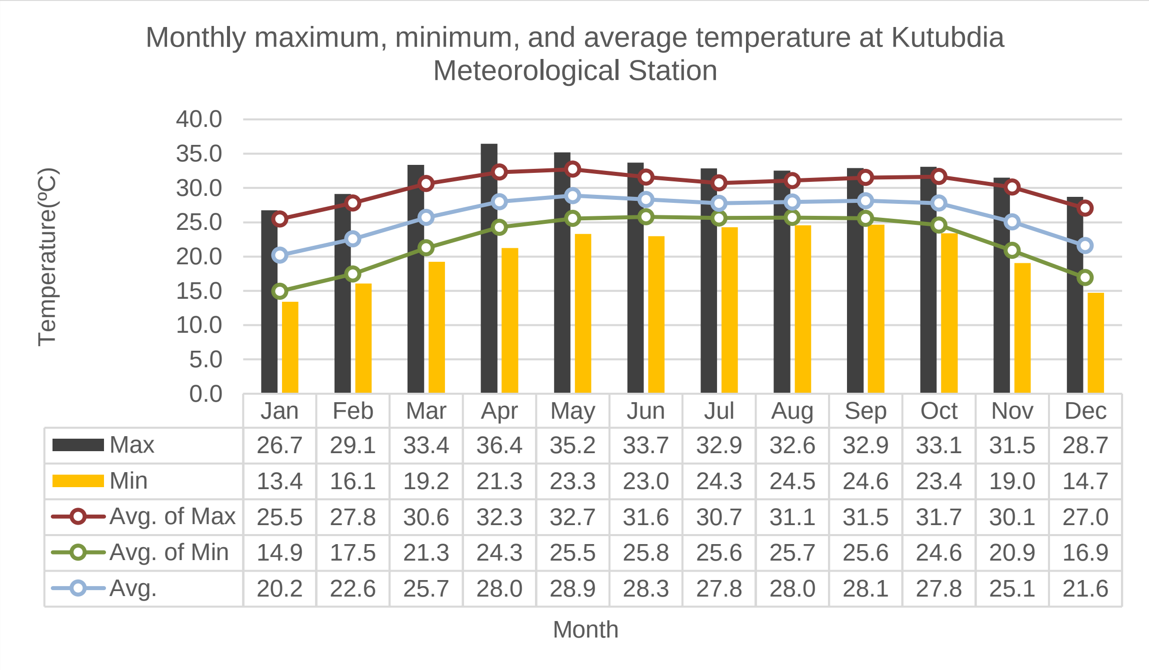


Source: Rashid H. E., 1991

4.4.1.1 Temperature

Based on temperature data recorded at Kutubdia Meteorological Station for the last 30 years (1991 to 2020), the maximum and minimum ambient temperatures are observed to be ranging from 26.7°C to 36.4°C and 13.4°C to 24.6°C, respectively. According to recorded average temperature data at Kutubdia Meteorological Station, the lowest average temperature was found in January 2003 (18.9°C) and the highest average temperature was found 30.3°C in May 2019. The period from March to October is marked by a continuous increase in the temperatures. April is the hottest month of the year with an average maximum and minimum temperature (in April) of 36.4°C and 21.3°C, respectively. From November onwards, both the day and night temperatures decrease, and January is the coldest month, with average monthly maximum and minimum temperatures of 26.7°C and 13.4°C, respectively. The monthly variation of the maximum, minimum, and average temperature at Kutubdia Meteorological Station is shown in **Figure 4-5**.

Figure 4-5: Monthly Maximum, Minimum, and Average Temperatures



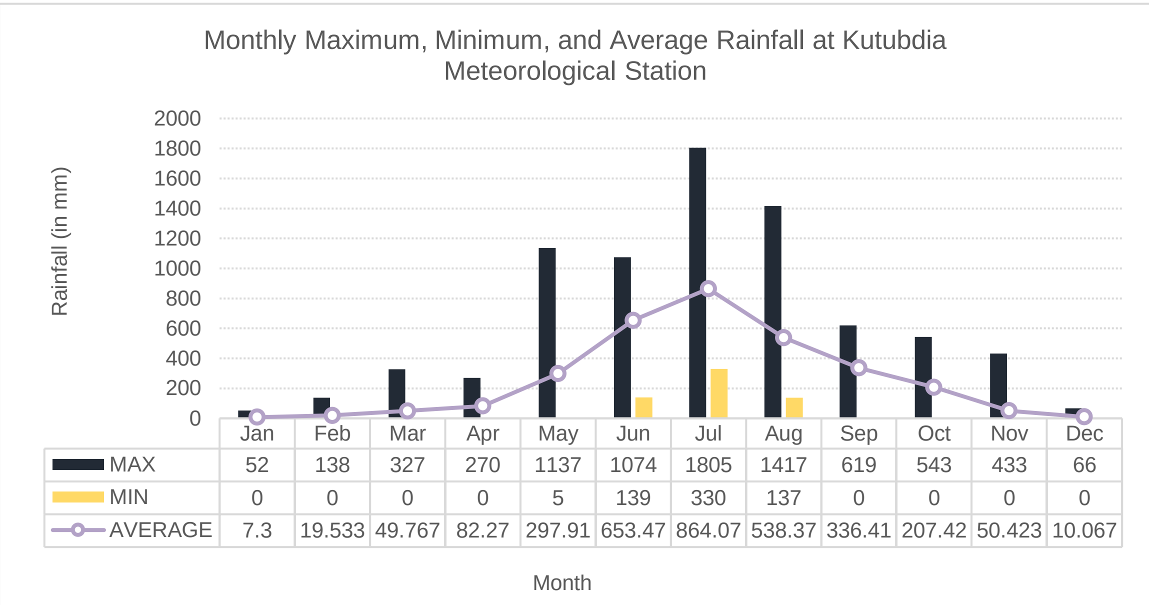
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	26.7	29.1	33.4	36.4	35.2	33.7	32.9	32.6	32.9	33.1	31.5	28.7
Min	13.4	16.1	19.2	21.3	23.3	23.0	24.3	24.5	24.6	23.4	19.0	14.7
Avg. of Max	25.5	27.8	30.6	32.3	32.7	31.6	30.7	31.1	31.5	31.7	30.1	27.0
Avg. of Min	14.9	17.5	21.3	24.3	25.5	25.8	25.6	25.7	25.6	24.6	20.9	16.9
Avg.	20.2	22.6	25.7	28.0	28.9	28.3	27.8	28.0	28.1	27.8	25.1	21.6

Source: Bangladesh Meteorological Department (BMD)

4.4.1.2 Rainfall

The annual rainfall based on rainfall data recorded at Kutubdia Meteorological Station for last 30 years (1991 to 2020) is 3117 mm. Annual rainfall shows considerable variability from year to year. The rainfall also varies considerably within a year (**Figure 4-6**) with 94.5% of rainfall occurring within the seven months from May to November. The highest rainfall is recorded in July 1998 (1805 mm). An insignificant amount of rainfall has also been recorded in winter (November to February).

Figure 4-6: Monthly Average Rainfall



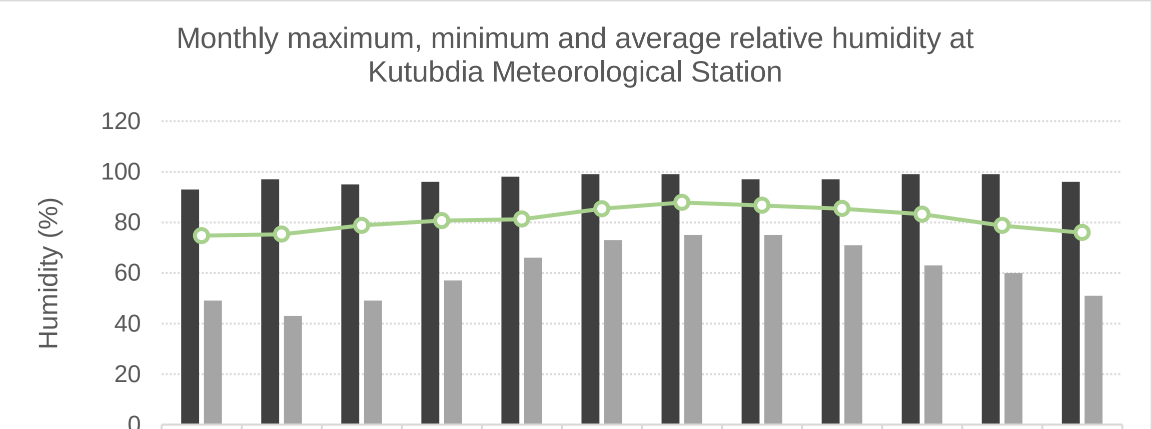
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MAX	52	138	327	270	1137	1074	1805	1417	619	543	433	66
MIN	0	0	0	0	5	139	330	137	0	0	0	0
AVERAGE	7.3	19.533	49.767	82.27	297.91	653.47	864.07	538.37	336.41	207.42	50.423	10.067

Source: Bangladesh Meteorological Department (BMD)

4.4.1.3 Humidity

Due to the heavy rainfall and proximity to the Bay of Bengal, the humidity levels in Bangladesh remain high. Based on humidity data recorded at Kutubdia Meteorological Station for the last 30 years (1991 to 2020), relative humidity in Kutubdia Meteorological Station is generally above 75% throughout the year except in January. The monthly average relative humidity varies from 74.7% to 87.8% with an average humidity of 81.1%. Humidity remains higher in the monsoon (June to September) season and comparatively lower in the winter season. November - March is the driest with the relative humidity at around (74.7-78.8). The monthly average relative humidity at the Kutubdia Meteorological Station is shown in **Figure 4-7**.

Figure 4-7: Monthly Average Relative Humidity



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	93	97	95	96	98	99	99	97	97	99	99	96
Min	49	43	49	57	66	73	75	75	71	63	60	51
Avg	74.7	75.3	78.8	80.6	81.2	85.3	87.8	86.7	85.4	83.2	78.7	75.9

Source: Bangladesh Meteorological Department (BMD)

4.4.2 Topography

The overall landscape of Bangladesh can be divided into three broad categories based on topography, physical features, and geological history (Brammer 1996).

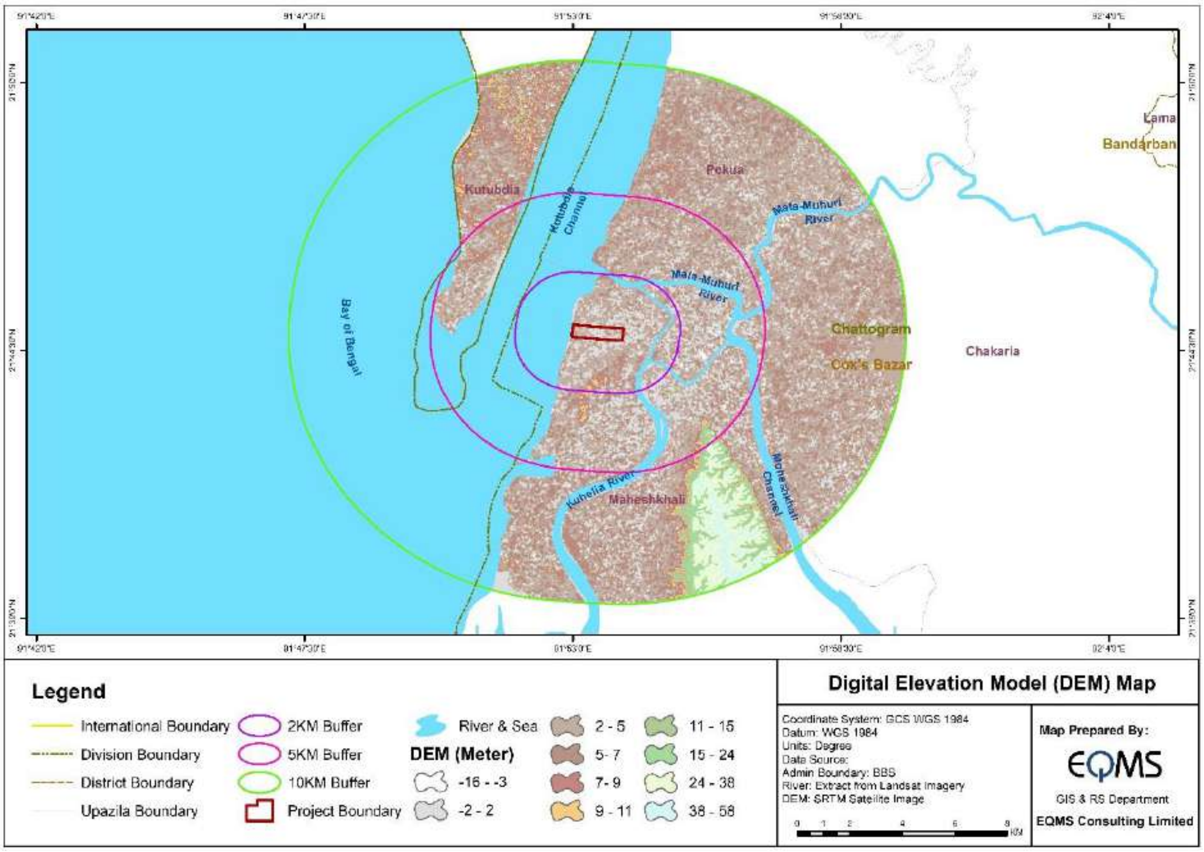
- Hills: Primarily found along the eastern border of Bangladesh, these areas occupy approximately 18,171 km^2 or 13% of the land surface. They are generally underlain by sandstones, siltstones, and shales of Tertiary and Quaternary age.
- Terraces: these are isolated tracts of land, primarily found within central-northern and north-western Bangladesh which occupy, in total, some 12,085 km^2 or 8% of the total land surface. They are generally underlain by unconsolidated clays of Tertiary age, which have been uplifted by seismic activity so that their surfaces are several meters higher than the adjoining floodplain; and
- Floodplain: most of the land surface of Bangladesh is floodplain in Bangladesh- approximately 114,580 km2 or 79% of the total land surface. These areas are generally comprised of Quaternary sediments which have been deposited over subsurface geological formations by the Ganges, Meghna, and Brahmaputra rivers.

The study area falls in the low laying coastal region in the south-eastern part of Bangladesh. Below **Figure 4-8** shows the detailed topographic features in the study area.

Features of the project site

There are no structures in the project site. Most of the land of the project site is salt pan that also used for shrimp/fish cultivation. There are no features like electric poles, roads, etc., located anywhere in the boundary lines.

Figure 4-8: Topography of the Study Area



Source: USGS Earth Explorer

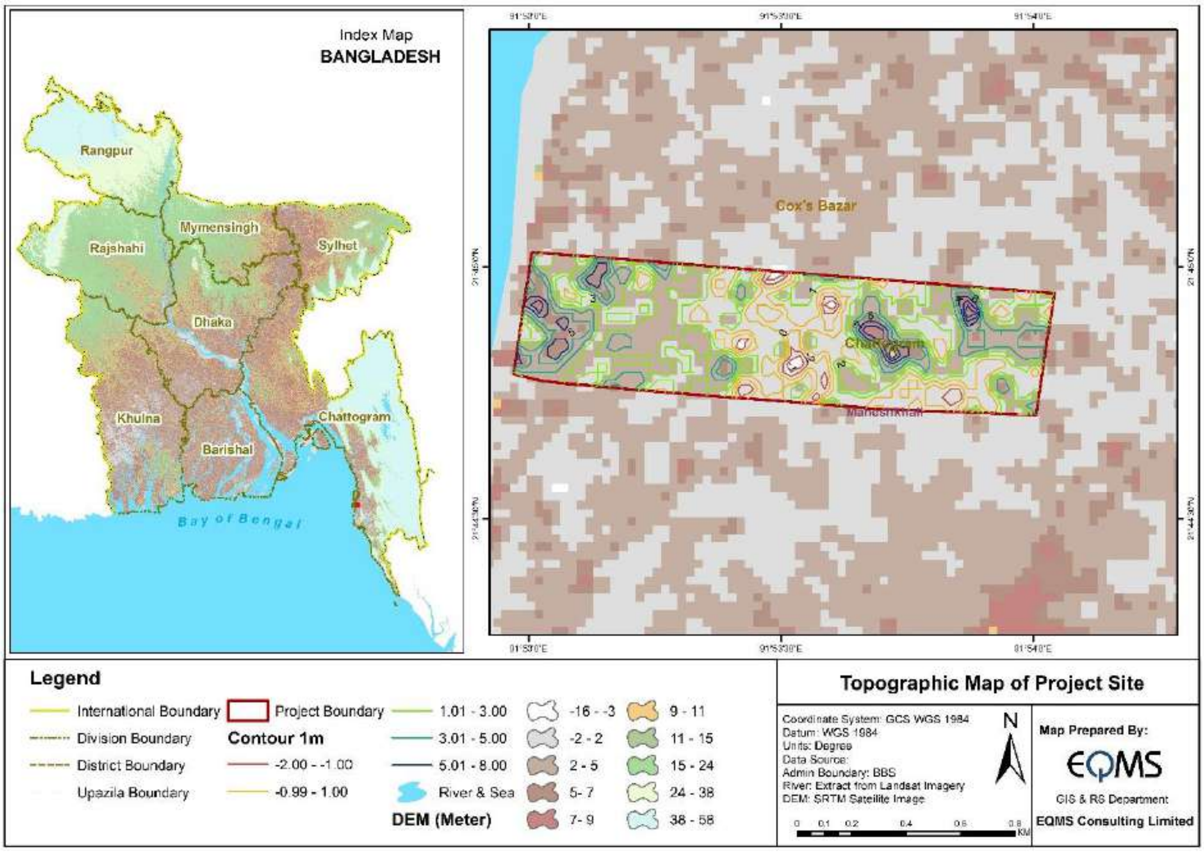
Surrounds of the project site

There is a long water course and the Kuhelia River and a Homestead village of Bandi shikdarpara on the East side, the Bay of Bengal and Kutubdia channel on the West side, a Homestead village of Sikdarpara on the South side, and Matamuhuri River on the North of the project area.

Existing ground level

On the basis of the Digital Elevation Model (DEM) Map the existing ground level of 10 km buffer area was found within the range of -16 to 58 m and the average elevation of the project site area is about +1.25 m.

Figure 4-9: Topography of the Project Site



Source: USGS Earth Explorer

4.4.3 Land Use

Due to the dynamic nature of land use patterns, land use/cover inventories are an essential part of evaluating land resources and environmental studies. The land use study for the proposed coal power plant and its 10 km buffer was undertaken with the following objectives:

- To study the land use/cover in the 5 km and 10 km radius areas of the proposed 635 MW coal based thermal power plant site and provide inputs for environmental planning of the proposed plant by analyzing the existing land use/land cover scenario: and
- To establish the existing baseline scenario using a GIS database for incorporation of thematic information on the different physical features including rivers and channels, water bodies, settlements, etc.

4.4.3.1 Land Use Interpretation of the Study Area

The evaluation of the existing environmental status of the study area was divided into three (3) zones of 0-2, 0-5 km and 0-10 km. This revealed that the land use/land cover consists mainly of saltpan, rivers and channels, agricultural land, and settlement area with homestead vegetation on land use categories. Existing land use composition 10 km of the study area is presented in **Table 4-1**. **Figure 4-10** gives the Land use/Land cover map for 10 km study area that shows the land use pattern within 2 km, 5 km and 10 km of the study area.

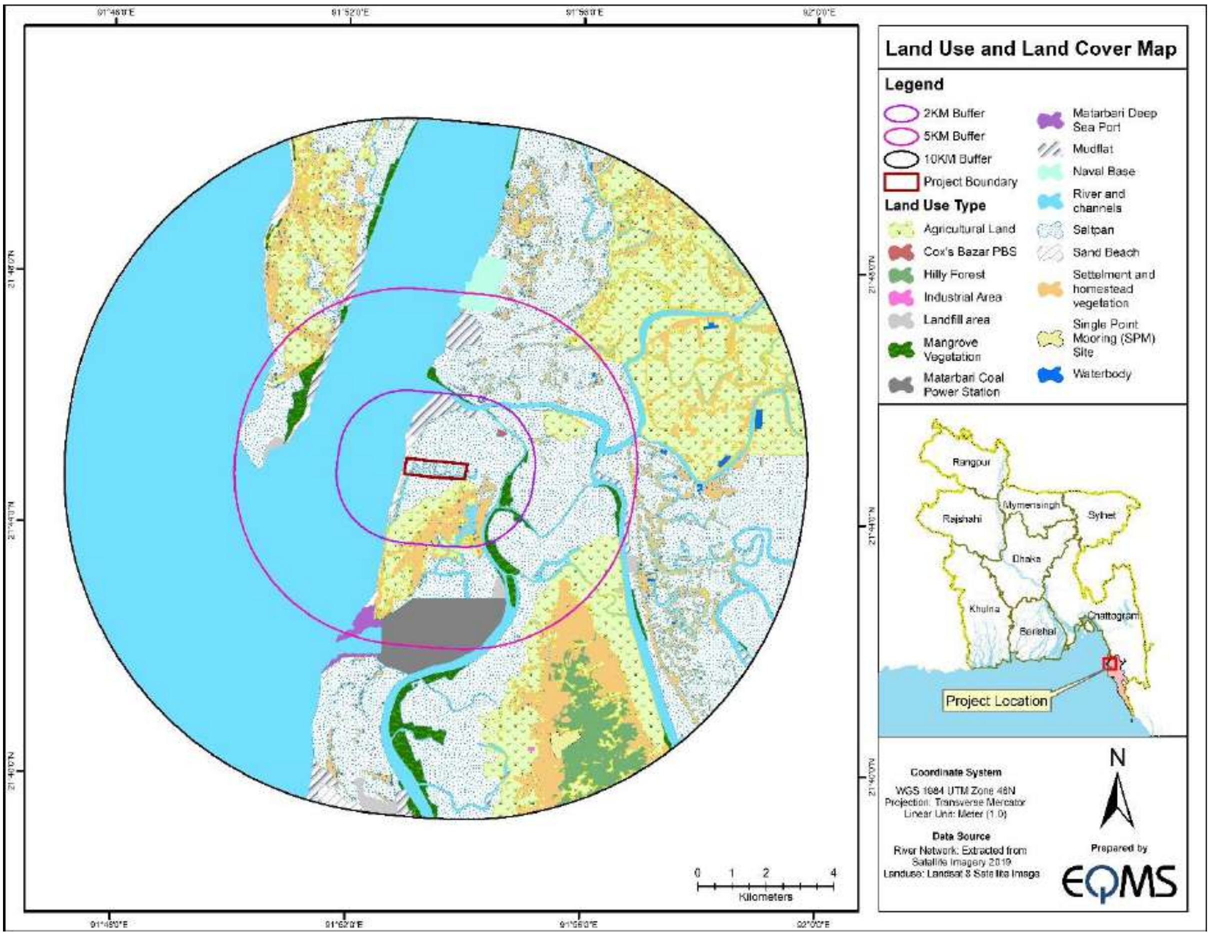
The land portion of the study area is about 88662.54 acres. The majority of the land area (about 42.30%) is covered by River and channels. Salt pans covers about 27.14% of total land area which in parts is also used for shrimp culture, followed by Agricultural Land (14.17%), Settlement and homestead vegetation (8.49%), Matarbari Coal Power Station (1.70%) and Hilly Forest (1.57%) etc.

Table 4-1: Land Use Pattern of 10 km Study Area

Land Use Type	Area (Acres)	Percentage (%)
Settlement and homestead vegetation	7528.22	8.49
Landfill area	289.88	0.33
Cox's Bazar PBS	10.95	0.01
Hilly Forest	1389.59	1.57
Sand Beach	399.57	0.45
Mangrove Vegetation	1242.00	1.40
Matarbari Coal Power Station	1503.40	1.70
Matarbari Deep Sea Port	155.47	0.18
Mudflat	1028.23	1.16
Agricultural Land	12559.07	14.17
River and channels	37502.02	42.30
Saltpan	24066.56	27.14
Naval Base	370.02	0.42
Industrial Area	5.70	0.01
Single Point Mooring (SPM) Site	102.86	0.12
Waterbody	508.99	0.57
Total	88662.54	100.00

Source: GIS Mapping and Interpretation of Satellite Imagery by EQMS

Figure 4-10: Land Use/Land Cover for 10 km Study Area



Source: GIS Mapping and Interpretation of Satellite Imagery by EQMS

4.4.3.2 Land Use Interpretation of the Project Site

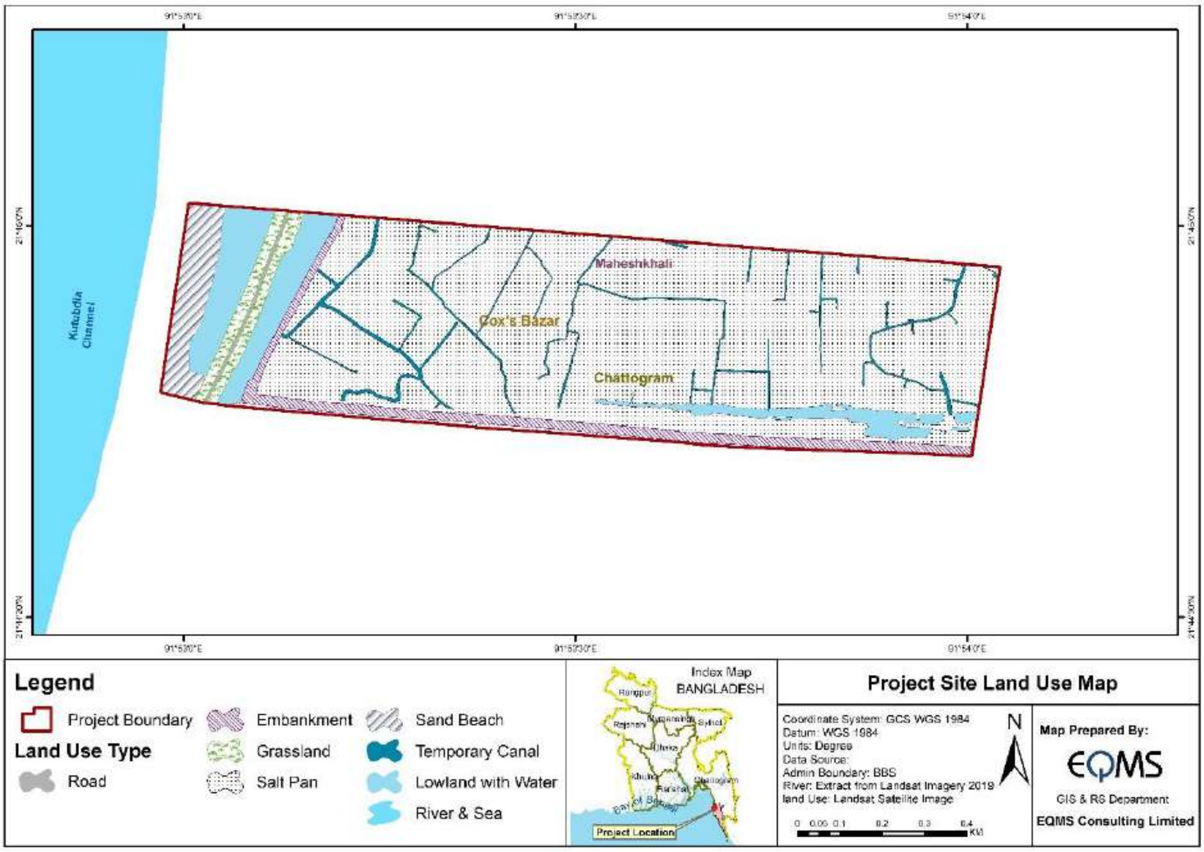
It is clearly evident from the **Table 4-2** that salt pans with about 74.49 percent of the share of the total land uses dominates the project site area. Apart from this, Low land with water (9.49%) followed embankment (5.09%), sand beach (3.98%), temporary canal (2.91%), grass land (2.66) and road (0.42%) share the project site land area. The land use/land cover map of the project site is depicted in **Figure 4-11**.

Table 4-2: Existing Land Use of the Project Site

Land Use Type	Area (Acres)	Percentage
Embankment	10.52	5.09
Grassland	5.50	2.66
Road	0.88	0.42
Salt Pan	153.90	74.49
Sand Beach	8.22	3.98
Temporary Canal	6.01	2.91
Lowland with Water	19.61	9.49
Total	204.64	100.00

Source: GIS Mapping and Interpretation of Satellite Imagery by EQMS

Figure 4-11: Land use/Land Cover Map of the Project Site



Source: GIS Mapping and Interpretation of Satellite Imagery by EQMS

4.4.4 Physiography

Physiography is the form of the earth 's surface. In Bangladesh this may be classified into three distinct physiographic regions (a) floodplains, (b) terraces, and (c) hills. Each physiographic region has unique distinguishing characteristics. The three main physiographic regions can be further subdivided into 24 sub-regions and 54 units.

The Project study area occurs primarily within the Sundarbans, Chittagong Coastal Plain and within 10 km study area the Northern and Eastern Hills also covered which are comprised of two main kinds of topography - a) *Low Hill Ranges* (Dupi Tila and Dihing Formations), b) *High Hill or Mountain Ranges* (Surma and Tipam Formations) physiographic sub-region as shown in **Figure 4-12**. Details of the physiographic sub-regions are described below.

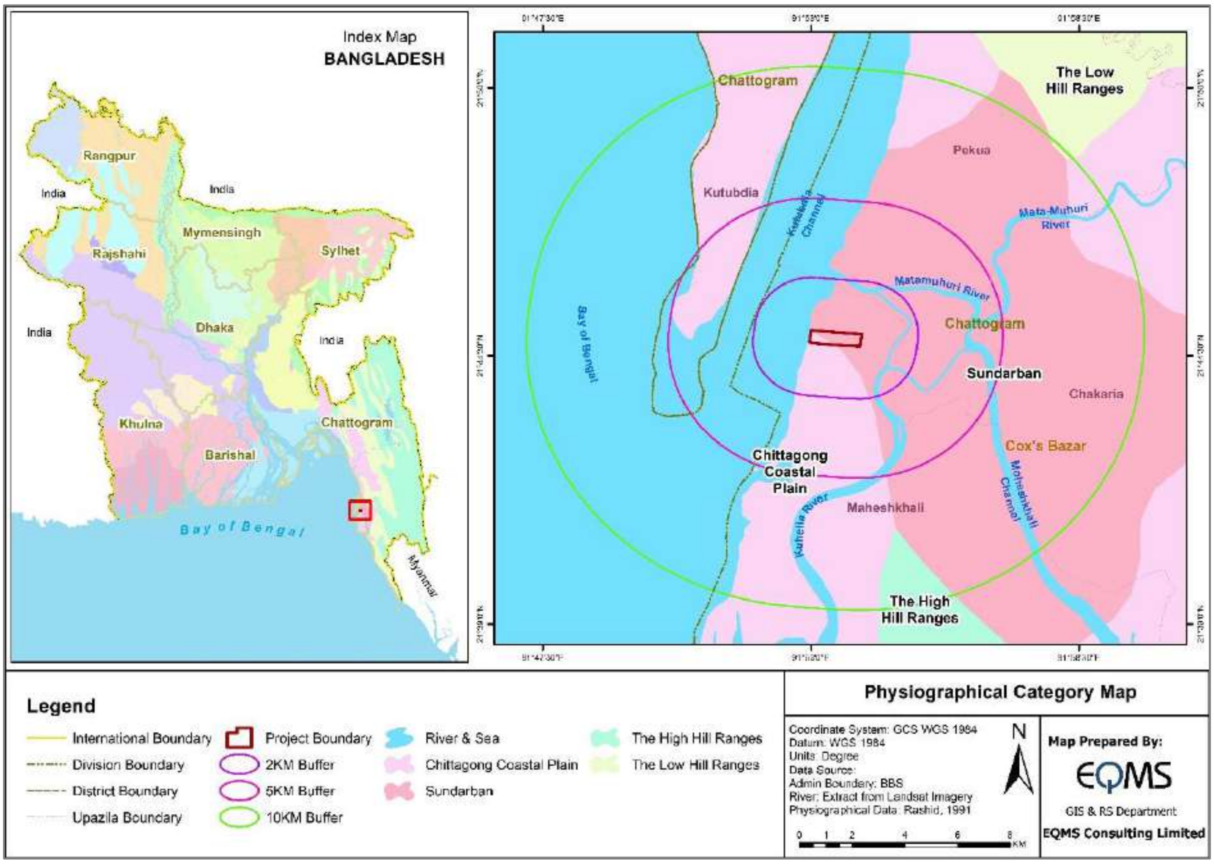
Sundarbans:

South and southwest of the Ganges tidal floodplain, there is a broad belt of land, barely above sea level with an elevation of only 0.91m. This very low land of some 4,827 sq km area contains the Sundarbans Forest and the reclaimed estates (cultivated land) - classified as the Sundarbans unit. There are two possible causes for the existence of such a large very low estuarine area - insufficient deposition by the Ganges distributaries or subsidence. The main distributaries of the Ganges never flowed through this region, and the small ones did last a few centuries at most. The building up of this estuarine area is consequently not complete. On the other hand, it is possible that subsidence has played a major part in depressing this area. There is much evidence of this, such as large ruins in the heart of the swampy estuarine areas such as at Shekertek and Bedkashi, and the presence of human artefacts and tree stumps, buried in the alluvium many feet below the sea level. There is also an isolated part of Sundarbans (Chakaria Sundarbans) at the mouth of the Matamuhuri river near Cox's Bazar.

Chittagong Coastal Plain:

The coastal plain stretches 121 kilometers from the mouth of the Matamuhuri delta to the Feni River. It comprises gently sloping piedmont plains near the hills, river floodplains alongside the Feni, Karnafuli, Halda and other rivers, tidal floodplains along the lower courses of these rivers, a small area of a young estuarine floodplain in the north, adjoining sub-regional young Meghna estuarine floodplain, and sandy beach ridges adjoining the coast in the south. Sediments near the hills are mainly silty, locally sandy, with clays more extensive in floodplain basins. The whole of the mainland area is subjected to flash floods. Flooding is mainly shallow and fluctuates in depth with the tide (except where this is prevented by river or coastal embankments). The average daily rise in the tide is about two meters. Some soils on tidal and estuarine floodplains become saline in the dry season.

Figure 4-12: Physiography of the project area



Source: Rashid, 1991

4.4.5 Geology

The geology profile of Bangladesh is reflective of the country's location, as Bangladesh is a riverine country. The geological evolution of Bangladesh is related to the uplift of the Himalayan mountains and outbuilding of deltaic landmass by major River systems having their origin in the uplifted Himalayas. This geology is mostly characterized by the rapid subsidence and filling of a basin in which a huge thickness of deltaic sediments was deposited as a mega delta built out and progressed towards the south. The floodplains of the Ganges, the Brahmaputra (Jamuna) and the Meghna Rivers cover approximately 40% of Bangladesh.

The geology of Bangladesh can be divided into three distinct regions, each having distinguishing characteristics of their own:

i. **Stable Precambrian Platform in the North-west** characterized by limited to moderate thickness of sedimentary rocks above a Precambrian igneous and metamorphic basement.

ii. **Geo-Synclinal Basin in the south-east:** Characterized by the huge thickness of clastic sedimentary rocks, mostly sandstone and shale of tertiary age. The basin is further subdivided into two parts, i.e., a fold belt in east and a foredeep to the west. As the intensity of the folding decreases towards the west, the fold belts unit merges with the foredeep unit, which is characterized by only mild or no folding. Therefore, the sedimentary layers are mostly horizontal to sub-horizontal and free from major tectonic deformation in the foredeep area covering the central part of the basin and this is depressed as River to delta plain topography of the land.

iii. Hinge Zone: A 25 km wide northeast-southwest zone that separates the Precambrian platform in the northwest from the geosyncline basin to the southeast. It is also known as the Eocene hinge zone.

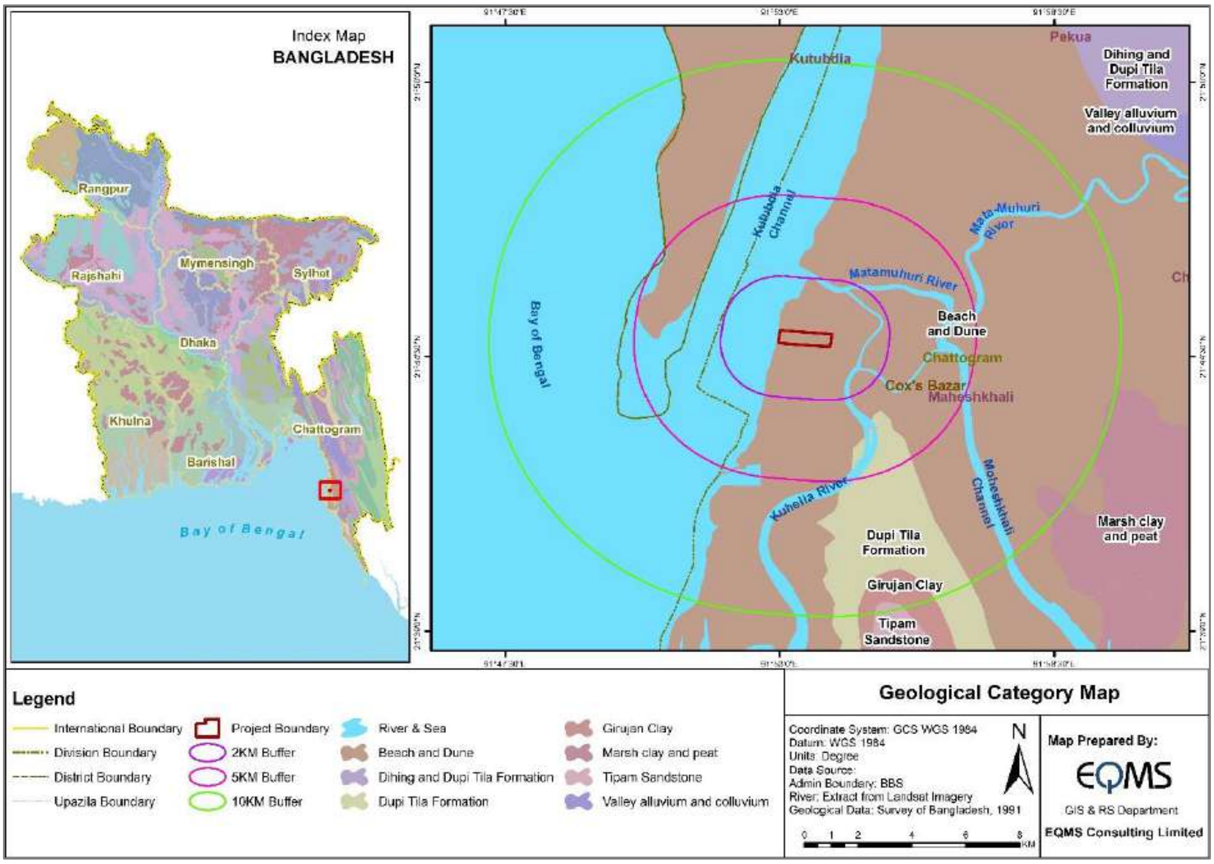
Geology of the Study Area

The geology of the project site area is Beach and dune sand, within 5 km study area Dupi Tila Formation and within 10 km study area Tipam Sandstone, Girujan Clay and Marsh clay and peat geology formations have been found. The geological formations of the project study area shown in **Figure 4-13**.

Beach and Dune Sand:

Light- to whitish-grey sand. Medium to fine, well sorted, surrounded; contains concretions, shell fragments, heavy minerals, and rare clasts. Includes small mud-flat deposits. Unconformably overlies Late Tertiary formations.

Figure 4-13: Geology of the Study Area



Source: GSB, 1991

4.4.6 Soil

Most of the soils within Bangladesh are alluvial (rather than colluvial) in origin and have been deposited over time by the various river networks that drain into the Bay of Bengal. However, this has not created uniformity of soil types and physio-chemical soil characteristics can vary considerably based on factors such as age, relief, biological activity, parent material and anthropogenic influences.

In general, most of the soils within the country, particularly those found within alluvial floodplains, share the following broad characteristics (Brammer, 1996 and Rashid, 1991):

- Moderately fertile to fertile.

- Clay to loam structure (including sandy loams).
- Slightly to moderately acidic; and
- Relatively deep (often around 4 km including underlying shale/sandstone layers)

Another unique characteristic of alluvial soils in Bangladesh is their rapid rate of formation, which is primarily attributed to the significant deposition of sediments as well as warm, humid climate.

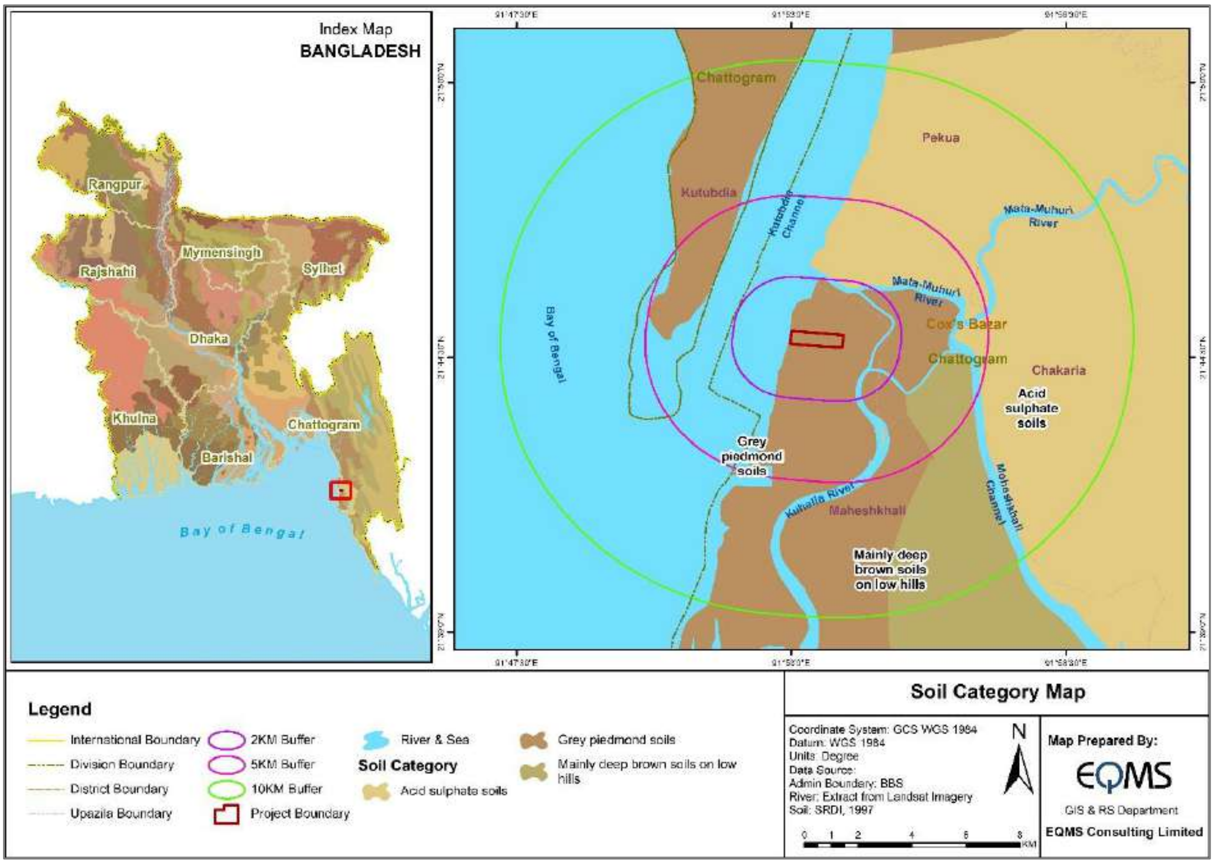
Regarding soil formation, two distinct conditions occur in Bangladesh: alternating seasonal wet or inundated and dry conditions, as prevalent on most of the floodplain areas and intermittently wet or moist or dry conditions, as on the upland areas of hills and terraces. This is due to variation of agro-climatic parameters in different seasons. The soil formation process differs significantly between floodplain, hill and uplifted terrace. The project site falls under the floodplain ranges. The SRDI has identified about 500 soil series in Bangladesh and FAO-UNDP has identified 21 different general soil types based on the diagnostic horizons and diagnostic properties of the soil (FAO-UNDP, 1998).

The project site can be classified as Grey Piedmont soils which are described below. The 10 km buffer area is also classified as the mainly deep brown soils on low hills with Grey Piedmont soils and Acid Sulphate soils which are depicted in **Figure 4-14**.

Grey Piedmont Soils:

These soils occur on alluvial outwash fans at the foot of the northern and eastern hills and locally on the Chittagong coastal plain. Seasonal flooding is shallow, but they are severely affected by occasional flash floods caused by heavy rainfall. The topsoil's have a 5–10-cm thick cultivated layer. They are grey to pale brown when dry and grey to olive-grey when wet. These layers are strongly to extremely acidic when dry, but neutral in reduced condition. The subsoils vary from 15 cm to more than 60 cm in thickness. They are grey with yellow-brown, brown, or red mottles. The structure is prismatic and blocky. The substratum comprises stratified material. Most soils are loamy in texture. They usually are more sandy close to hills, and more silty and clayey on the lower parts of the piedmont slopes. The topsoil usually is lighter in texture than that of the subsoil. The agricultural productivity of these soils is mainly moderate to low. Most soils except sandy ridge soils are much better suited for paddy cultivation than dryland crops. These soils are classified as dystric or eutric gleysols.

Figure 4-14: Soil Category Map of the Study Area



Source: SRDI

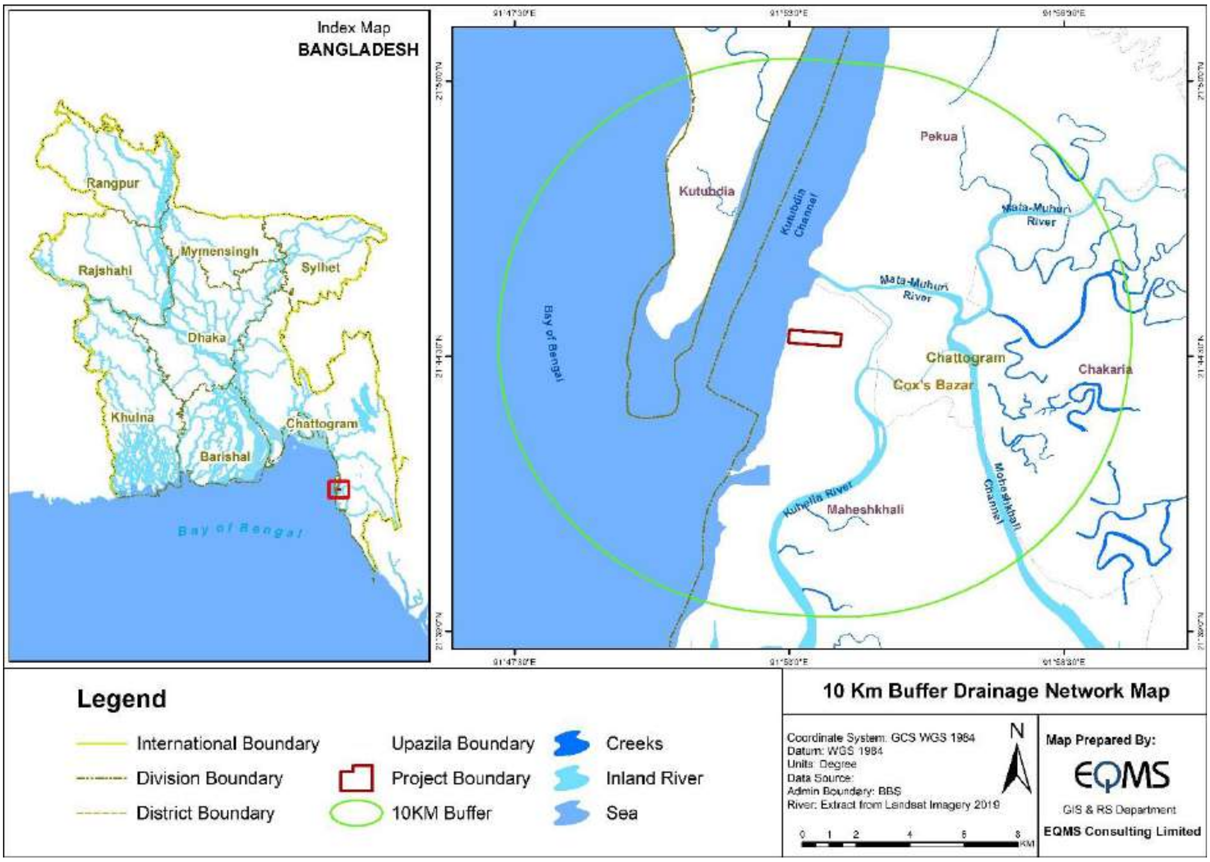
4.4.7 Hydrology and Hydraulics

4.4.7.1 Drainage

The proposed plant site is located near the confluence of Kutubdia channel, Matamuhuri River and the Bay of Bengal. It is also closest to the river Kuhelia and Matamuhuri. They flow into the same sea after confluence. On the northeast side of the plant site Matamuhuri River and Kuhelia River has the tidal river channel, of which the flowage is obviously influenced by the rising and falling tides. The water from the sea pours into the river channel during rising tides, and during lowering tides, the water from the river flows into the sea, which results in an unstable river direction near the plant.

Several freshwater ponds are present within the AOI. Small streams are also present within the AOI which drains into the Kohelia River. Salt marsh are present within the AOI. Salt marshes are coastal wetlands that are flooded and drained by salt water brought in by the tides. They produce marshy texture because the soil may be composed of deep mud and peat. The salt marshes are generally low lying areas. Part of low-lying flat areas within the AOI are used for shrimp cultivation and salt cultivation by allowing sea water influx into the low-lying areas through small channels during tide. As sea water recedes during low tide a part of tide water trapped into low-lying areas due to presence of low embankments in those lands. Some minor channels are present for the intake of water for salt cultivation during the dry season and shrimp cultivation during the monsoon season. The drainage map of the study area is presented in **Figure 4-15.**

Figure 4-15: Drainage Map of the Study Area



Source: EQMS, 2022

4.4.7.2 Hydraulics

Hydraulics is concerned with the flow and conveyance of fluids. The area is characterized by fluviotidal environment with intertidal zone and tidal channel. Tidal current speed at sea during 4th June to 14th June, 2019, the maximum speed was 0.7m/s to 1.0m/s and the minimum speed was about 10cm/s. The direction of tidal current is northeast to southwest and vice versa. Flow speed of river during same period was maximum 0.9m/s and minimum 0.1m/s to 0.3m/s. River flow direction is mostly east to west and vice versa. This reverse flow phenomenon is due to the influence of the sea tide level[12].

As per WTF (Wave, Tidal and Fluvial) diagram, the AOI is part of tide dominated estuary environment. Tide-dominated estuaries contain tidal sand bars at the seaward end, separated from the fluvial zone by relatively fine-grained tidal flats (e.g., salt marshes); fluvial channel deposits exhibit heterolithic characteristics and sometimes tidal-bundle sequences[12].

Dredging of riverbed affects the upstream and downstream flow of tidal river. Dredging of riverbed is a common phenomenon and widely undertaken in Bangladesh. It is occasionally conducted for improving channel navigability and mostly collection of sand/ gravel/soil which are used as construction and filling materials. In Bangladesh every year millions of tons of sand/soil materials are collected through dredging riverbed. Dredging creates unusual depression riverbed, alters the equilibrium profile of the streambed, creating a locally steeper gradient at upstream. Riverbed dredging or in stream mining directly alters the channel geometry and bed elevation i.e. vertical instability of riverbed and lateral

[12] ESIA for the New Imported LNG based Gas-fired combined cycle power plant at Matarbari, Maheshkhali

channel instability. Lateral channel instability causes accelerated stream bank erosion and channel widening[12].

Another determinant of flow and sedimentation in AOI is the sea level rise. Sea level rise can have devastating effects on coastal habitats farther inland, it can cause destructive erosion, wetland flooding, aquifer and agricultural soil contamination with salt, and lost habitat for fish, birds, and plants. Sea level rise is associated with landward movement of shoreline, as a result landward erosion increases. As shoreline move landward, the saline-water and freshwater mixing zone also moves landward. As a result of shoreline movement and more influx sea water due to sea level rise, erosion of the riverbeds also increases rapidly.

4.4.8 Traffic Volume

Assessment of the existing traffic characteristics within the study area was undertaken to evaluate the traffic movement and to identify the best suitable solution for vehicle movement required for material and personnel movement during the project's construction phase.

The current traffic (road and boat) assessment was conducted at two (2) locations in the project AOI, which are connected to the project site. Road traffic survey on the main access road (Maheshkhali-Matarbari road) which will provide connectivity to the project for transportation of manpower and materials. River traffic was conducted at the Bank of Kutubdia Channel. The location details are provided in. The traffic volume was monitored continuously for 24 hours, one time, during the study period.

Table 4-3: Locations of Traffic Survey

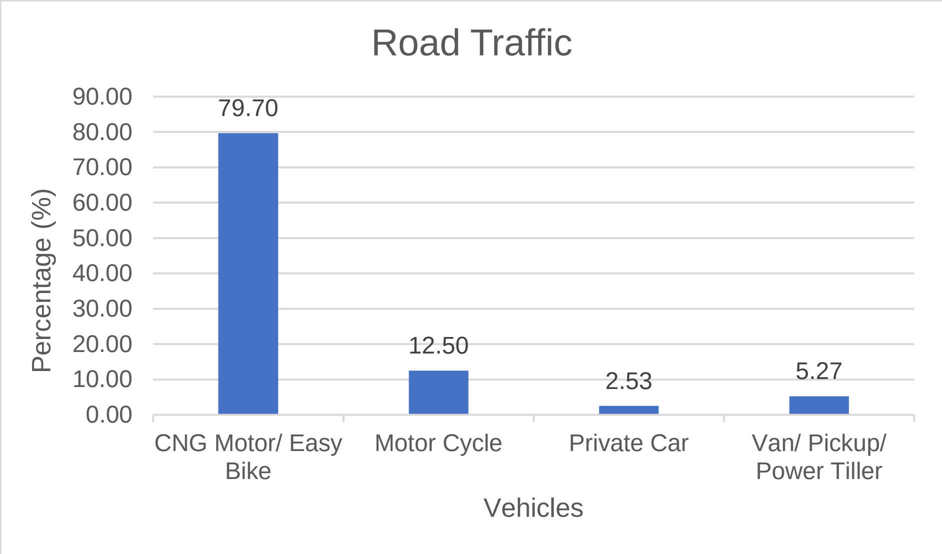
S/N	Survey	Survey Locations	Coordinates	Survey Date
1	Road Traffic	West side of Rajghat bridge (South Rajghat Shah majidia Jame Mosque), Rajghat, Matarbari	21º43'43.5" N 91º54'16.9" E	17.10.2022 to 18.10.2022
2	River Traffic	Near Kankadi Ghuna Mosque at left bank of Kutubdia Channel, Matarbari	21º45'13.5" N 91º53'09.7" E	17.10.2022 to 18.10.2022

Source: Field Survey by EQMS Team, October 2022

4.4.8.1 Road Traffic Survey

The project site can be accessed from Matarbari Road. At this location, the road traffic survey was conducted continuously for 24 hours, one time, during the study period. The road traffic survey was done for both-way movement of vehicles and different types of vehicles were found such as CNG, easy bike, motorcycle, private car, van, pickup, power tiller etc. No rickshaw, bicycle, truck, lorry was found on the road during survey time. A summary of the traffic observed in the study area is given in **Figure 4-16**.

Figure 4-16: Road traffic Observed in the Study Area



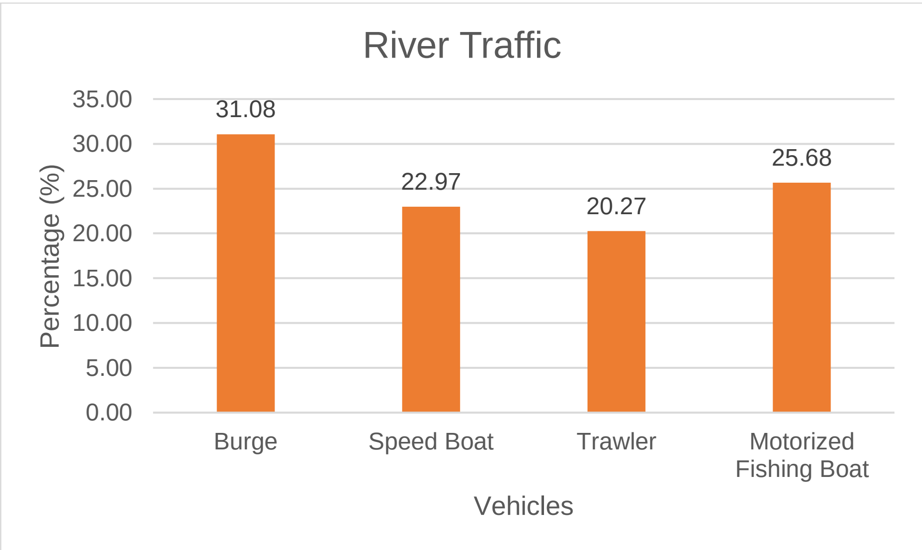
Source: Field Survey by EQMS, October 2022

A total of 3720 vehicles were recorded at the traffic monitoring station. It was noticed that a major contributor (around 80%) of the vehicular traffic was CNG Motor/ Easy Bike followed by Motorcycles (12.50%). Usually, people of the area mostly use CNG/ Easy bike for their transportation purpose. Moreover, the workers of Matarbari Coal Power Plant which is situated at "Sairer Dale" also use easy bikes and CNGs to travel towards their workplace/ residence. Few private cars, Pickup, power tiller was found to pass the road some time, but no rickshaw, bus, truck or lorry was seen on the road during the survey time.

4.4.8.2 River Traffic Survey

The project site can be accessed through Kutubdia Channel. At this location, the river traffic survey was conducted continuously for 24 hours, one time, during the study period. The river traffic survey was done for both-way movement of water vehicles and different types of water vehicles were found such as burge, speed boat, trawler and motorized fishing boats. A summary of the river traffic observed in the study area is given in **Figure 4-17**.

Figure 4-17: River Traffic Observed in the Study Area



Source: Field Survey by EQMS, October 2022

A total of 74 river vehicles were recorded at the traffic monitoring station. It was noticed that a major contributor (around 31%) of the vehicular traffic was Burge followed by Motorized Fishing Boat (25.68%). Usually, the Matarbari Coal Power Plant uses the Burge to bring its heavy materials from different areas through the river. Moreover, local people use motorized fishing boat for capturing fish and also use speed boat and trawler for crossing the river.

4.5 Environmental Quality

4.5.1 Ambient Air Quality

The objective of the ambient air quality monitoring program was to establish the baseline ambient air quality in the study area.

4.5.1.1 Monitoring Parameter

The air quality monitoring parameters were Particulate Matter (SPM, PM_{10} and $PM_{2.5}$), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), Carbon Monoxide (CO).

4.5.1.2 Source of Air Pollution

There is no industry in this area. The Matarbari coal fired power plant is under construction. Agriculture and fishery are the main industry of the Moheshkhali Island. There is no official air quality data for the project area due to the non-availability of a regular air quality-monitoring program. However, the study area resembles a pre-dominantly rural landscape with villages interspersed between homestead plantation, agricultural lands, and salt pan area, which signifies generally good conditions. There are hardly any factories/industries located in the project areas; therefore, air pollution is comparatively less than in other areas of Bangladesh. Generally, air pollution in the project area would be from road dust, black smoke from diesel engines, construction dust, windblown dust from agricultural lands, domestic heating and cooking and brick kilns. The principal source of pollutants in the region is from vehicular traffic which may also be termed as insignificant.

4.5.1.3 Monitoring Location

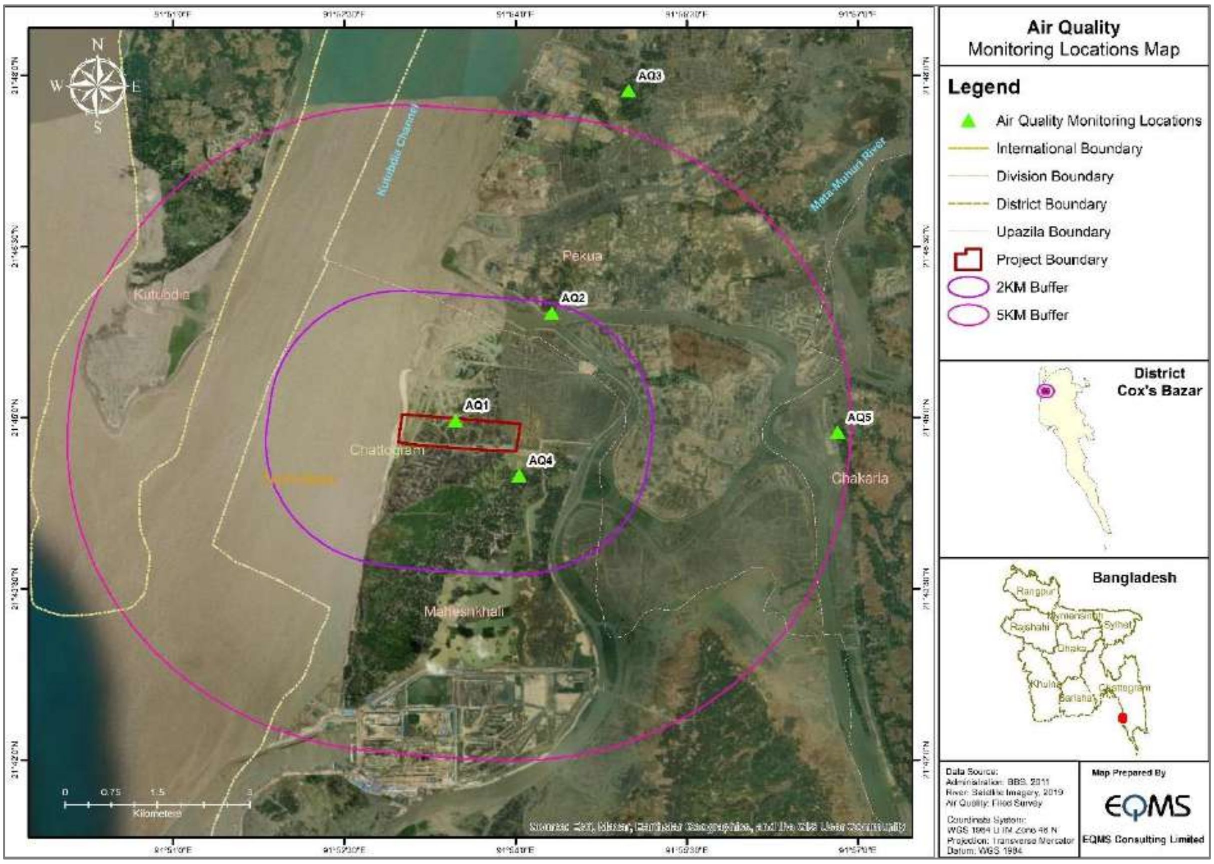
To assess the present air quality of the area, five (5) Ambient Air Quality Monitoring (AAQM) Stations were setup. The air quality monitoring locations were selected based on the locations of settlements and receptors within the study area. Logistical factors such as the consent of villagers, mainly the house owners, power connection, accessibility, security, etc. were also considered in finalizing the monitoring stations. The details of the location of air quality monitoring are presented in **Table 4-4** and **Figure 4-18**. The photographs of ambient air quality monitoring are presented in **Figure 4-19**.

Table 4-4: Ambient Air Quality Monitoring Locations

Code	Monitoring Locations	Coordinates	Distance and direction from the Plant
AAQ-1	Project Site	21º44'51.7" N 91º53'59.2" E	Within the project boundary
AAQ-2	Near West Ujantia Govt: Primary School, Ujantia	21º45'54.5" N 91º54'18.0" E	1.8 km north from project boundary
AAQ-3	Behind Hasem House, Bedarbill Para, New Market, Mognama	21º47'51.2" N 91º54'57.4" E	5.6 km north from project boundary
AAQ-4	Near Anamul Haque House, South Sikdarpara, 2 No: Ward, Matarbari	21º44'30.9" N 91º54'08.2" E	355 m south from project boundary
AAQ-5	Joynal Abedin House, Notun Ghuna Para, 1 No: Ward, Badarkhali	21º44'52.5" N 91º56'50.0" E	4.5 km east from project boundary

Source: EQMS

Figure 4-18: Ambient Air Quality Monitoring Location Map



Source: EQMS, October 2022

Figure 4-19: Photographs of Ambient Air Quality Monitoring

	
AAQ-1: Project Site	AAQ-2: West Ujantia Govt: Primary School, Ujantia
	

AAQ-3: Behind Hasem House, Bedarbill Para, New Market, Mognama	AAQ-4: Near Anamul Haque House, South Sikdarpara, 2 No: Ward, Matarbari

AAQ-5: Joynal Abedin House, Notun Ghuna Para, 1 No: Ward, Badarkhali

Source: EQMS

4.5.1.4 Monitoring Period

Air quality monitoring was conducted in five locations once a week for eight weeks during the monitoring period (October 2022 - January 2023). Total 40 samples have been collected from five locations. During the monitoring period, SPM and CO were monitored for 8 hours whereas PM_{10}, $PM_{2.5}$, SO_2 and NO_2 were monitored for 24-hour to compare with the standard.

4.5.1.5 Monitoring Method

Sampling and analysis of ambient air quality were conducted by referring to the recommendation of the United States Environmental Protection Agency (USEPA). The Haz-Scanner (HIM-6000) Environmental Perimeter Air Station (EPAS) was used to collect ambient air monitoring data. Sampling rate or air quality data were measured automatically every one minute and directly read and recorded onsite for measured parameters (SO_2, NO_2, CO, SPM, PM_{10}, $PM_{2.5}$) as shown in **Table 4-5**. Sampling pump was operated at 2 L/min. Different analysis methods are integrated in the instrument, such as Particulates 90° Infrared Light Scattering for particulate matters (SPM, PM_{10}, $PM_{2.5}$) and electrochemical sensors for toxic gases (NO_2, SO_2 and CO).

Table 4-5: Sampling and Analysis Method for Air Quality

Parameter	Methods of Testing	Sensors
Suspended Particulate Matter (SPM)	On-Site Recording	Light Scattering Technique
Particulate Matter 10 (PM_{10})	On-Site Recording	Light Scattering Technique
Particulate Matter 2.5 ($PM_{2.5}$)	On-Site Recording	Light Scattering Technique
Nitrogen dioxide (NO_2)	On-Site Recording	High Sensitivity Electrochemical
Sulfur dioxide (SO_2)	On-Site Recording	High Sensitivity Electrochemical
Carbon monoxide (CO)	On-Site Recording	High Sensitivity Electrochemical

4.5.1.6 Ambient Air Quality Monitoring Results

The air quality survey results obtained every minute at each monitoring site were combined to make 8 hourly and daily average values (24 hours) for further evaluation and comparison with corresponding National Ambient Air Quality Standards (NAAQS). Eight weeks data have been calculated and presented as maximum, minimum and average for wet and dry seasons. The summary of the ambient air quality results is presented in **Table 4-6**.

Table 4-6: Summary of Ambient Air Quality Monitoring Results

Location	Season	Observed	Concentration in (µg/m³)					
			SPM*	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO*
AQ1	Wet (October 2022)	Maximum	57.0	27.3	19.0	6.8	10.2	130.0
		Minimum	50.3	23.0	16.5	5.6	9.2	123.0
		Average	53.7	25.2	17.8	6.2	9.7	126.5
	Dry (Dec 22-Jan 23)	Maximum	80.3	34.7	25.6	11.2	14.5	118.0
		Minimum	56.0	22.6	16.5	6.1	9.5	80.0
		Average	69.6	28.9	20.4	7.7	11.7	93.8
AQ2	Wet (October 2022)	Maximum	67.2	32.7	19.0	9.8	15.2	110.0
		Minimum	59.0	24.0	18.8	8.3	12.4	110.0
		Average	63.1	28.4	18.9	9.1	13.8	110.0
	Dry (Dec 22-Jan 23)	Maximum	93.0	42.3	31.5	13.5	17.6	380.0
		Minimum	60.9	25.0	19.9	7.9	12.6	85.0
		Average	81.3	37.3	25.6	10.3	15.3	139.3
AQ3	Wet (October 2022)	Maximum	68.2	30.8	20.1	11.6	17.8	100.0
		Minimum	59.7	24.8	18.9	9.8	14.2	74.0
		Average	64.0	27.8	19.5	10.7	16.0	87.0
	Dry (Dec 22-Jan 23)	Maximum	92.8	39.7	29.3	12.8	18.7	110.0
		Minimum	73.9	30.1	20.6	8.5	12.3	83.0
		Average	84.5	34.9	26.1	10.5	16.1	97.2
AQ4	Wet (October 2022)	Maximum	66.9	30	20.2	8.7	16.7	80.0
		Minimum	64.2	27.2	19	7.9	13.4	65.0
		Average	65.55	28.6	19.6	8.3	15.05	72.5
	Dry (Dec 22-Jan 23)	Maximum	90.4	40.5	29.8	9.8	14.6	110.0
		Minimum	59.5	23.0	19.9	5.8	10.2	80.0
		Average	75.9	34.2	23.1	7.8	12.2	89.2
AQ5	Wet (October 2022)	Maximum	68.1	30.6	19.5	9.6	16.1	106.0
		Minimum	55.5	22	18.7	6.7	11.9	97.0
		Average	61.8	26.3	19.1	8.15	14	101.5
	Dry (Dec 22-Jan 23)	Maximum	92.4	44.5	32.8	12.4	18.7	153.0
		Minimum	62.8	27.2	17.8	7.4	9.5	64.0
		Average	77.3	35.5	24.3	9.9	15.6	108.3
Standards								
Bangladesh**	**8-hourly**		**200**	**-**	**-**	**-**	**-**	**5000**
	24-hourly		**-**	**150**	**65**	**80**	**80**	**-**
	Annual		**-**	**50**	**35**	**-**	**40**	**-**
WHO***	**24-hourly**		**-**	**45**	**15**	**40**	**25**	**4**
	Annual		**-**	**15**	**5**	**-**	**10**	**-**

Source: Field Measurement and Laboratory Analysis by EQMS, October 2022 and January 2023

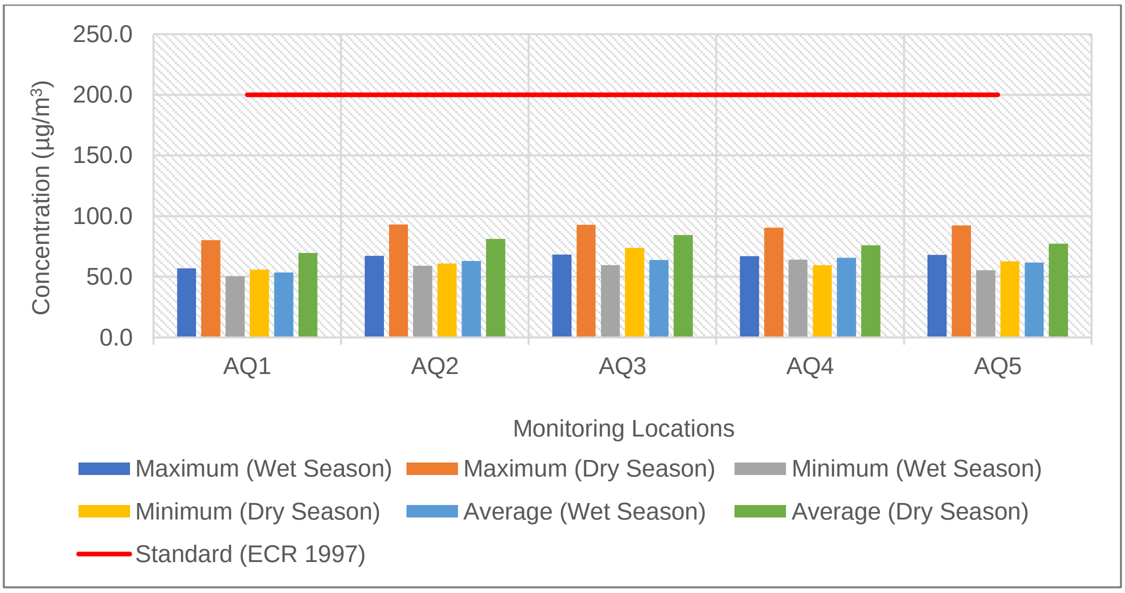
Note: SPM standard taken from ECR 1997, amendment in 2005
* SPM and CO concentrations and standards are 8-hourly only.
** The Bangladesh National Ambient Air Quality Standards have been taken from the Air Pollution Control Rules 2022
*** WHO Ambient Air Quality Guideline Values 2021

4.5.1.7 Result Analysis

Suspended Particulate Matter (SPM): SPM (8 hrs calculation) concentrations in the monitoring locations was found from 50.3 µg/m³ (AAQ1) to 68.2 µg/m³ (AAQ3) in wet season (October) and 56.0

µg/m³ (AAQ1) to 93.0 µg/m³ (AAQ2) in dry season (December-January). Average concentration of SPM was reported in the range of 53.7 – 65.6 µg/m³ during wet season whereas 69.6 µg/m³ – 84.5 µg/m³ during dry season. The SPM concentration found within the standard (200 µg/m³-8 hourly average) of ECR 1997 (amendment 2005) at all monitoring locations. The maximum SPM concentration was found at west Ujantia primary school (AAQ2) as 93.0 µg/m³ in dry season. SPM at this location is primarily due to road and water traffic. The suspended particulate matters were found higher in dry season than winter season. The result is shown in **Figure 4-20**.

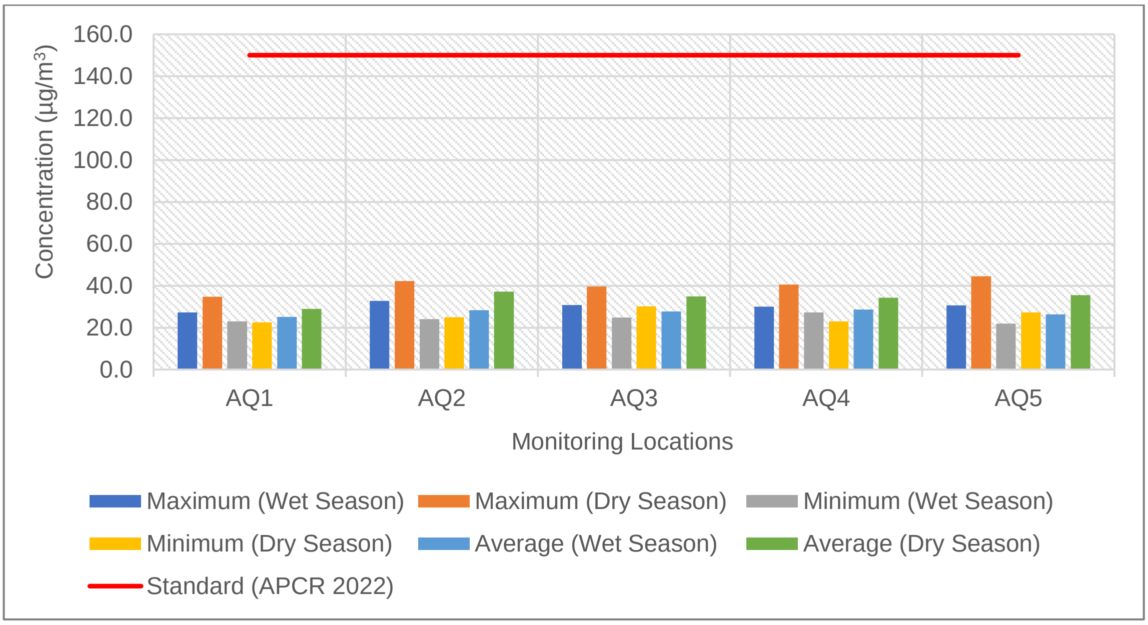
Figure 4-20: SPM Concentration in the Study Area



Source: Monitoring and analysis in wet season (October 22) and dry season (December 22 & January-2023)

Particulate Matter (PM_{10}): PM_{10} (24 hrs calculation) concentrations in the monitoring locations was found from 22.0 µg/m³ (AQ5) to 32.7 µg/m³ (AQ2) in wet season (October) and 22.6 µg/m³ (AQ1) to 44.5 µg/m³ (AQ5) in dry season (December-January) which are within the national ambient air quality standard-NAAQS (150 µg/m³-24 hourly average). The average PM_{10} concentration varies between 25.2 µg/m³- 28.6 µg/m³ in wet season and 28.9 µg/m³ –37.3 µg/m³ in dry season. The particulate matters (PM_{10}) were found higher in dry season than winter season. The result is shown in **Figure 4-21**.

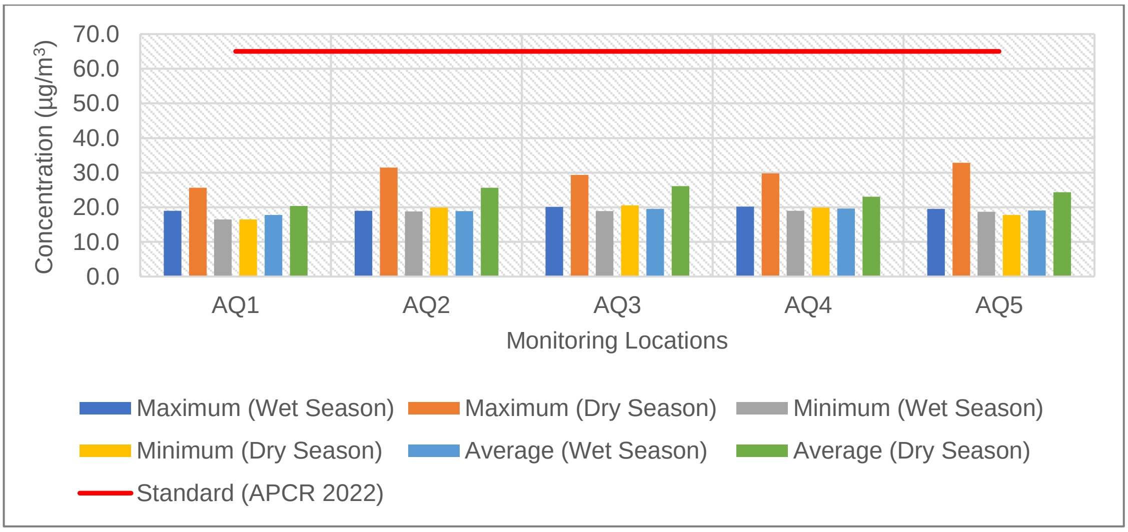
Figure 4-21: PM_{10} Concentration in the Study Area



Source: Monitoring and analysis in wet season (October 22) and dry season (December 22 & January-2023)

Particulate Matter ($PM_{2.5}$): Minimum and Maximum $PM_{2.5}$ (24hrs) concentrations in the monitoring locations were found from 16.5 µg/m^3 (AQ1) to 20.2 µg/m^3 (AQ4) in wet season and 16.5 µg/m^3 (AQ1) to 32.8 µg/m^3 (AQ5) in dry season. The average $PM_{2.5}$ concentrations were found between 17.8 µg/m^3- 19.6 µg/m^3 in wet season whereas it was 20.4 µg/m^3 –25.6 µg/m^3 in dry season. The $PM_{2.5}$ concentration was within the NAAQS (65 µg/m^3-24 hourly average) in all the monitoring locations. The $PM_{2.5}$ concentration in the study area is presented in **Figure 4-22**.

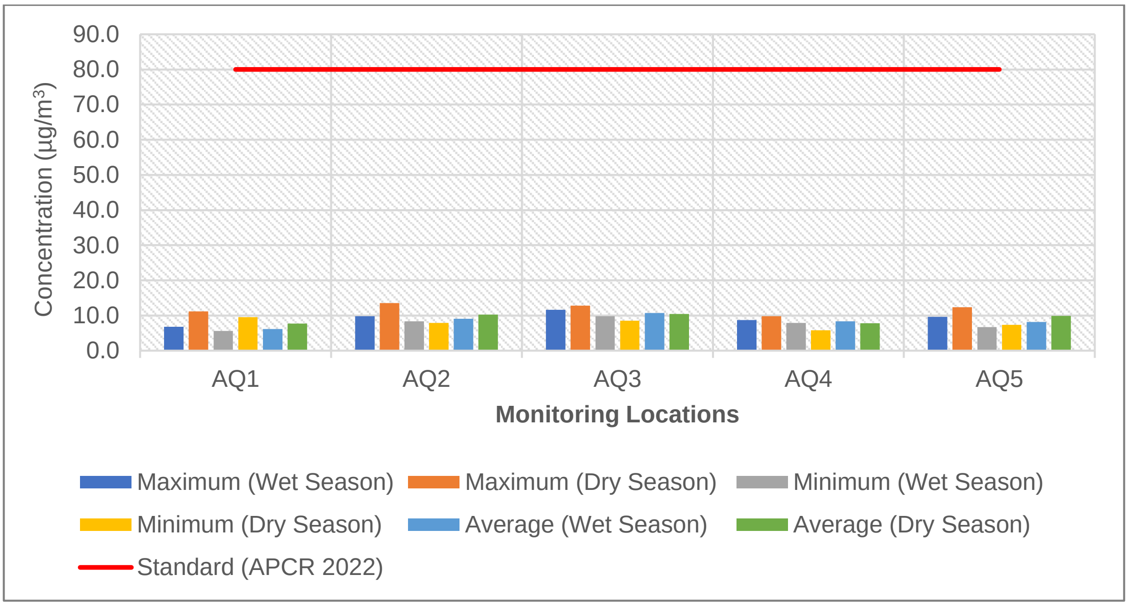
Figure 4-22: $PM_{2.5}$ Concentration in the Study Area



Source: Monitoring and analysis in wet season (October 22) and dry season (December 22 & January-2023)

Sulphur Di-oxide (SO_2): The maximum and minimum concentration of SO_2 at the monitoring locations ranged from 5.6 µg/m^3 (AQ1) to 11.6 µg/m^3 (AQ3) during wet season whereas it was found 5.8 µg/m^3 (AQ4) to 13.5 µg/m^3 (AQ2) which are within the range of NAAQS (80 µg/m^3-24 hourly average). The average SO_2 concentrations were found in the range of 6.2 µg/m^3- 10.7 µg/m^3 during wet season and 7.7 µg/m^3 –10.5 µg/m^3 in dry season. SO_2 was found slightly higher in dry season compared to wet season. The SO_2 concentration in the study area is given in **Figure 4-23**.

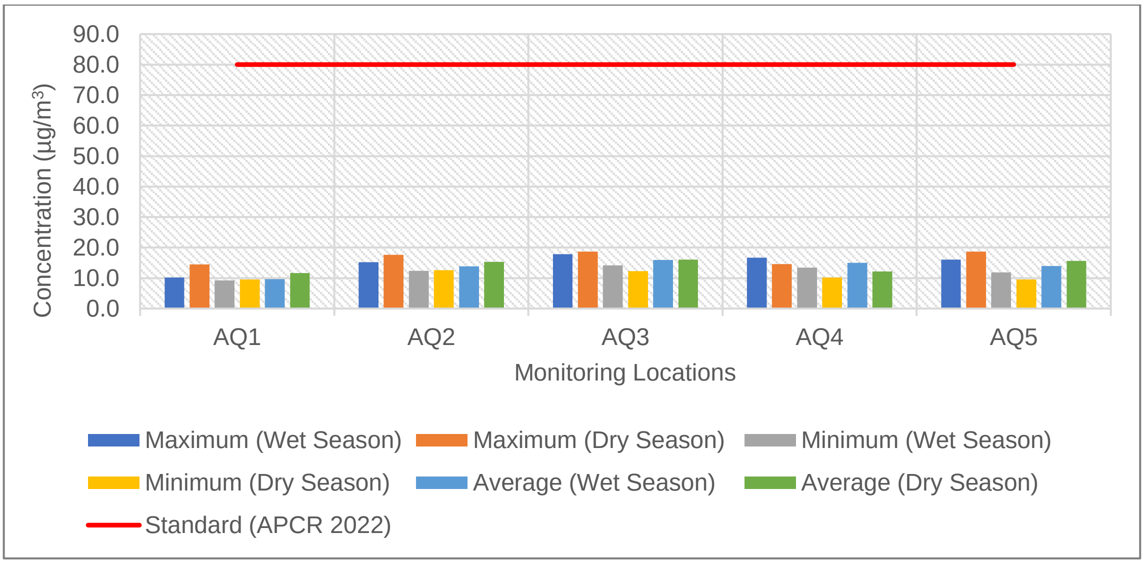
Figure 4-23: SO_2 Concentration in the Study Area



Source: Monitoring and analysis in wet season (October 22) and dry season (December 22 & January-2023)

Nitrogen di Oxide (NO_2): The concentration of NO_2 in the monitoring locations were found from 9.2 µg/m³ (AQ1) to 17.8 µg/m³ (AQ3) in wet season and 9.5 µg/m³ (AQ1) to 18.7 µg/m³ (AQ3) which are within the value of NAAQS (80 µg/m³-24-hour average). Average NO_2 concentration were found between 9.7 µg/m³- 16.0 µg/m³ in wet season and 11.7 µg/m³ –16.1 µg/m³ in dry season. The NO_2 concentration was higher during the dry period. The NO_2 concentration of the study area is shown in **Figure 4-24**.

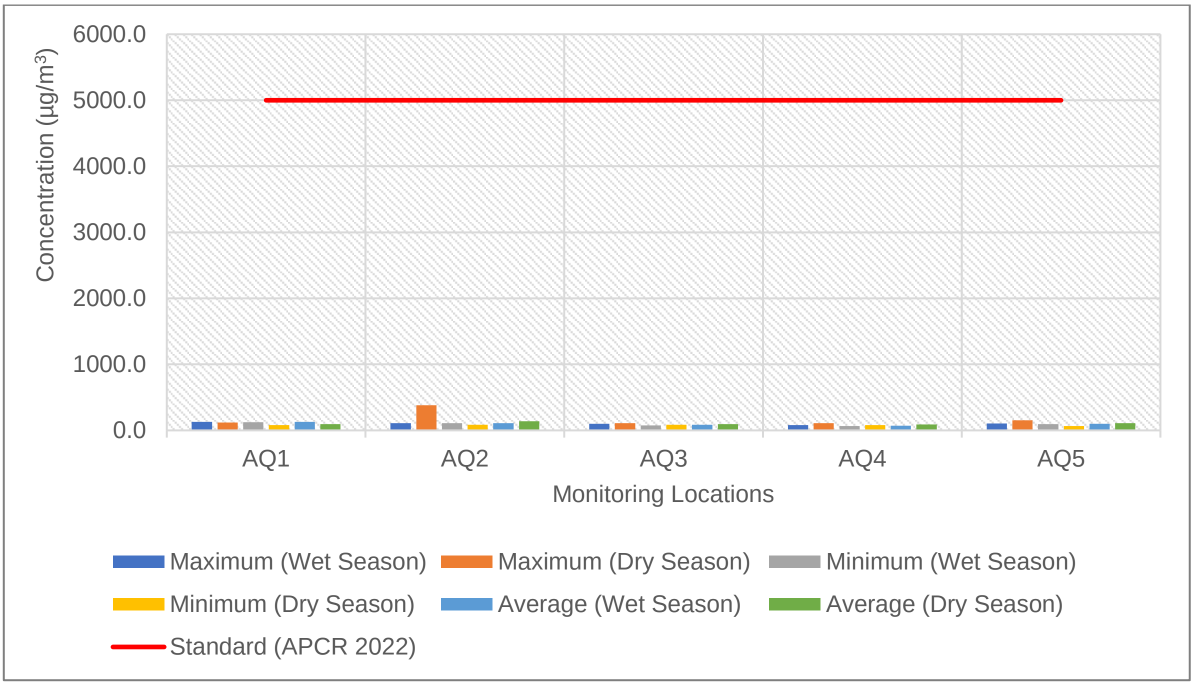
Figure 4-24: NO_2 Concentration in the Study Area



Source: Monitoring and analysis in wet season (October 22) and dry season (December 22 & January-2023)

Carbon Mono-oxide (CO): The 8 hourly maximum and minimum concentration of CO in the monitoring locations was found 65.0 µg/m³ (AQ4) to 130.0 µg/m³ (AQ1) in wet season whereas it was 64.0 µg/m³ (AQ5) to 380.0 µg/m³ (AQ2) in dry season which is covered the value of NAAQS (5000 µg/m³-8 hourly average). The result of CO concentration of the study area is shown in **Figure 4-25**.

Figure 4-25: CO Concentration in the Study Area



Source: Monitoring and analysis in wet season (October 22) and dry season (December 22 & January-2023)

4.5.2 Ambient Noise Quality

The purpose of ambient noise level measurement was to determine sound intensity at the monitoring locations. These locations are chosen in such way that a representative data could be recorded all over the block.

4.5.2.1 Sampling Methodology

Noise level measurement data were collected during both day and night-time for 24- hours with 1- min interval. Digital sound level meter Tekoplus was used for the measurement of noise level. It was mounted on a tripod at 1.5m above ground level and at least 3.5m away from any sound-reflecting surfaces. The sound level meter was calibrated before the noise monitoring survey. Noise levels were recorded as sound pressure levels with the help of a digital sound level meter. The purpose of ambient noise level measurement was to determine sound intensity at the monitoring locations. These locations were chosen to record representative data all over the project site. The sound level is recorded as A-weighted equivalent continuous sound pressure level values using A-weighting filters in the noise measuring instrument. The measurements were calculated by dividing 24 hours into two parts, i.e., daytime, which is considered from 0600 to 2100 hours and night from 2100 to 0600 hours. At each location, daytime Leq has been computed from the hourly sound pressure level values measured between 0600 to 2100 hours and nighttime Leq has been computed between 2100 to 0600 hours.

4.5.2.2 Ambient Noise Monitoring Locations

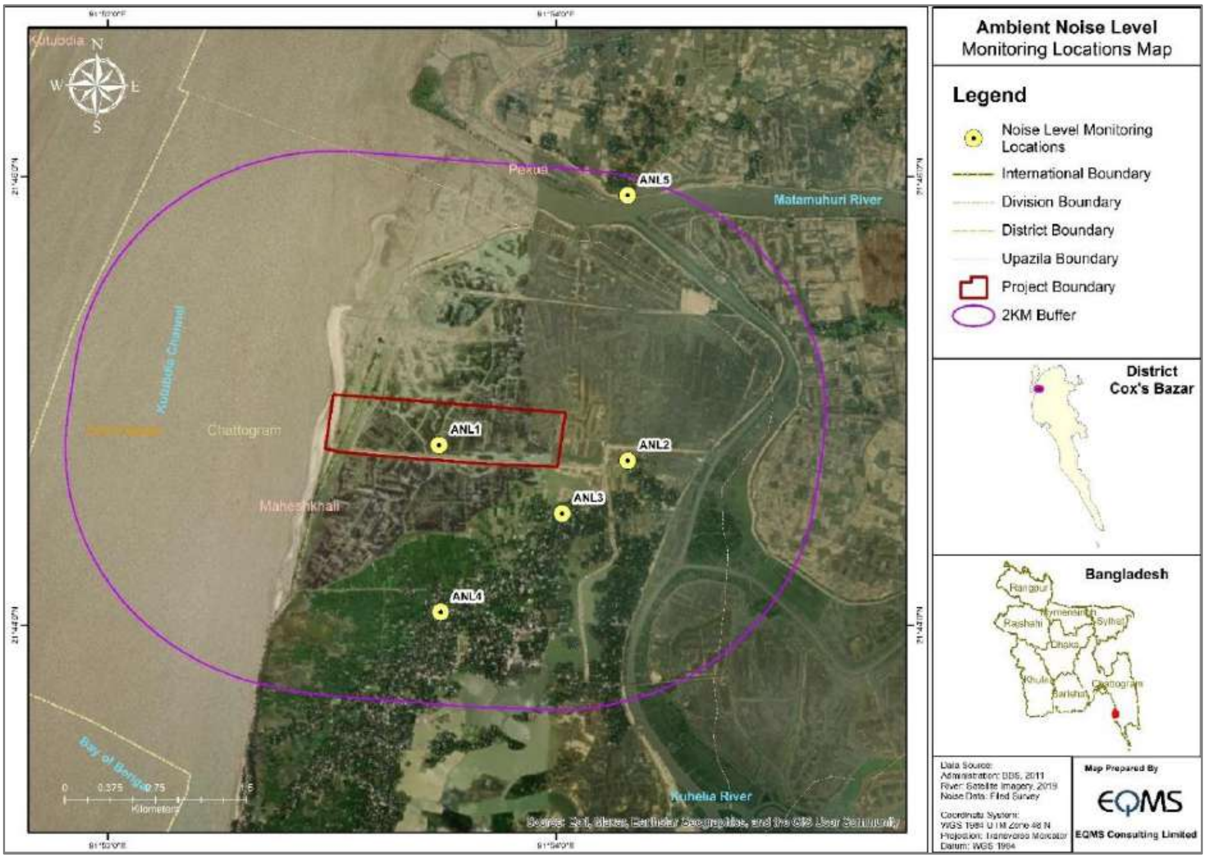
Noise levels were recorded at five (5) locations in the study area during the monitoring period. The details of noise monitoring locations are presented in **Table 4-7** and depicted in **Figure 4-26**. The photographs of ambient air quality monitoring are presented in **Figure 4-27**.

Table 4-7: Ambient Noise Monitoring Locations

Code	Location	GPS Coordinate	Distance and Direction from project boundary	Monitoring Date
NL-1	Project Site	21º44'44.8" N 91º53'58.9" E	Within the project site	17-10-2022
NL-2	Near Aminullah House, Baniakata, 2 no. Ward, Matarbari	21º44'44.3" N 91º54'19.5" E	530 meters east	16-10-2022
NL-3	Near Anamul Haque House, South Sikdarpara, 2 no. Ward, Matarbari	21º44'30.9" N 91º54'08.2" E	380 meters south	16-10-2022
NL-4	Near Fokir Miyazee Jame Mosque, Miyazeepara, Matarbari	21º44'00.7" N 91º53'33.4" E	1.23 km south	17-10-2022
NL-5	Near West Ujantia Govt: Primary School, Ujantia	21°45'54.38"N 91°54'18.98"E	1.90 km north	17-10-2022

Source: Field Survey by EQMS Team, October 2022

Figure 4-26: Ambient Noise Monitoring Location Map



Source: Field Survey by EQMS Team, October 2022

Figure 4-27: Photographs of Ambient Noise Monitoring

ANL-1: Project Site

ANL-2: Near Aminullah House, Baniakata, 2NO: Ward, Matarbari

ANL-3: Near Anamul Haque House, South Sikdarpara, 2 no: Ward, Matarbari

ANL-4: Near Fokir Miyazee Jame Mosque, Miyazeepara, Matarbari

ANL-5: Near West Ujantia Govt: Primary School, Ujantia

Source: Field Survey by EQMS Team, October 2022

4.5.2.3 Ambient Noise Monitoring Results

The recorded noise levels in the study area are summarized in **Table 4-8**. The equivalent sound pressure level (Leq) during day and nighttime measured is also presented in **Figure 4-28**.

Table 4-8: Ambient Noise Level in the Study Area

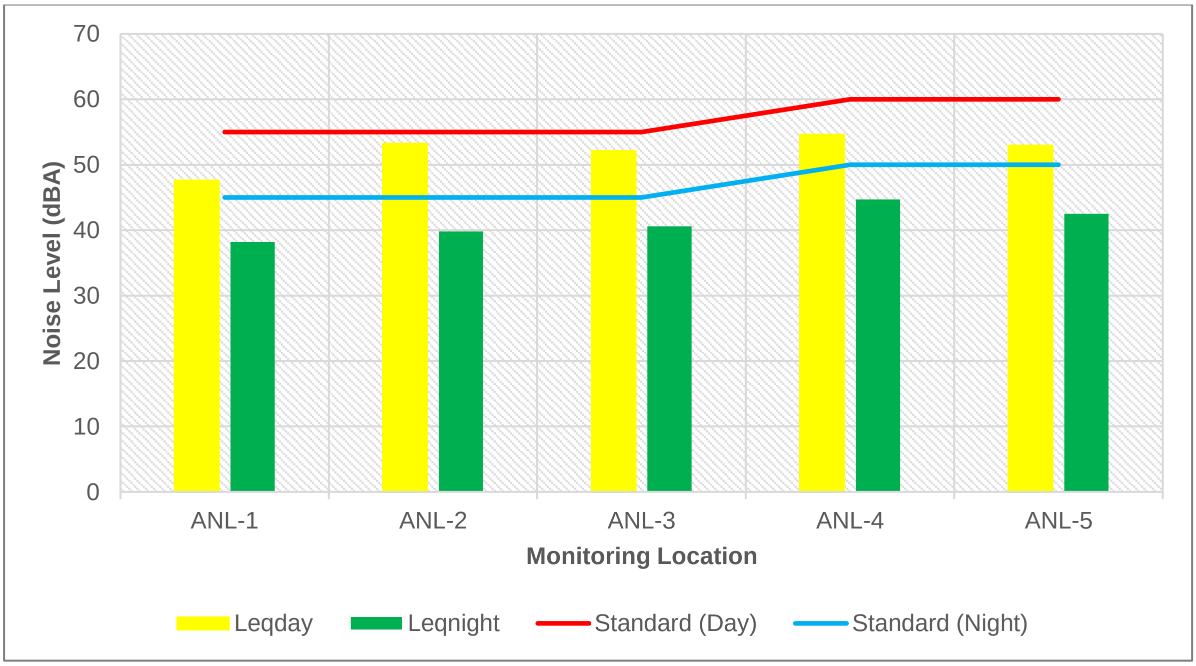
Location	Noise Level in dB(A)				Location Setting	Bangladesh Standard*	
	Leq_{day}	Leq_{night}	L_{max}	L_{min}		Day	Night
ANL-1	47.6	38.2	65.1	30.5	Open Field	55	45
ANL-2	53.2	39.8	72.5	31.3	Residential Area	55	45
ANL-3	52.1	40.6	75.7	33.6	Residential Area	55	45

Location	Noise Level in dB(A)				Location Setting	Bangladesh Standard*	
	Leq_{day}	Leq_{night}	L_{max}	L_{min}		Day	Night
ANL-4	54.6	44.7	79.6	36.8	Mixed Area	60	50
ANL-5	52.9	42.5	74.9	31.9	Mixed Area	60	50

Source: Field Survey by EQMS Team, October 2022

Note: Time from 0600 hrs to 2100 hrs is counted as daytime and from 2100 hrs to 0600 hrs is counted as nighttime.
*Noise Pollution Control Rules 2006

Figure 4-28: Noise Levels Recorded in the Study Area



Source: Filed monitoring, October 2022

Ambient daytime noise level (Leq_{day}) was recorded in the range of 47.6 to 54.6 dB (A). In contrast, the study area's ambient nighttime noise levels (Leq_{night}) varied from 38.2 to 44.7 dB (A). Maximum noise levels (L_{max}) at the monitoring locations were recorded in the range of 65.1 to 79.6 dB (A), and the minimum noise levels (L_{min}) at the monitoring locations were recorded in the range of 30.5 to 36.8 dB (A). The highest and lowest noise level was recorded at 79.6 dBA and 30.5 dBA at ANL4 and ANL1 respectively. The noise levels of all the location have found below the Noise Pollution Control Rules, 2006 Standards.

4.5.3 Water Quality

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

4.5.3.1 Methodology

Surface water samples were collected as grab water samples in a standard sampling bottle and 1000 ml sterilized clean PET bottle for complete physicochemical and bacteriological tests respectively. The samples were analyzed as per standard procedure/method given in Standard Method for Examination of Water and Wastewater Edition 20, published by APHA. Details of the analysis method and protocol for the surface water and groundwater are presented in **Table 4-9**.

Table 4-9: Analysis Method for Water Samples

Parameter	Unit	Test Method
Aluminum	mg/L	Aluminon Method
Ammonia	mg/L	D1426-92 Nessler Method
Arsenic	mg/L	Modified Gutzeit method
Barium	mg/L	Graphite Furnace AAS
Benzene	mg/L	Chromatographic Method
Biological Oxygen Demand (BOD_5)	mg/L	5 days incubation
Boron	mg/L	UVS
Cadmium	mg/L	AAS
Calcium	mg/L	Colorimetric Method
Chloride	mg/L	mercury (II) thiocyanate Method
Chlorine (residual)	mg/L	Photometric method
Chloroform	mg/L	Graphite Furnace AAS
Chromium (hexavalent)	mg/L	Diphenylcarbohydrazide
Chromium (total)	mg/L	Photometric method
COD	mg/L	USEPA 410.4 Approved Method
Fecal Coliform (FC)	n/100	AFNOR approved method
Total Coliform (TC)	n/100	AFNOR approved method
Colour	Hazen	Adaptation of the Standard
Copper	mg/L	Bicinchoninate Method
DO	mg/L	Ion Electrode method
Fluoride	mg/L	Photometric ion selective method
Hardness (as CaCo3)	mg/L	Titrimetric Method
Iron (Fe)	mg/L	Phhenantroline Method
Kjeldahl Nitrogen (total)	mg/L	Spectroscopic Method
Lead	mg/L	AAS
Magnesium	mg/L	Photometric method
Mercury	mg/L	AAS
Nickel	mg/L	AAS
Nitrate	mg/L	Cadmium Reduction
Nitrite	mg/L	Photometric method
Odour	--	2150 B. Threshold Odor Test
Oil & Grease	mg/L	Gravimetric Method

Parameter	Unit	Test Method
pH	--	Ion electrode method
Phosphate	mg/L	Amino acid method
Phosphorus	mg/L	Amino acid Method
Potassium	mg/L	Turbidimetric Method
Selenium	mg/L	Graphite Furnace AAS
Silver	mg/L	Graphite Furnace AAS
Sodium	mg/L	Flame Photometer
Suspended Particulate Matters	ppm	Dry and filtration
Sulfide	mg/L	Spectrophotometric Method
Sulfate	mg/L	Turbidimetric Method
TDS	ppm	Ion electrode method
Temperature	ºC	Ion electrode method
Tin	mg/L	AAS
Turbidity	NTU	Turbidimetric Photoelectric Method

The quality of surface water was compared with the standards for Inland Surface Water, Environment Conservation Rules (ECR), 2023-Schedule A (1) whereas the groundwater was compared with the Drinking Water Standard ECR, 2023 - Schedule 2 (B). The standards have been presented along with the monitoring results of surface and groundwater for comparison.

4.5.3.2 Surface Water Quality

The objective of the surface water sampling was to understand the baseline surface water quality characteristics of the surface water in the study area. Major surface-water parameters are Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), pH, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Total Coliform (TC), Fecal Coliform (FC), and Oil and Grease (O&G).

4.5.3.2.1 Surface Water Sampling Locations

The surface water sampling was based on the identification of major surface water bodies such as the Kutubdia Channel and upstream and downstream of Kuhelia River and Matamuhuri River adjacent to the project site. Surface water samples were collected from six (6) locations from the surface water sources during monitoring period (October 2022). Details of the surface water quality monitoring locations are presented in **Table 4-10** and **Figure 4-29**. The photographs of surface water quality monitoring are presented in **Figure 4-30**.

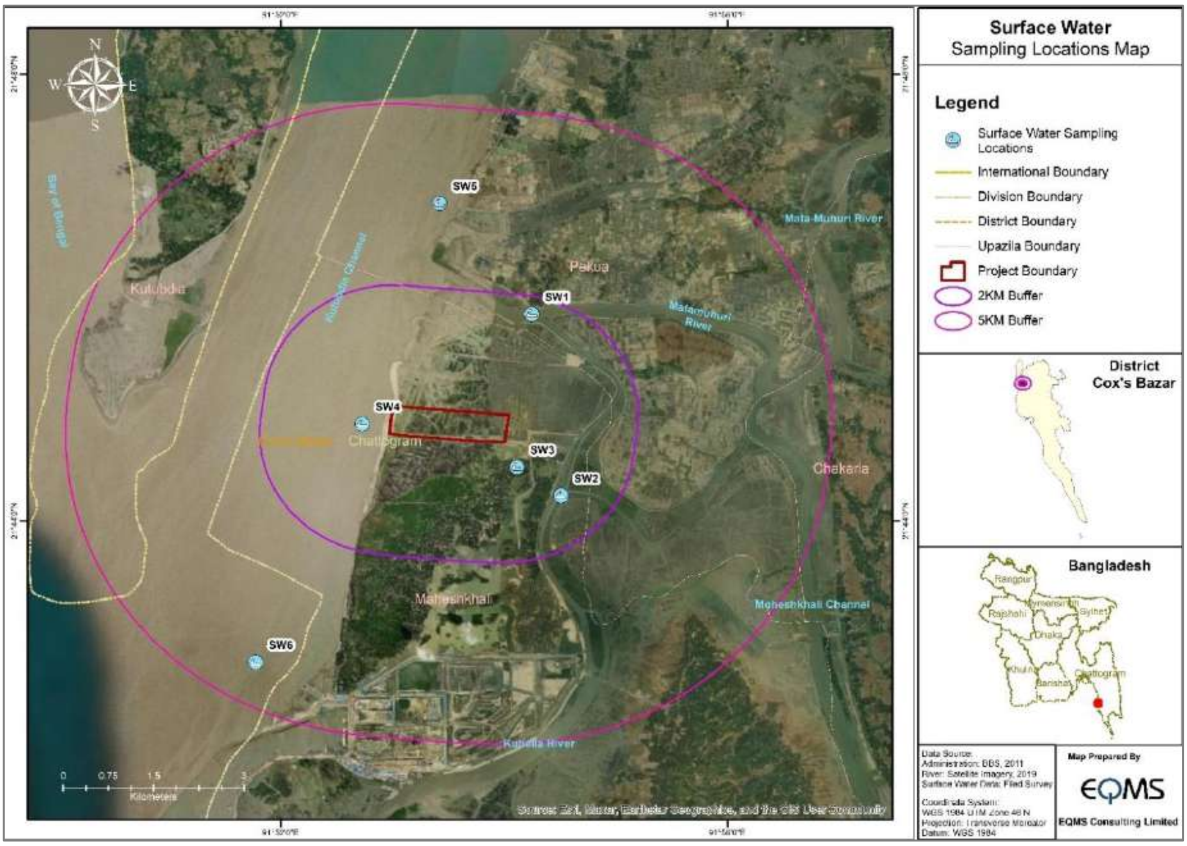
Table 4-10: Surface Water Sampling Location

Code	Location	GPS Coordinate	Sampling Date
SWQ-1	Ujantia Ghat, Matamuhuri River	21º45'50.5" N 91º54'15.6" E	18.10.2022
SWQ-2	Sadar Khal, Matamuhuri River	21º44'14.0" N 91º54'31.3" E	18.10.2022
SWQ-3	Misbah Uddin House Pond, Sikdarpar, Matarbari	21º44'28.7" N 91º54'07.5" E	20.10.2022

Code	Location	GPS Coordinate	Sampling Date
SWQ-4	Near proposed water discharge point, Kutubdia Channel	21º45'02.9" N 91º52'40.5" E	18.10.2022
SWQ-5	Upstream of Kutubdia Channel	21º46'54.2" N 91º53'26.7" E	18.10.2022
SWQ-6	Downstream of water intake point, Kutubdia Channel	21º43'07.3" N 91º52'04.5" E	18.10.2022

Source: Field Survey by EQMS Team, October 2022

Figure 4-29: Surface Water Sampling Location Map



Source: Field Survey by EQMS Team, October 2022

Figure 4-30: Photographs of Surface Water Sampling

	
SWQ-1: Ujantia Ghat, Matamuhuri River	SWQ-2: Sadar Khal, Matamuhuri River

	
SWQ-3: Misbah Uddin House Pond, Sikdarpar, Matarbari	SWQ-4: Near proposed water discharge point, Kutubdia Channel
	
SWQ-5: Upstream of Kutubdia Channel	SWQ-6: Downstream of water Intake point, Bay of Bengal

Source: Field Survey by EQMS Team, October 2022

4.5.3.2.2 Result Analysis

The surface water analyzed result were compared to ECR, 2023- schedule 2 A (1). Results of inland surface water analysis are presented in **Table 4-11**.

Table 4-11: Surface Water Analysis Result

Parameters	Unit	Concentration						Bangladesh Standard[13]					
								Conservation		Recreation		Fisheries	Industry
		SWQ-1	SWQ-2	SWQ-3	SWQ-4	SWQ-5	SWQ-6	Coral Community	Natural Area	Direct contact	Secondary contact	Aquaculture & Shellfish Culture	Industry & Others
Ammonia	mg/L	0.24	0.27	0.35	0.15	0.20	0.21	-	-	-	-	-	-
Arsenic (As)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.001		-	-	0.003	0.003
Biological Oxygen Demand (BOD_5)	mg/L	1.0	1.1	3.8	1.2	1.3	1.2	-	-	-	-	-	-
Cadmium (Cd)	mg/L	0.0026	0.001	0.0001	0.0002	0.00015	0.00017	0.005		-	-	0.005	0.005
Chemical Oxygen Demand (COD)	mg/L	11	14	24	11	9	13	2	8	-	-	5	5
Chloride (Cl)	mg/L	2300	2400	2400	2800	4500	5100	-	-	-	-	-	-
Chromium (total)	mg/L	0.53	0.62	<0.01	0.05	0.025	0.030	-	-	-	-	-	-
Coliform (Fecal)	n/100ml	4	6	900	4	6	4	200	200	200	1000	200	-
Coliform (Total)	n/100ml	8	10	3000	8	11	10	1000	1000	1000	5000	1000	-
Color	PCU	15	17	82	20	19	17	-	-	-	-	-	-
Copper (Cu)	mg/L	0.04	0.02	0.04	<0.01	<0.01	<0.01	-	-	-	-	-	-
Dissolved Oxygen (DO)	mg/L	6.1	6.1	5.8	6.0	6.1	6.0	≥5	≥5	-	-	≥5	≥4

[13] Bangladesh Environment Conservation Rules, 2023- Schedule 2 (Standards for Inland Surface Water).

Parameters	Unit	Concentration						Bangladesh Standard[13]					
								Conservation		Recreation		Fisheries	Industry
		SWQ-1	SWQ-2	SWQ-3	SWQ-4	SWQ-5	SWQ-6	Coral Community	Natural Area	Direct contact	Secondary contact	Aquaculture & Shellfish Culture	Industry & Others
Electric Conductivity	µS/cm	6670	1148	4490	28600	17730	3140	-	-	-	-	-	-
Fluoride	mg/L	1.9	2.0	1.7	1.8	2.0	2.1	-	-	-	-	-	-
Iron (Fe)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-
Lead (Pb)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05		-	-	0.05	-
Manganese (Mn)	mg/L	0.04	0.03	<0.01	0.04	0.03	0.04	-	-	-	-	-	-
Mercury (Hg)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0001		-	-	0.0001	0.0001
Nickel (Ni)	mg/L	0.008	0.001	0.001	0.05	0.05	0.05	-	-	-	-	-	-
Nitrate	mg/L	2.2	1.7	1.9	3.8	3.2	3.5	-	-	-	-	-	-
Odor	TON	O/L	O/L	Slight Odorous	O/L	O/L	O/L	-	-	-	-	-	-
Oil & Grease	mg/L	1.13	1.01	2.37	0.9	0.8	0.7	0.01		-	-	0.14	5.0
pH	-	7.45	7.84	7.67	8.01	8.27	8.30	7.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-9.0
Phosphate	mg/L	4.1	0.4	0.6	1.4	3.1	2.6	0.04	0.05	0.08	0.08	0.08	0.1
Potassium	mg/L	600	610	1950	625	630	650	-	-	-	-	-	-
Sulphate	mg/L	950	900	124	955	900	1000	-	-	-	-	-	-
Temperature	ºC	28.3	28.4	28.3	28.2	28.5	28.5	-	-	-	-	-	-
Total Alkalinity	mg/L	91	96	76	81	76	77	-	-	-	-	-	-
Total Dissolved Solid (TDS)	mg/L	3340	5720	2250	14300	8860	1570	1000	1000	1000	1000	1000	1000
Total Hardness	mg/L	540	570	300	540	546	549	-	-	-	-	-	-

Parameters	Unit	Concentration						Bangladesh Standard[13]					
								Conservation		Recreation		Fisheries	Industry
		SWQ-1	SWQ-2	SWQ-3	SWQ-4	SWQ-5	SWQ-6	Coral Community	Natural Area	Direct contact	Secondary contact	Aquaculture & Shellfish Culture	Industry & Others
Total Suspended Solid (TSS)	mg/L	108	117	121	121	128	121	2	25	5	10	50	100
Turbidity	NTU	4.1	4.0	5.2	4.1	4.2	4.2	-	-	-	-	-	-
Zinc (Zn)	mg/L	0.05	0.08	0.03	0.09	0.07	0.08	-	-	-	-	-	-

Source: Analysed by EQMS Laboratory, November 2022

Note: O/L- Odorless

Interpretation of Surface Water Quality

The analysis results show that the pH ranges from 7.45 to 8.30. pH is higher in marine water compared to inland water. pH values are under the specified standard (6.5 to 9.0) for all categories of coastal water quality. The temperatures of the surface water samples were observed in the ranges of 28.2°C to 28.5°C in the month of October.

The Dissolved Oxygen (DO) levels at all locations exhibited values of 5.8 mg/L to 6.1 mg/L indicating favorable conditions for the growth and reproduction of fish and other aquatic organisms in the water.

Biochemical Oxygen Demand (BOD) values of the samples were found to be ranging from 1.0 mg/L to 3.8 mg/L. It indicates good water quality and favourable for fisheries. Chemical Oxygen Demand (COD) values of the samples vary from 9.0 mg/L to 24.0 mg/L. The highest COD level was found in the pond water (SW3). The COD level is higher than the coastal water quality standard (2 mg/l to 8 mg/l).

Coliforms are indicators of contamination from sewage and fecal matter. Fecal coliform was found in the range of 4-9000 n/100 mL and the total coliform contents of all the samples were found to be 8-3000 n/100mL. Fecal and total coliform were found higher in the pond water than the standard.

The electric conductivity of water sample collected ranges from 1148 µS/cm to 28600 µS/cm. The Total Dissolved Solids (TDS) of the samples were found in between 2250.0 mg/L and 14300.0 mg/L which are higher than the standard. TSS were found in the range of 117-128 mg/L which exceeds the coastal water quality standard. The concentration of alkalinity in surface water samples was found to be ranging from 76 mg/L to 96 mg/L. Total hardness contents in the samples were found to be ranging from 300-570 mg/L. The Turbidity was found to be ranging from 4.0 NTU to 5.2 NTU.

The nitrate concentration ranges between 1.7 mg/L to 3.8 mg/L. Nitrate concentration found higher in marine water. Chloride concentrations in all surface water samples were found to be ranging from 2300 mg/L to 5100 mg/L. The values of sulphate in the collected sample ranges from 124 mg/L to 1000 mg/L.

The concentration of Phosphate and Potassium in the surface water samples were found to be 0.4 mg/L to 3.1 mg/L and 600-1950 mg/L respectively. Phosphate level is higher than the standard.

Arsenic concentrations were found below <0.005 mg/L. Cadmium found in all water samples in the range of 0.0001-0.0026 mg/L. Chromium (total), Copper, Manganese were found in the range of <0.01-0.62 mg/L, <0.01-0.04 mg/L and <0.01-0.04 mg/L respectively. Nickel and Zinc were found to be 0.001-0.05 mg/L and 0.03-0.09 mg/L respectively. Total chromium was found higher in SW1 and SW2. Iron, Lead and Mercury contents in all surface water samples were found to be below detection limits.

Oil and grease concentrations were found to be 0.7-2.37 mg/L. Oil and grease concentrations were found higher in pond water (SW3) compared to the other water samples. The oil and grease level is well within the limit to use for industry and other uses as per ECR 2023-Schedule 2 (b).

4.5.3.3 Groundwater Quality

The objective of the ground water sampling was to understand the baseline ground water quality characteristics of the ground water in the study area. Ground -water parameters are like Temperature, Alkalinity, Arsenic, Cadmium, Boron, Calcium, Chloride, Chromium, Conductivity, Fluoride, Iron, Lead, Mercury, pH, Total Dissolved Solids (TDS), Total Hardness, Sodium, Potassium, Salinity, Phosphorus, Total Coliform (TC), Fecal Coliform (FC), and Oil and Grease etc.

4.5.3.3.1 Groundwater Sampling Locations

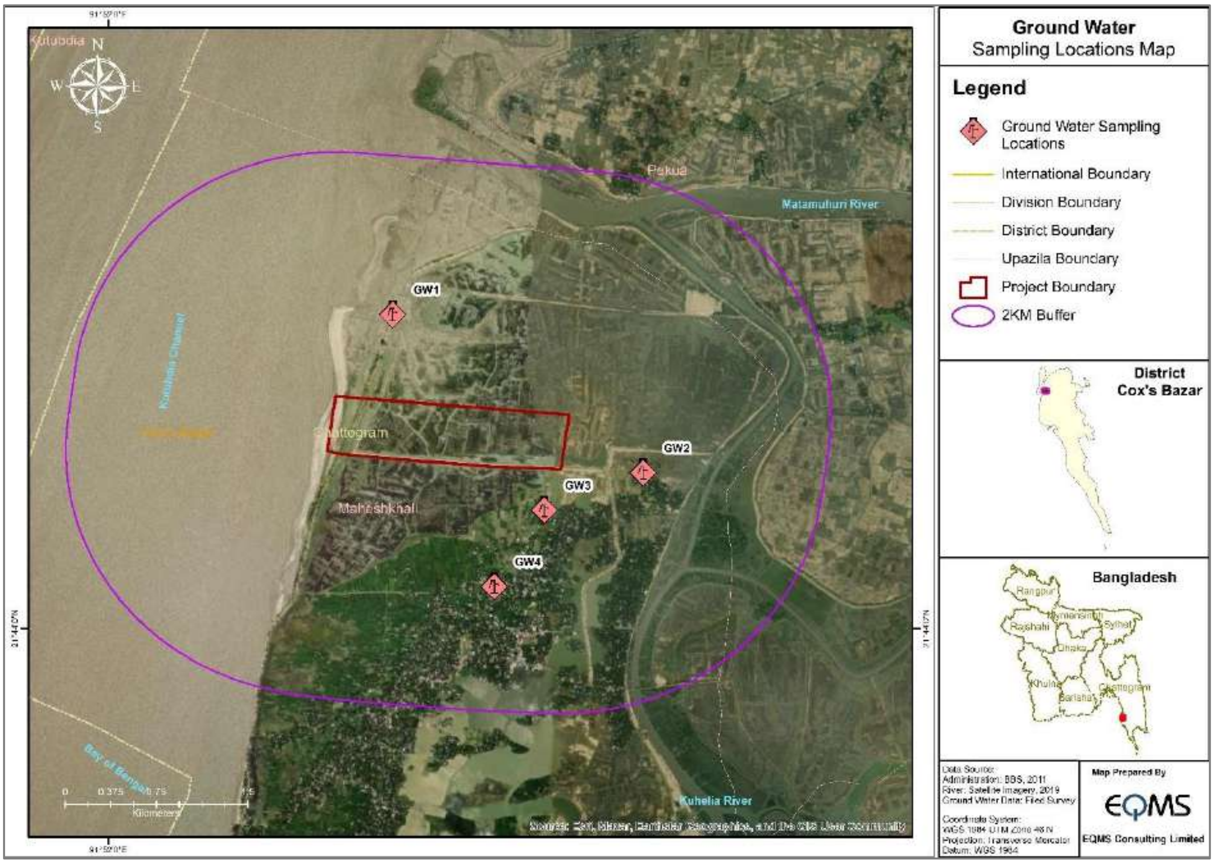
Ground water samples were collected from four (4) representative selected groundwater sources close to the project site during monitoring period (October 2022). Details of the ground water quality monitoring locations are depicted in **Table 4-12** and **Figure 4-31**. The photographs of surface water quality monitoring are presented in **Figure 4-32**.

Table 4-12: Groundwater Sampling Location

Code	Location	GPS Coordinate	Sampling Date
GWQ-1	Kankadi Ghuna Jame Mosque, Matarbari	21º45'23.8" N 91º53'15.9" E	20.10.2022
GWQ-2	Nadir Hossain House, Banti Shikdarpara, Matarbari	21º44'41.2" N 91º54'22.0" E	20.10.2022
GWQ-3	Abu Taher House, South Sikdarpara, Matarbari	21º44'31.4" N 91º53'58.4" E	20.10.2022
GWQ-4	Monhajipara Jame Mosque, Monhajipara, 4 No: Ward, Matarbari	21º44'10.2" N 91º53'43.4" E	20.10.2022

Source: Field Survey by EQMS Team, October 2022

Figure 4-31: Groundwater Sampling Location Map



Source: Field Survey by EQMS Team, October 2022

Figure 4-32: Photographs of Groundwater Sampling

GWQ-1: Kankadi Ghuna Jame Mosque, Matarbari

GWQ-2: In Front of Nadir Hossain House, Banti Shikdarpara, Matarbari

GQW-3: Behind the Abu Taher House, South Sikdarpara, Matarbari

GWQ-4: Monhajipara Jame Mosque, Monhajipara, 4 No: Ward, Matarbari

Source: Field Survey by EQMS Team, October 2022

4.5.3.3.2 Result Analysis

Analytical results from the groundwater sample test are presented in **Table 4-13**.

Table 4-13: Groundwater Analysis Results

Parameters	Unit	Groundwater Quality				
		GWQ-1	GWQ-2	GWQ-3	GWQ-4	Bangladesh Standard[14]
Aluminum	mg/L	0.01	<0.001	<0.001	0.01	0.2
Ammonia	mg/L	<0.001	<0.001	<0.001	<0.001	1.5
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001	0.05
Barium	mg/L	<0.001	<0.001	<0.001	<0.001	0.7
Benzene	mg/L	<0.001	<0.001	<0.001	<0.001	0.01

[14] Bangladesh Environment Conservation Rules, 2023, Schedule-2 (b).

Parameters	Unit	Groundwater Quality				
		GWQ-1	GWQ-2	GWQ-3	GWQ-4	Bangladesh Standard[14]
Biological Oxygen Demand (BOD_5)	mg/L	0.1	0.1	0.1	0.1	0.2
Boron	mg/L	0.2	0.2	0.4	0.1	1.0
Cadmium	mg/L	<0.001	<0.001	<0.001	<0.001	0.003
Calcium	mg/L	21	17	29	22	75
Chloride	mg/L	<0.02	<0.02	<0.02	<0.02	250
Chlorine (residual)	mg/L	<0.001	<0.001	<0.001	<0.001	0.2
Chloroform	mg/L	<0.001	<0.001	<0.001	<0.001	0.09
Chromium (hexavalent)	mg/L	0.001	0.001	0.001	0.001	-
Chromium (total)	mg/L	<0.001	<0.001	<0.001	<0.001	0.05
COD	mg/L	BDL	BDL	BDL	BDL	-
Coliform (Fecal)	N/100	0	0	0	0	0
Coliform (Total)	N/100	0	0	0	0	0
Color	Hazen	8	8	3	2	15
Copper	mg/L	0.02	0.01	0.02	0.03	1.5
Dissolved Oxygen (DO)	mg/L	5.0	5.2	5.4	5.1	-
Electrical Conductivity (EC)	µS/cm	360	380	360	350	-
Fluoride	mg/L	0.4	0.2	0.1	0.3	1.0
Hardness (as $CaCO_3$)	mg/L	57	54	55	51	500
Iron (Fe)	mg/L	0.01	0.01	0.01	0.02	0.3-1.0
Kjeldahl Nitrogen (total)	mg/L	0.2	0.1	0.2	0.4	1.0
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	0.01
Magnesium	mg/L	4	7	8	1	30-35
Mercury	mg/L	<0.001	<0.001	<0.001	<0.001	0.001
Nickel	mg/L	<0.001	<0.001	<0.001	<0.001	0.05
Nitrate	mg/L	1.1	1.0	1.2	1.0	45
Nitrite	mg/L	0.4	0.3	0.1	0.2	1.0
Odour	--	Odorless	Odorless	Odorless	Odorless	Odorless
Oil & Grease	mg/L	<0.001	<0.001	<0.001	<0.001	0.01
pH	--	8.06	7.83	7.85	7.90	6.5 – 8.5
Phosphate	mg/L	0.9	0.4	0.5	0.4	-
Phosphorus	mg/L	<0.001	<0.001	<0.001	<0.001	-
Potassium	mg/L	11.1	7.8	8.1	10.2	12
Selenium	mg/L	<0.001	<0.001	<0.001	<0.001	0.01
Silver	mg/L	<0.001	<0.001	<0.001	<0.001	0.02

Parameters	Unit	Groundwater Quality				
		GWQ-1	GWQ-2	GWQ-3	GWQ-4	Bangladesh Standard[14]
Sodium	mg/L	18.4	11.2	13.6	9.8	200
Suspended Particulate Matters	mg/L	4	5	6	3	10
Sulfide	mg/L	<0.001	<0.001	<0.001	<0.001	0.05
Sulfate	mg/L	2.0	2.1	2.1	2.0	250
Total Dissolved Solid (TDS)	mg/L	180	190	180	180	1000
Total Hardness	mg/L	57	54	57	51	-
Total Alkalinity	mg/L	41	38	40	35	-
Temperature	ºC	29.4	28.5	28.6	28.7	20-30
Turbidity	NTU	0.02	0.05	0.03	0.02	5.0
Zinc	mg/L	0.01	0.01	0.02	0.02	5.0

Source: Analysed by EQMS Laboratory, November 2022

Note: BDL- Below Detection Limit

<u>Interpretation of Groundwater Quality</u>

The analysis results show that the Aluminum ranges from <0.001 to 0.01 which is within the standard of ECR 2023 (Schedule 2 b). Ammonia, Arsenic, Barium and Benzene were found below detection limit in all ground water samples.

Biological Oxygen Demand (BOD_5) values were found to be 0.1 mg/L in all samples. Boron ranges 0.1-0.4 mg/L in analysed samples which is within the limit. Calcium values were found in the range of 17-29 mg/L and Chloride was found <0.02 mg/L. Chloride (residual), Chloroform and COD were found below detection limit.

Both fecal and total coliform were absent in the samples. Copper values were found to be in range 0.01-0.03 mg/L. Dissolved Oxygen ranges from 5.0-5.4 mg/L. EC were found between 350-380 µS/cm.

Fluoride and hardness were found in the range of 0.1-0.4 mg/L and 51- 57 mg/L respectively. Iron concentrations were found within the standard value. Kjeldahl Nitrogen (total) and Magnesium concentrations were found in the range from 0.1-0.4 mg/L and 1-8 mg/L respectively. Nitrate and Nitrite values were found in the range from 1.0-1.2 mg/L and 0.1-0.4 mg/L respectively. Oil and grease were found below detection limit.

pH concentrations were found in the range of 7.83-8.06. pH values found under the specified standard of 6.5 to 8.5. Phosphate and Potassium values were found in between 0.4-0.9 mg/L and 7.8-11.1 mg/L respectively. Phosphorous, Selenium and Sulfide were found below detection limit. Sodium and Sulfate ranged 9.8-18.4 mg/L and 2.0-2.1 mg/L respectively.

Suspended Particulate Matter were found to be 3-6 mg/L whereas Total Dissolved Solid (TDS) were found in the range of 180-190 mg/L. Both the parameters value was found within the permissible limit.

Total hardness and Total Alkalinity were found in between 51-57 mg/L and 35-41 mg/L. The temperatures of the ground water samples were observed in the ranges of 28.5°C to 29.4°C in the month of October.

Turbidity was found to be ranging from 0.02 NTU to 0.05 NTU. Oil and grease were found below detection limit.

Heavy metal (Cadmium, Chromium, Lead, Mercury, Nickel, Silver) were found below detection limit (<0.001 mg/L) in all ground water samples.

All parameters' value were found within the standard stipulated in ECR 2023 (Schedule-2). It can be concluded that the ground water of the project area is good in quality.

4.5.4 Soil Quality

Soil quality is the ability of a soil to perform functions that are essential to people and the environment. Soils support plant growth, recycle dead material, regulate, and filter water flows, support buildings and roads, and provide habitat for many plants and animals. Depending on the land use, many of these functions occur simultaneously. Soil quality assessments go beyond measuring degradation (erosion, compaction, or contamination) to focus on these soil functions and the processes that create them.

The SRDI has identified about 500 soil series in Bangladesh and FAO-UNDP has identified 21 different general soil types based on the diagnostic horizons and diagnostic properties of the soil (FAO-UNDP, 1998). According to the classification three types of soil class; Grey Piedmont soils, Acid sulphate soils and mainly deep brown soils on low hills are found within the 10 km buffer area of the project site.

4.5.4.1 Sampling Methodology

The soil sampling strategy was designed to assess the existing soil quality over the study area. A composite sampling was used for soil sampling from each location. Soil samples were collected using tools from a depth of 45 cm from the topsoil surface. At each location, soil samples were collected from three spots and homogenized. The homogenized samples were collected following quartering technique and then packed in polythene plastic jars and sealed. The sealed samples were sent to the laboratory for analysis. The soil samples were analyzed for physical and chemical characteristics including minerals, heavy metals and trace elements.

4.5.4.2 Soil Sampling Locations

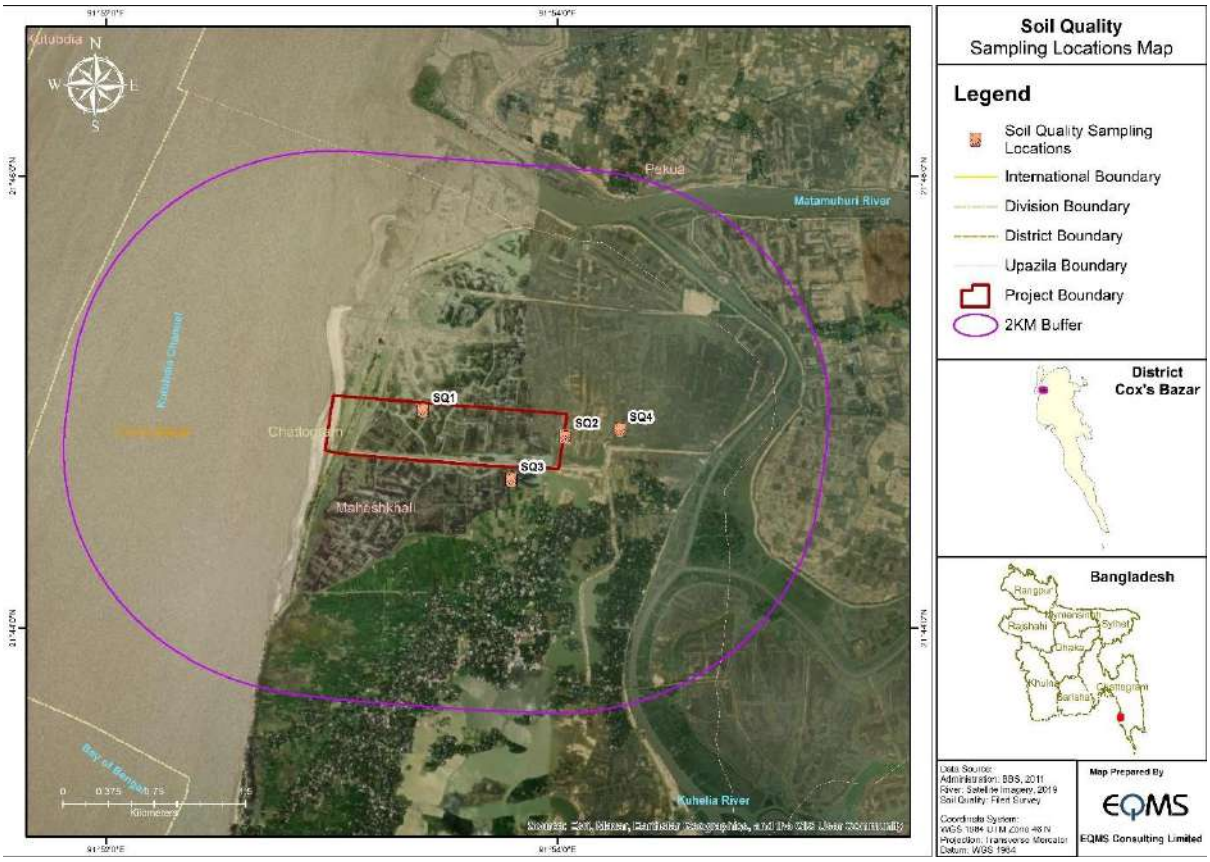
Soil samples were collected from four (4) different representative locations adjacent to the project site. The details of the sampling location are presented in Table 4-14 and Figure 4-33. The photographs of soil sampling are presented in Figure 4-34.

Table 4-14: Soil Sampling Locations

Code	Location	GPS Coordinate	Sampling Date
SQ-1	North-West Corner of Project Site	21º45'01.4" N 91º53'12.7" E	20.10.2022
SQ-2	Middle East of the Project Site	21º44'53.0" N 91º54'01.8" E	20.10.2022
SQ-3	South Side of the Project boundary	21º44'38.8" N 91º53'47.4" E	20.10.2022
SQ-4	East Side of the Project boundary	21º44'38.6" N 91º54'21.6" E	20.10.2022

Source: Field Survey by EQMS Team, October 2022

Figure 4-33: Soil Sampling Location Map



Source: Field Survey by EQMS Team, October 2022

Figure 4-34: Photographs of Soil Sampling

	
SQ-1: North-West Corner of Project Site	SQ-2: Middle East of the Project Site

SQ-3: South Side of the Project Boundary

SQ-4: East Side of the Project Boundary

Source: Field Survey by EQMS Team, October 2022

4.5.4.2.1 Result Analysis

Results of soil quality analysis are presented in **Table 4-15**.

Table 4-15: Analysis Result of Soil Sample

Parameter	Unit	SQ-1	SQ-2	SQ-3	SQ-4
Boron	ppm	1.32	1.15	0.63	1.12
Bulk Density	gcm^{-3}	1.05	1.14	1.13	1.24
Cadmium (Cd)	ppm	Nil	Nil	Nil	Nil
Calcium (Ca)	meq /100g soil	2.32	2.45	2.68	2.85
Carbonate	ppm	0.0012	0.0015	0.00	0.00
Cation Exchange Capacity	%	0.357	0.295	0.252	0.278
Chloride	ppm	5720.5	5231.2	3214.6	6173.4
Copper (Cu)	ppm	0.21	0.28	0.27	0.46
Electrical Conductivity	DS/m	6.1	4.7	4.4	6.3
Iron (Fe)	ppm	54.35	58.27	84.60	125.32
Lead (Pb)	ppm	Nil	Nil	Nil	Nil
Manganese (Mg)	meq /100g soil	0.82	0.90	0.85	1.05
Mercury (Hg)	ppm	Nil	Nil	Nil	Nil
Moisture Content	%	2.1	2.3	2.6	2.4
Organic Carbon	%	0.84	0.87	1.2	1.7
pH	-	4.7	5.2	5.0	5.9
Particle Size Distribution	%	Sand: 5.9 Silt: 64.3 Clay: 29.8	Sand: 5.3 Silt: 65.5 Clay: 29.2	Sand: 3.2 Silt: 61.8 Clay: 35	Sand: 11.3 Silt: 63.2 Clay: 25.5
Permeability	cm/hour	0.21	0.18	0.32	0.25
Phosphorous	ppm	3.20	3.35	2.90	2.75
Porosity	%	58.50	59.58	56.00	62.31
Potassium	mg/100g	1.50	1.38	0.45	1.62

Parameter	Unit	SQ-1	SQ-2	SQ-3	SQ-4
Salinity	-	Slightly Saline	Slightly Saline	Slightly Saline	Slightly Saline
Sodium (Na)	meq/100g soil	8.52	7.58	6.21	8.92
Sodium Adsorption Ration (SAR)	-	11	09	11	10
Sulphur	ppm	212.5	230.8	208.3	218.6
Texture	-	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
Total Nitrogen	%	0.025	0.021	0.095	0.018
Zinc (Zn)	ppm	4.92	4.57	3.64	3.35

Source: Laboratory Analysis, October-November 2022

Interpretation of Soil Quality Analysis

Texture and pH: Texture indicates the relative content of particles of various sizes, such as sand, silt and clay in the soil. Texture influences the ease with which soil can be worked, the amount of water and air it holds, and the rate at which water can enter and move through soil. Sand, silt and clay contents of the soil samples vary 3.2%-11.3%, 61.8%-65.5% and 25.5%-35.0% respectively. Three soils are silty clay loam and one is silt loam in texture. pH value varies 4.7-5.9 which indicates acidic in nature.

Electrical Conductivity: Soils are slightly saline in nature. The electrical conductivity values found in the range of 4.4-6.3 DS/m.

Macronutrients Content: The nutrient content of the soil samples was compared with the land and soil resource use guidelines by Soil Resource Development Institute (SRDI). Organic carbon content of the samples varies between 0.93-2.72% which is very low. Moisture content varies 2.1%-2.6%. Total nitrogen contents were found in the range of 0.018%-0.095% indicates very low to low. Phosphorous content (2.75 ppm -3.35 ppm) was found to be very low whereas Potassium contents were found 0.45-1.62 meq/100 g soil which indicates high to very high. Calcium and Magnesium contents were found in the range of 2.32-2.85 meq/100 g soil and 0.82-1.05 meq/100 g soil. It indicated calcium contents low whereas Magnesium is medium. Sulphur was found in between 208.3-230.8 ppm which is very high.

Micronutrients Content: Boron content of the soil samples were found 0.63-1.32 ppm which is moderate-very high. Iron contents (54.35-125.32 ppm) were found to be high whereas Zinc (3.35-4.92 ppm) were found to be very high. Copper contents (0.21-0.46 ppm) were found to low- moderate in water samples.

Heavy Metal: Lead, Mercury and Cadmium were found below detection limit in the soil samples.

4.5.5 Sediment Quality

Sediment quality is a measure of the condition of soil relative to the requirements of one or more biotic species and or to any human need or purpose. According to the United States Department of Agriculture Natural Resources Conservation Service, "Sediment quality is the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation.

4.5.5.1 Sampling Methodology

The sediment sampling strategy was designed to assess the existing sediment quality over the project area. Each location used a composite sampling technique for sediment sampling.

At each location, sediment samples were collected from two spots and homogenized. Care was taken to minimize the surface disturbance to the sediments. The homogenized samples were then packed in polyethylene plastic bags, sealed, and sent to the laboratory for analysis.

4.5.5.2 Sediment Sampling Locations

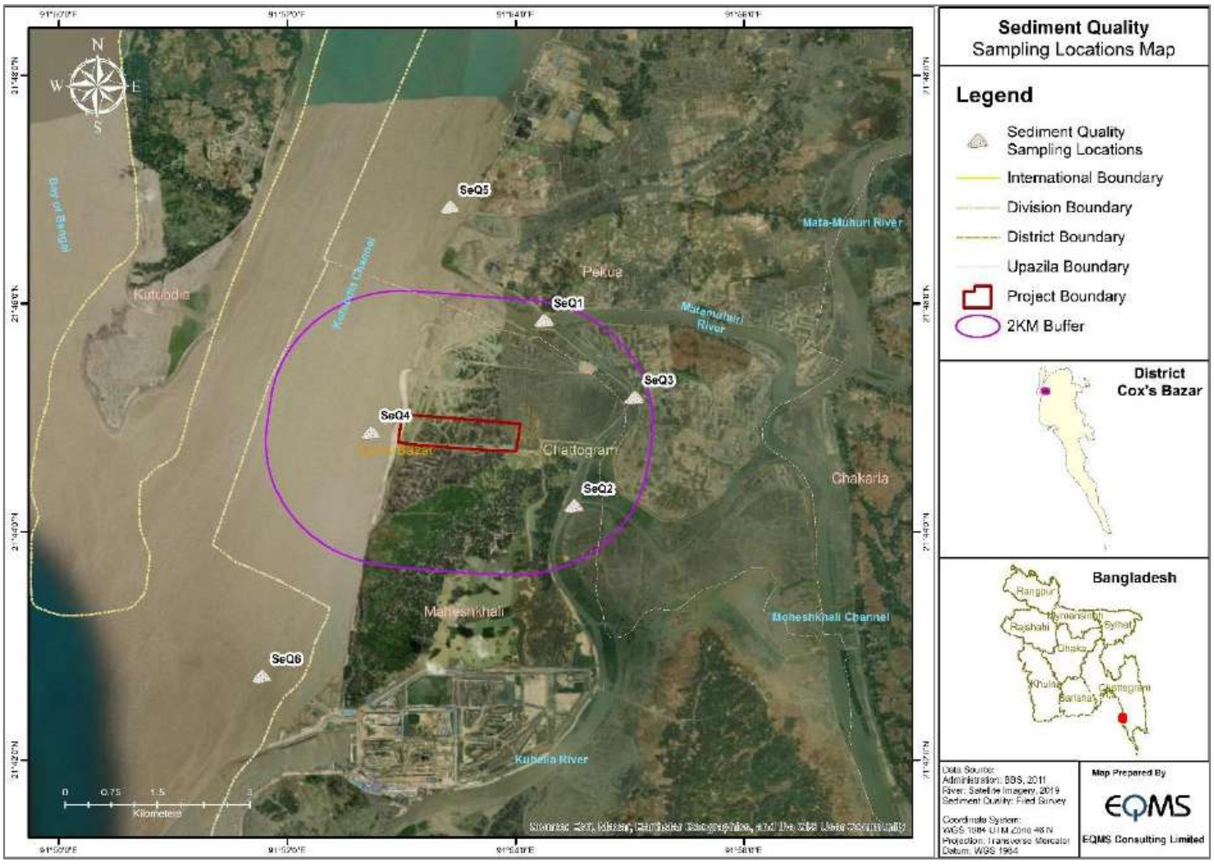
Sediment samples were collected from Six (6) different locations adjacent to the project site of Kutubdia Channel, upstream and downstream of Kuhelia and Matamuhuri River using the Ekman dredger during monitoring period in October 2022. The details of the sampling location are presented in **Table 4-16** and **Figure 4-35**. The photographs of soil sampling are presented in **Figure 4-36**.

Table 4-16: Sediment Sampling Locations

Code	Location	GPS Coordinate	Sampling Date
SeQ-1	Ujantia Ghat, Matamuhuri River	21º45'50.5"N 91º54'15.6"E	18.10.2022
SeQ-2	Sadar Khal, Matamuhuri River	21º44'14.0"N 91º54'31.3" E	18.10.2022
SeQ-3	Misbah Uddin House Pond, Sikdarpar, Matarbari	21º45'11.1"N 91º55'02.6" E	20.10.2022
SeQ-4	Near proposed water discharge point, Kutubdia Channel	21º45'02.9"N 91º52'40.5" E	18.10.2022
SeQ-5	Upstream of Kutubdia Channel	21º46'54.2"N 91º53'26.7" E	18.10.2022
SeQ-6	Downstream of water intake point, Sea	21º43'07.3"N 91º52'04.5" E	18.10.2022

Source: Field Survey by EQMS Team, October 2022

Figure 4-35: Sediment Sampling Location Map



Source: Field Survey by EQMS Team, October 2022

Figure 4-36: Photographs of Sediment Sampling

	
SeQ-1: Ujantia Ghat, Matamuhuri River	SeQ-2: Sadar Khal, Matamuhuri River

SeQ-3: Sadar Khal, Matamuhuri River

SeQ-4: Kutubdia Channel

SeQ-5: Kutubdia Channel

SeQ-6: Near Matarbari Deep Sea Port, Kutubdia Channel

Source: Field Survey by EQMS Team, October 2022

4.5.5.2.1 Result Analysis

The analyzed results for sediment sample were compared to Dutch intervention value 2013. Results of sediment quality analysis are presented in **Table 4-17**.

Table 4-17: Analysis Result of Sediment Sample

Parameter	Unit	SeQ-1	SeQ-2	SeQ-3	SeQ-4	SeQ-5	SeQ-6	Dutch Intervention Value 2013[15]
Acidity	ppm	Nil	Nil	Nil	Nil	Nil	Nil	-
Alkalinity	ppm	157	161	152	142	148	139	-
Arsenic (As)	ppm	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-
Cadmium (Cd)	ppm	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	13.0
Cation Exchange Capacity	meq/ 100 gm	42	40	38	34	38	36	-
Chromium (Cr+6)	ppm	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-

[15] Dutch Intervention Values (Soil Remediation Circular July 2013 Revision)

Parameter	Unit	SeQ-1	SeQ-2	SeQ-3	SeQ-4	SeQ-5	SeQ-6	Dutch Intervention Value 2013[15]
Cobalt (Co)	ppm	19.0	15.0	17.0	18.0	20.0	18.0	-
Copper (Cu)	ppm	34.8	27.5	24.6	34.7	34.2	30.5	190
Electrical Conductivity	uS/cm	22982	23028	22467	12125	12745	12360	-
Lead (Pb)	ppm	26.5	34.2	29.5	21.3	23.6	19.7	530
Manganese (Mn)	ppm	587.3	531.8	540.6	455.2	478.5	418.4	-
Mercury (inorganic)	ppm	<0.1	0.31	0.24	<0.1	<0.1	<0.1	-
Mercury (organic)	ppm	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
Nickel (Ni)	ppm	58.6	53.4	51.7	47.2	57.1	46.7	100
pH	-	7.61	7.48	7.60	7.23	7.52	7.12	-
Silica	%	48	44	41	47	43	50	-
Texture	-	Clay loam	Clay loam	Clay loam	Clay loam	Clay loam	Clay loam	-
Total Organic Carbon	%	0.76	0.72	0.80	0.63	0.58	0.50	-
Zinc (Zn)	ppm	73.2	63.7	67.4	72.6	70.1	51.7	720

Source: Laboratory Analysis, October-November 2022

Interpretation of Sediment Quality Analysis

Texture: The texture of the sediment is identified based on the relative proportion of sand, silt and clay content. All the samples were found as clay loam.

pH: pH level indicates the reliability of the biological and chemical processes. Changes in sediment pH could potentially impact benthic dwelling organisms by affecting their biological processes, such as growth, respiration, calcification, metabolic rate and activity. pH level of the sediment samples varies between 7.12-7.61. The pH level found neutral.

Organic Carbon: Organic carbon on marine sediment is a critical component of the global carbon cycle. It is an important indicator of sediment to determine the productivity od biological cycles in the marine environment. In natural condition, 0.5% organic carbon presents in the marine sediment. Organic content in the sediment samples were found to be 0.50-0.80% which is high.

Electrical Conductivity (EC): EC in the sediment samples were found in the range of 12125-23028 µS/cm.

Cation Exchange Capacity: Cation exchange capacity of sediment samples were found in the range of 34-42 meq/100gm.

Acidity and Alkalinity: All sediment samples are non-acidic whereas alkalinity values were found in range between 139-161 ppm.

Heavy Metal: Arsenic and hexavalent chromium were found <2.0 ppm in all sediment samples. Organic Chromium were found <0.1 ppm whereas inorganic chromium varied <0.1-0.31 ppm. Cadmium, Copper, Lead, Nickel and Zinc were found low compared to the Dutch Intervention Values. Cobalt and Manganese values were found in the range of 15.0-20.0 ppm and 418.4-587.3 ppm respectively.

4.6 Biological Environment

A biological environment study is essential for any project that may have an impact on the environment. A coal-based thermal power plant has the potential to significantly alter the biological environment in its surrounding area. The construction of such a plant can cause habitat fragmentation, loss of vegetation, and disruption of wildlife populations. Additionally, the operation of the plant can result in emissions of greenhouse gases and air pollutants, which can have negative impacts on the health of local ecosystems and wildlife. Therefore, a comprehensive biological environment study is necessary to understand the potential impacts of the proposed coal-based thermal power plant in Matarbari, Maheshkhali, Cox's Bazar. This study will help to identify vulnerable species, evaluate the potential for habitat loss, and assess the impact of air pollution on the surrounding environment. The study can also inform the development of mitigation strategies to minimize the negative impacts of the power plant and ensure the sustainable development of the region.

In this regard, an ecosystem and biodiversity assessment study were undertaken in diverse habitat types within the project Area of Influence (AOI) of the Matarbari coal based thermal power plant project in Maheshkhali Upazila of Cox's Bazar. The study was conducted from October 15 to October 24, 2022 and from January 29 to February 4, 2023 to gather primary and secondary data necessary for establishing a concrete baseline for the biological environment. The Study Area/ Area of Influence (AOI) encompasses a buffer zone of 5 km radius around the proposed project site for the primary survey and a 10 km radius for secondary data review. The following objectives were considered for this study:

- Establishing a comprehensive ecological and biodiversity profile of the project Area of Influence (AOI).
- Identifying of areas of conservation significance within the AOI.
- Identifying different habitat types occurring in the AOI.
- Determining vegetation type and diversity associated with respective habitat types.
- Identifying protected species threatened species (Critically Endangered, Endangered & Vulnerable species) and endemic species occurring in the AOI following Wildlife (Conservation and Security) Act, 2012 and IUCN Red list of Threatened Species.
- Assessing fisheries resources of the project AOI through direct observation, fish market survey, formal and informal consultation, and FGD with local fishermen.
- Conducting the baseline aquatic sample collection and analyzing the sample of phytoplankton, zooplankton, and benthos organisms of the AOI.
- Collecting of secondary information, including literature review and FGDs to understand the floral and faunal components and habitats of the AOI.

4.6.1 Bio-ecological Zones of the Study Area

Flora and fauna in a particular bio-geographic region or zone tend to have shared characteristics in terms of broader climatic & geographical feature preferences/requirements. Therefore, IUCN has classified Bangladesh into 25 Bio-ecological Zones[16] in the context of physiographic and biological diversity. The project site has fallen under bio-ecological zone '8a: Coastal plain' and project AOI has fallen under five bio-ecological zones, namely, 8a: Coastal plain, 12: Coastal and Marine Waters, 8b: Offshore Islands, 7b: Chakaria Sundarban, and 9a: Chattogram Hills and the CHTs (IUCN, 2002). Typical Characteristics of bio-ecological zone of Project site is provided in **Table 4-18**, and the map of bio-ecological zones of the AOI is provided in **Figure 4-37**.

[16] Nishat, A., S.M.I. Huq, S.P. Barua, A.H.M.A. Reza and A.S.M. Khan. 2002. Bio-ecological Zones of Bangladesh. The World Conservation Union (IUCN), Dhaka, Bangladesh. 141 pp

4.6.1.1 8a: Coastal plain

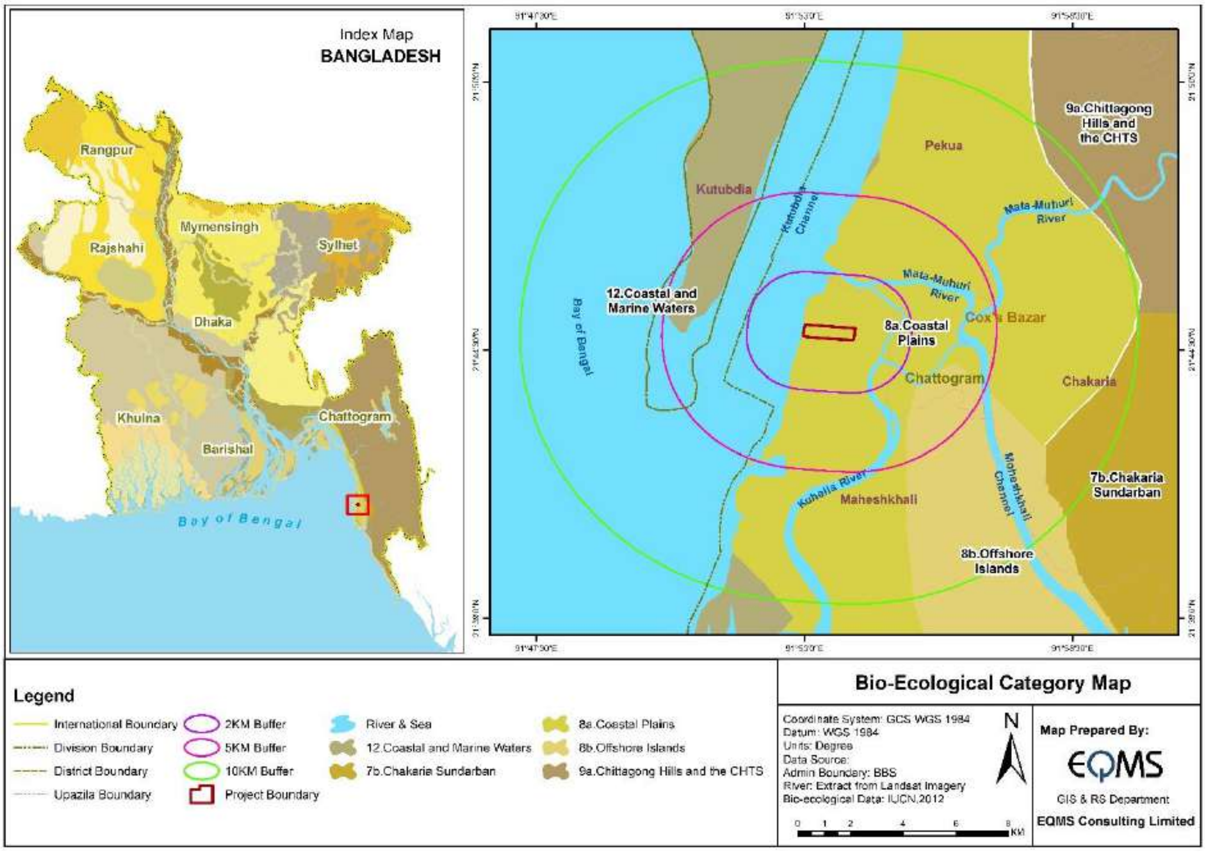
The coastal plains are underlain by heavy marine or tidal clays; but these have been buried under by more sandy or silty deposits near the foot of the hills and along the courses of rivers and streams which run across the plains. The eastern coastline, extending from the mouth of the Feni River to the southern tip of the mainland along Chittagong, is regular and unbroken, and protected along the sea by mudflats and submerged sands. The riverbanks of this zone are covered with a dense growth of tropical evergreen and semievergreen forests. The dominant floral and faunal species of this zone is presented in **Table 4-18**.

Table 4-18: Typical Characteristics of Bio-ecological Zones of AOI

8a: Coastal Plains		
Floral diversity	Trees	Narikel (*Cocos nucifera*), Supari (*Areca catechu*), Khejur (*Phoenix sylvestris*), Bhadi (*Lunnea coromandelica*)
	Herbs	Bashak (*Adhatoda vasica*), Paresh (*Thespesia populnea*), Ulu (*Imperata cylindrica*), Hargoza (*Acanthus illicifolius*)
Faunal Diversity	Mammals	Asian Elephant (*Elephas maximus*), Hoolock Gibbon (*Hylobates hoolock*), Mainland Serow (*Capricornis Sumatraensis*), Oriental Small-clawed Otter (*Aonyx Cinerea*), Binturong (*Arctictis binturong*)
	Birds	Ashy Bulbul (*Hemixos flavala*), Gull-Billed Tern (*Gelochelidon nilotica*), Spot Throated Babbler (*Pellorneum albiventre*), Asian Glossy Starling (*Aplonis panayensis)*
	Reptiles	Slender Coral Snake (*Calliophis melanurus*), Green Pit Viper (*Trimeresurus gramineus*), Banded Krait (*Bungarus fasciatus*), Ring Lizard (*Varanus salvator*)
	Amphibians	Ornate Microhylid Frog (*Microhyla ornata*), Indian Bull Frog (*Hoplobatrachus tigerinus*)

Source: Atlas of Bio-ecological Zones of Bangladesh, IUCN, 2002

Figure 4-37: Map of Bio-Ecological Zones of the AOI



Source: Atlas of Bio-ecological Zones of Bangladesh, IUCN, 2002

4.6.2 Terrestrial Ecosystem

4.6.2.1 Habitats

Terrestrial habitat includes Agricultural Habitat, Homestead Plantation, Roadside Plantation, Riparian Vegetation, etc. (**Figure 4-38**). The habitats present in the AOI are seminatural and modified in nature.

4.6.2.1.1 Agricultural Habitat

Agricultural habitats cover approximately 14.17% of the study area within the AOI. Agricultural practices of the project AOI is mostly mono-cropping of Paddy. Ropa Aman paddy is cultivated during monsoon season and Boro paddy is cultivated during the dry season (November to May) in the agricultural lands of the AOI. Rabi crops include chilli, onion, lady fingers, long yard beans, eggplants, pulses, and tomatoes, which are grown around mid-November and harvested from April to May. The popular cash crop, Betel Leaf (*Piper betle*) is also cultivated in the villages of Kaliganj, Jhapua and Uttar Nalbila. Common tree species observed near the agricultural lands are *Mangifera indica*, *Samanea saman*, *Cocos nucifera*, *Eucalyptus* sp., *Acacia auriculiformis*, *Phoenix sylvestris, Bambusa* sp., *Areca catechu*, *Borassus flabellifer,* etc. Humans extensively modify agricultural habitats to increase crop productivity, so "Agricultural Habitats" can be classified as "Modified habitat".

4.6.2.1.2 Homestead Plantation Habitat

Apart from human settlement, the villages are always associated with homestead plantations. Maximum diversity of plant species, particularly of tree species, are expected from homestead plantations, which assemblage many flowerings and fruit-bearing trees. Homestead plantation covers the 8.49% of the AOI. Most common plant species observed in this habitat are *Samanea saman, Acacia auriculiformis, Azadirachta indica, Eucalyptus sp., Ziziphus mauritiana, Switenia mahogani, Tectona grandis, Phoenix sylvestris, Bambusa sp., Cocos nucifera, Mangifera indica, Tamarindus indica, Areca catechu,* *Borassus flabellifer, Artocarpus heterophyllus*, etc. Though compared to agricultural habitat, homestead plantation habitat is more diverse, and even homestead plantation can host many native species, still, species assemblage of homestead plantation habitat, particularly assemblage floras species is largely controlled by human intervention and often floral species are regularly modified or tended to increase production of fruit or flowers. So "Homestead Plantation Habitat" is also classified as "Modified Habitat".

4.6.2.1.3 Roadside Plantation

Diverse roadside plantation is an important habitat of the project AOI. Roadside vegetation can perform many important functions, including the provision of habitat for rare plants and animals, a source of seeds for adjacent landscapes, a buffer to reduce the penetration of traffic noise and light, carbon sinks and enhanced aesthetics for road users. In a boarder sense, roadside plantation supports greater ecosystem functions than adjacent agricultural land. Some common floral species observed in the project AOI are *Samanea saman, Acacia auriculiformis, Acacia mangium, Pithecellobium dulce Swietenia mahogani, Eucalyptus sp., Bombax ceiba, Delonix regia, Albizia lebbeck, Albizia procera, Areca catechu, Dalbergia sissoo, Saccharum spontaneum*, etc. Roadside vegetation in AOI contain a large amount of non-native plant species mainly used for fuel, wood production and aesthetics purposes. So, "Roadside Plantation" is classified as "Modified Habitat".

4.6.2.1.4 Riparian Vegetation

Riparian vegetation is present along the riverbanks, adjacent areas to ponds, canals, and other waterbodies. The riparian vegetation species play an important role to reduce the riverbank erosion which contributes to the maintenance of the river depth. The main plant species observed are *Samanea saman*, *Cocos nucifera*, *Acacia auriculiformis, Sonneratia apetala*, *Ipomoea* sp., *Dalbergia sissoo, Typha elephantiana*, *Sida rhombifolia, Saccharum spontaneum, Ricinus communis, Sesuvium portulacastrum,* etc.

4.6.2.1.5 Mangrove Plantation

Mangroves are amongst the most productive coastal ecosystems, providing a unique habitat opportunity for many species, feeding sites, and spawning grounds. The mangrove plantation is present at the eastern and south-eastern bank of Kohelia river near Rajghat and Matamuhuri River near Ujantia, eastern coast of Kutubdia near Kutubdia Channel. Mangrove species used for plantation of this area are *Avicennia officinalis, Avicennia marina and Sonneratia apetala*. In addition, some other species like *Acanthus ilicifolius* and *Pandanus tectorius* are also found in this area. However, no mangrove plantation is observed in the project site. Mangrove plantation found in the AOI is not unique and planted by the local Coastal Forest Department Office of Maheshkhali and Kutubdia. So, "Mangrove Plantation" is classified as "Modified Habitat".

A strip of Casuarina (Jhau) plantation is also observed at western and south-western side of proposed project site as a shelter belt. Casuarina trees have been planted by the Forest department as part of the coastal afforestation program at Matarbari and designated "Modified Habitat". Common species observed are *Casuarina equisetifolia, Acacia auriculiformis, Ipomea pes-carpae, Cynodon dactylon, Phragmites australis* etc.

Figure 4-38: Different Types of Terrestrial and Wetland Habitats within the AOI

Homestead Vegetation



Agricultural Land (Paddy, Betel Leaf, and Vegetables)


Mixed Plantation (Roadside Plantation and Homestead Plantation)

Casuarina plantation



Riparian Vegetation

Mangrove plantation in east coast of Kutubdia

Mangrove plantation adjacent to the mouth of Matamuhuri River (Ujantia Canal)

Mangrove plantation along Kohelia River (South-eastern side near Rajghat Bridge)

Source: EQMS Field Survey, October 2022

4.6.2.2 Terrestrial Flora

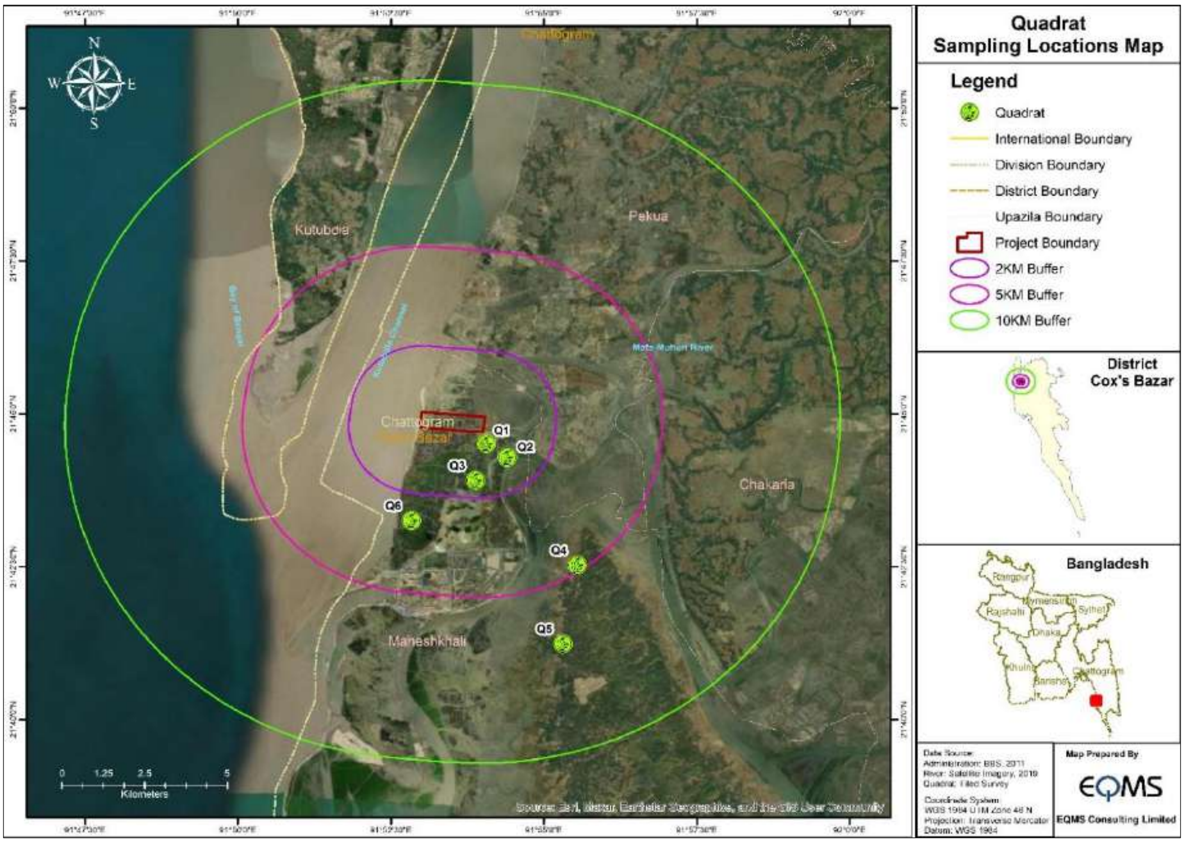
The quadrat sampling method was used for assessing the vegetation structure in and around the project area. A total of six quadrates were taken for phytosociological assessment where the sampling plot size was considered 10 m x 10 m for trees, 5 m x 5 m for shrubs and 1 m x 1 m for herbs. The location and GPS of the Quadrat sites have been provided in **Table 4-19** and shown in **Figure 4-39**. Field activities while conducting the Quadrat Survey are given in **Figure 4-40**.

Table 4-19: Details of Quadrates for Floral Species

SL. No.	Quadrate No.	Location/ Nearest Village	Latitude	Longitude
1.	Q1	Uttar Shikdar Para, Matarbari	21°44'30.67"N	91°54'3.41"E
2.	Q2	Uttor Rajghat, Matarbari	21°44'17.15"N	91°54'23.89"E
3.	Q3	Notun Bazar, Matarbari	21°43'54.61"N	91°53'53.13"E
4.	Q4	Uttar Nalbila, Kalarmarchara	21°42'31.46"N	91°55'32.89"E
5.	Q5	Jhapua Bazar, Kalarmarchara	21°41'14.17"N	91°55'18.61"E
6.	Q6	Sardarpara, Matarbari	21°43'15.18"N	91°52'50.23"E

Source: EQMS Field Survey, October 2022, and February 2023

Figure 4-39: Map of Quadrates for Floral Assessment



Source: EQMS Field Survey, October 2022, and February 2023

Figure 4-40: Field Activities Conducted for Quadrat Survey

		
Floral sampling at Q1 in Uttar Shikdarpara Village	Floral sample counting at Q2 in Uttar Para, Rajghat, Matarbari	Floral sampling at Q4 in Uttar Nolbila

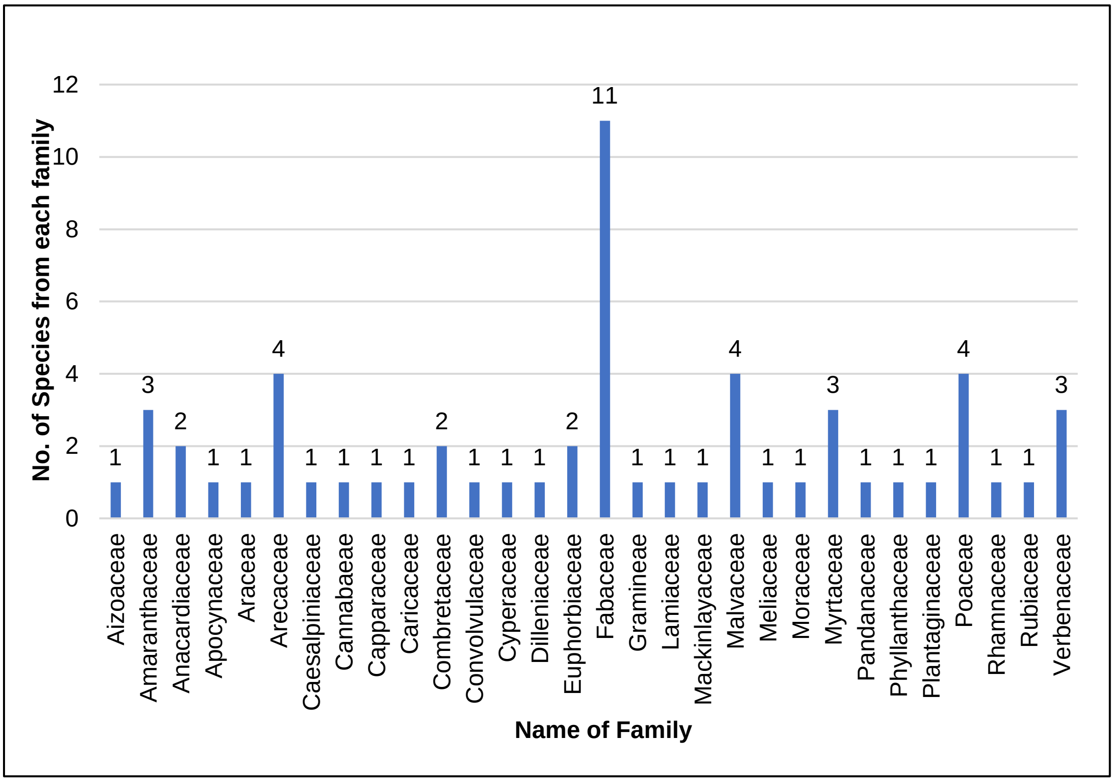
		
Floral sample counting at Q4 in Uttar Nolbila village	Floral sampling (Herbs) at Q5 in Jhapua Bazar, Kalamarchara	Floral Sampling (Herb) at Q6 in Sardarpara village

Source: EQMS Field Survey, October 2022, and February 2023

4.6.2.2.1 Species Composition

A total of 59 terrestrial floral species were recorded under 30 families from the field survey (October 2022, and February 2023). Among these plant species, 31 species under 14 families of trees and 28 species under 20 family of herbs and shrubs were recorded from six quadrat plots (**Appendix E-1** & **Appendix E-2**). The most abundant family is Fabaceae which includes Eleven (11) plant species. It was observed that the abundance of the plants within the project area is very low because salt pans occupy 89.28% of the project lands. Some photographs of tree species observed in the AOI has been presented in **Appendix F-1**. In addition, a comparison of all flora species based on their family (taxonomic classification) has been shown in **Figure 4-41**.

Figure 4-41: Comparison of Number of Floral Species by Family



Source: EQMS Field Survey, October 2022, and February 2023

4.6.2.2.2 Floral Species Diversity

Shannon Diversity index (*H*) is used to characterize species diversity for different quadrats. The biodiversity indices of different quadrates are presented in **Table 4-20**. The highest value of Shannon diversity index (H) was found for Quadrat Q1 (2.046) at Uttar Shikdarpara followed by Quadrat Q5 (1.937) at Jhapua Bazaar, Kalamarchara and the lowest value was found for Quadrat Q2 (1.176) at Uttar Rajghat, Matarbari. The value of Evenness (E) is highest in Quadrat Q1 followed by Quadrat Q6. The highest species richness (9) was recorded in Quadrat Q1, and the greatest number of individuals (36) was recorded in Quadrat Q2. As Quadrat Q2 and Quadrat Q3 were found to be woodlot plantations which were dominated by Mahogany (*Swietenia mahagoni*) and Mangium (*Acacia mangium*) trees, respectively, the least values of Shannon diversity index (H) were observed for these quadrats.

Mahogany (*Swietenia mahagoni*) is Near Threatened as per the global IUCN Red List of Threatened Species (Version 2022-2), but it is a non-native species (native to Caribbean) commonly planted in homestead plantations of Bangladesh primarily for its timber value.

Table 4-20: Biodiversity Indices of Different Quadrats

Parameter	Quadrat 1 (Q1)	Quadrat 2 (Q2)	Quadrat 3 (Q3)	Quadrat 4 (Q4)	Quadrat 5 (Q5)	Quadrat 6 (Q6)
Shannon-Wiener Diversity Index (H)	2.046	1.176	1.663	1.878	1.937	1.827
Evenness (E)	0.931	0.848	0.928	0.903	0.932	0.939
Species Richness (S)	9	4	6	8	8	7
Total Abundance	21	36	29	20	18	18

Source: EQMS Field Survey, October 2022, and February 2023

4.6.2.3 Terrestrial Fauna

4.6.2.3.1 Avifauna

The transect method was applied to survey the bird species present in the project AOI. The avifauna was also counted visually by hearing their calls and then recorded in the datasheet. Transect method is a good way to survey birds because by using this method we can cover a lot of ground by walking along a route and identifying all the birds; it has been seen or heard while standing at a series of points along with a transect.

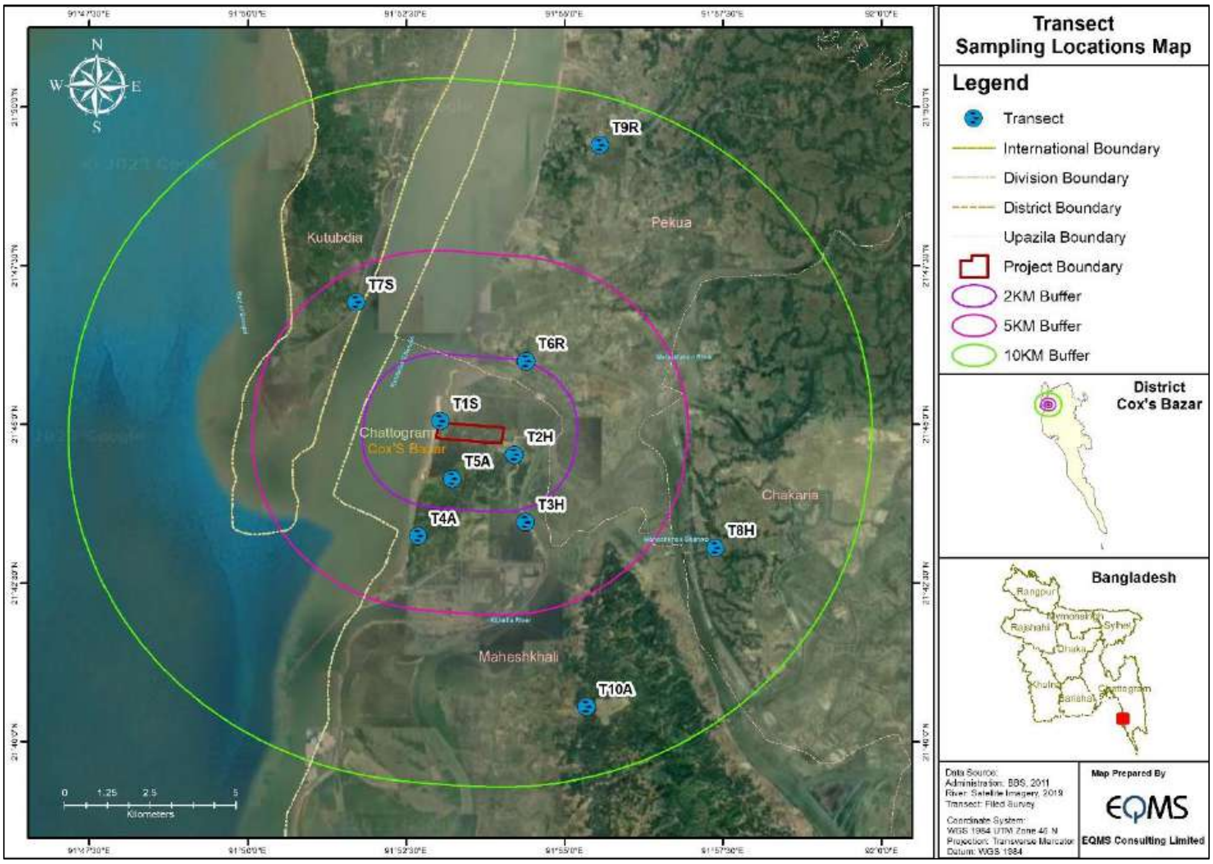
Data on avian fauna was collected from Ten transects (1 km long) laid within different habitat types of the study area. Details of these transects are provided in **Table 4-21** and **Figure 4-42**.

Table 4-21: Details of Transects

Transect name	Habitat Type	Start Point	End Point
T1S	Shore	21°45'3.080"N, 91°53'2.570"E	21°44'33.95"N, 91°52'53.80"E
T2H	Homestead	21°44'31.270"N, 91°54'12.490"E	21°44'10.02"N, 91°53'44.28"E
T3H	Homestead	21°43'32.92"N, 91°54'18.76"E	21°43'44.94"N, 91°54'8.66"E
T4A	Agriculture	21°43'12.077"N, 91°52'39.335"E	21°43'42.68"N, 91°53'4.44"E
T5A	Agriculture	21°43'56.658"N, 91°53'23.581"E	21°44'25.04"N, 91°53'34.99"E
T6R	Roadside	21°46'28.421"N, 91°54'9.315"E	21°46'47.61"N, 91°54'51.52"E
T7S	Shore	21°46'55.470"N, 91°51'42.660"E	21°46'25.44"N, 91°51'15.07"E
T8H	Homestead	21°43'3.07"N, 91°57'22.77"E	21°42'57.50"N, 91°57'54.95"E
T9R	Roadside	21°49'24.14"N, 91°55'33.34"E	21°49'19.10"N, 91°54'55.51"E
T10A	Agriculture	21°40'33.03"N, 91°55'20.75"E	21°40'28.94"N, 91°54'42.05"E

Source: EQMS Field Survey, October 2022, and February 2023

Figure 4-42: Transect Sampling Locations Map for Avifauna Survey

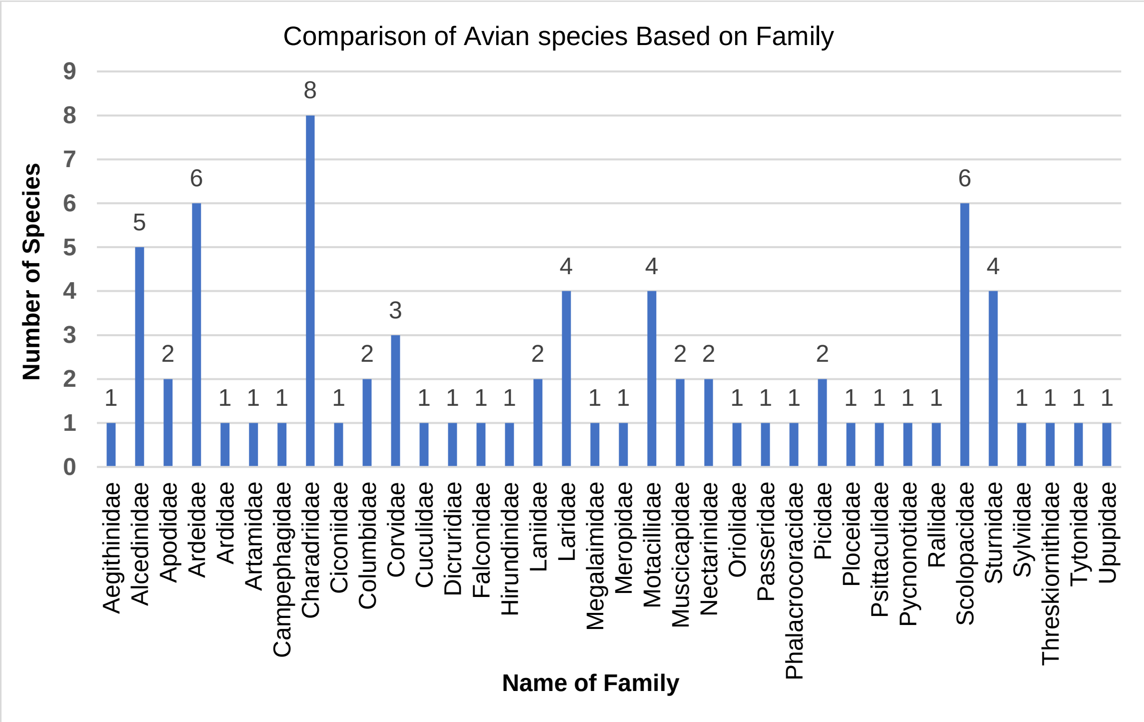


Source: EQMS Field Survey, October 2022, and February 2023

A total of 74 species of birds under 36 families were recorded (primary survey and secondary information) from the study area in two season study (October 2022 and February 2023). The highest number of birds belong to the family Charadriidae (8 species) followed by Ardeidae and Scolopacidae (6 species each). Among the recorded bird species, Black-headed ibis (*Threskiornis melanocephalus*) is Vulnerable (VU) and Eurasian Curlew (*Numenius arquata*) is Near Threatened (NT), according to the IUCN Red List of Threatened Species of Bangladesh, 2015.

According to Global IUCN Red List Status (Version 2022-2), Black-headed ibis and Eurasian Curlew both are Near threatened (NT). All the other 72 bird species found in the study area are Least Concern (LC) both for Global IUCN Red List Status (Version 2022-2) and IUCN Bangladesh Red List (2015). A Comparison of Avian species based on family is presented in **Figure 4-43**. A checklist of all recorded avian species has been provided in **Appendix E-3** and some observed bird species are shown in **Appendix F-2.**

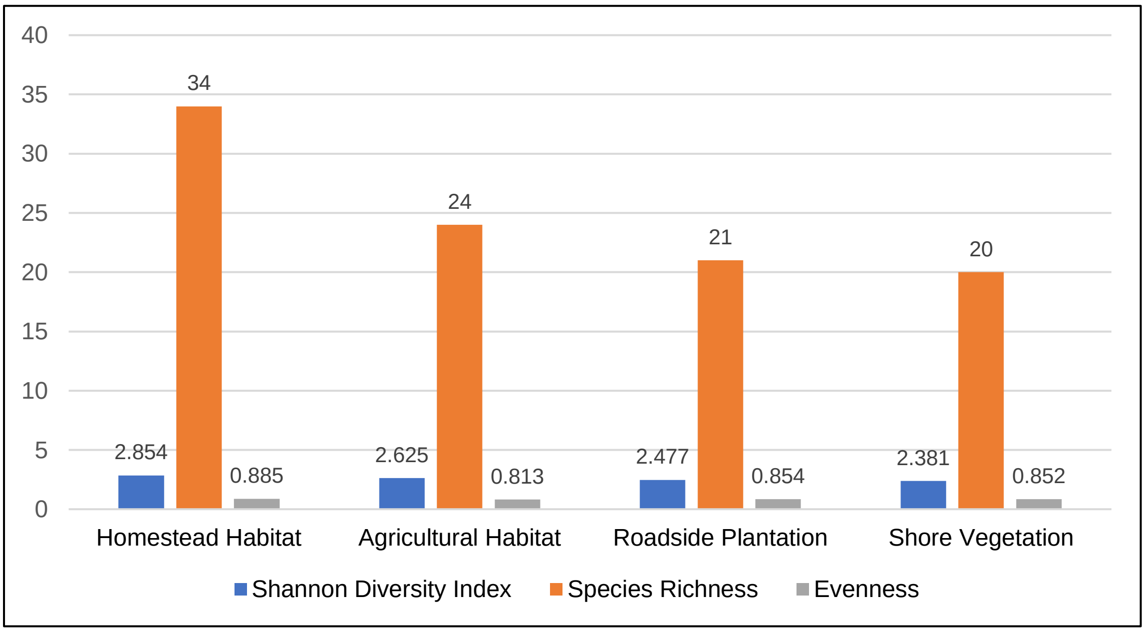
Figure 4-43: Number of Avian species Based on Family



Source: EQMS Field Survey, October 2022, and February 2023

Out of 74 species recorded during primary survey, 48 species are terrestrial birds, i.e., they are mostly distributed in terrestrial habitats, i.e., agricultural habitat, homestead plantation habitat, roadside plantation, and riparian vegetation. The diversity indices by habitat type have been presented in **Figure 4-44**. The species diversity index indicates that avifaunal diversity is higher in homestead vegetation, followed by agricultural land, roadside plantation, and Riparian vegetation habitat. Evenness of avifauna is also higher in Homestead Habitat followed by Riparian Vegetation, Roadside Plantation, and Agricultural Habitat, respectively.

Figure 4-44: Diversity Indices of Avifauna



Source: EQMS Field Survey, October 2022, and February 2023

4.6.2.3.1.1 Shorebirds and Migratory Birds

A total Twenty-four (24) Migratory bird were observed during the field visit (15-24 October 2022, and 29 January- 04 February 2023)) within the Project AOI. Among them twenty species are shore birds belonging to Charadriidae (7 species), Scolopacidae (6 species), Laridae (4 species), Ardeidae (2 species), and Threskiornithidae (1 species) families. Two species (*Casmerodius albus*, *Ardea cinerea*) of Ardeidae family are common resident shore bird species of Bangladesh.

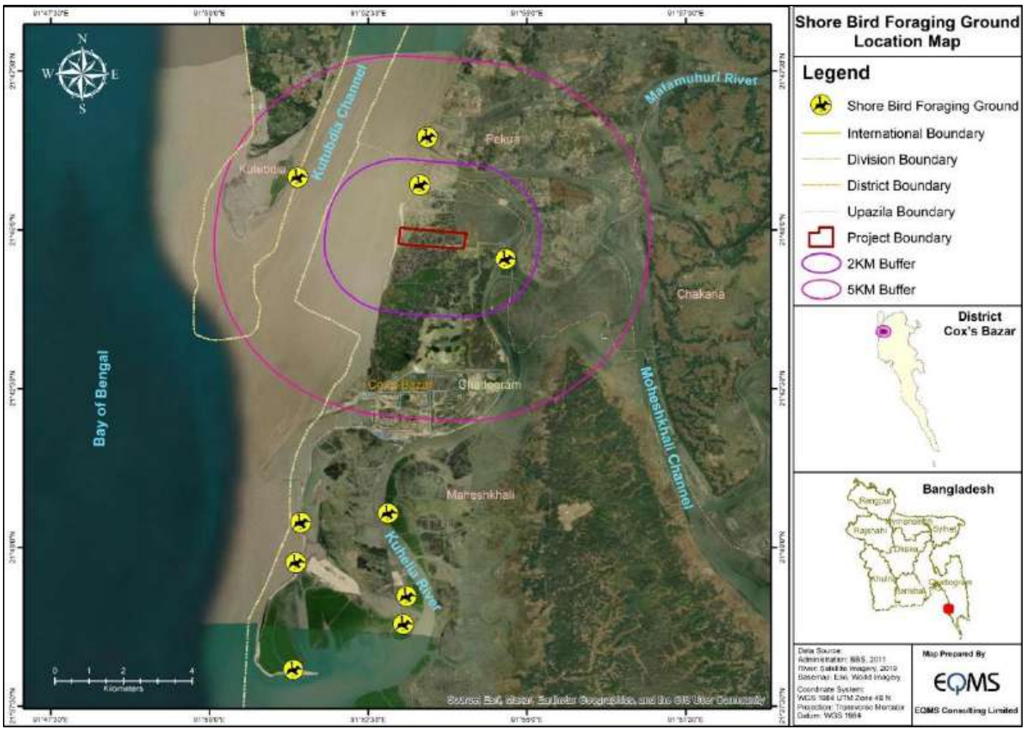
Four (04) Species of terrestrial and aquatic associated migratory birds were also observed in the AOI namely, Common kestrel (*Falco tinnunculus*), Brown shrike (*Lanius cristatus*), White Wagtail (*Motacilla alba*), Citrine Wagtail (*Motacilla citreola*).

Among the Migratory and Shore birds, Eurasian Curlew (*Numenius arquata*) and Black-headed Ibis (*Threskiornis melanocephalus*) is classified as a Near Threatened and Vulnerable, respectively (IUCN Red List of Bangladesh, 2015). However, Eurasian Curlew (*Numenius arquata*) and Black-headed Ibis (*Threskiornis melanocephalus*) is classified as a Near Threatened in Global IUCN Red List (Version 2022-2)

Eurasian Curlew and Black-headed Ibis is observed in the shore area of Matarbari and Ujantia union, approximately 3km north (21°46'29.38"N and 91°53'33.12"E) and approximately 2 km north-west (21°45'52.26"N and 91°53'16.34"E) from the project site.

According to the primary survey and secondary information from local people, Shore bird (Migratory) species are commonly found in the mudflat and mangrove plantation area of Kohelia River and Matamuhuri River (adjacent to Kutubdia channel), sandy beach of Matarbari union (North-western from the project site), Dhalghata union and north-western side of Kutubdia Upazila. Some shore birds are also observed in the Eastern side of Dhalghata Union (mudflat and mangroves area near Panditer Deil). A map of Shore bird foraging ground (based on Primary survey and secondary information) has been presented in **Figure 4-45**. A photo plate and a checklist of some observed shore birds have been provided in **Figure 4-46** and **Appendix E-4.**

Figure 4-45: Shore Bird Foraging Ground in Project AOI



Source: EQMS Field Visit, October 2022, and February 2023

Figure 4-46: Some Observed and Notable Shorebirds in Project AOI

		
Eurasian Curlew (*Numenius arquata*)	Black-headed Ibis (*Threskiornis melanocephalus*)	Whimbrel (*Numenius phaeopus*)
		
Common Sandpiper (*Actitis hypoleucos*)	Kentish Plover (*Charadrius alexandrinus*)	Common redshank (*Tringa totanus*)
		
Pacific Golden Plover (*Pluvialis fulva*)	Grey Heron (*Ardea cinerea*)	Great egret (*Ardea alba*)
		
Black-headed Gull (*Larus ridibundus*)	Lesser sand plover (*Charadrius mongolus*)	Foraging Ground of Eurasian Curlew, Whimbrel, Pacific Golden Plover, Grey heron (northwestern side mudflat of Matarbari union)

		
Flocks of Black-headed Gull and Brown-headed Gull in Dhalghata Sea Beach	Flock of Common Redshank, and Lesser sand Plover in mudflat area of Matamuhuri River estuary	

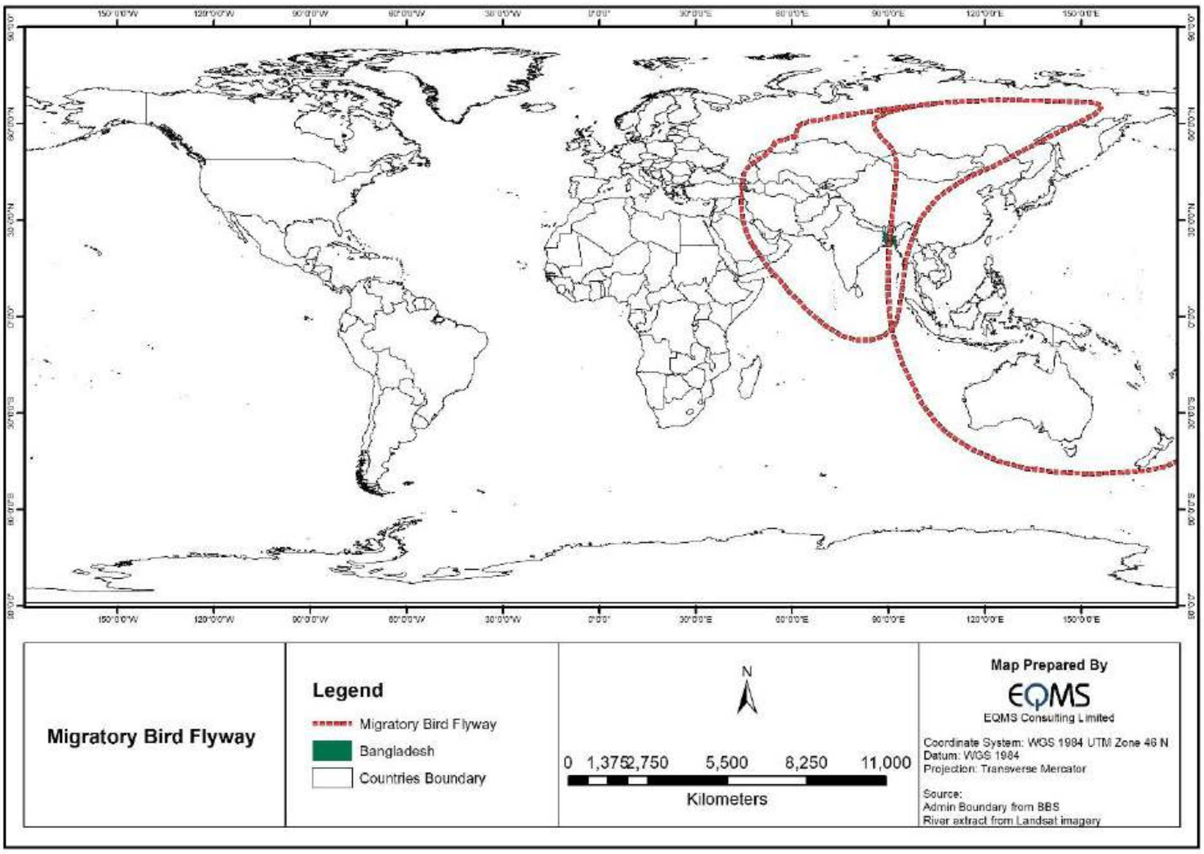
Source: EQMS Field Survey, October 2022, and February 2023

Migratory Bird Flyways

Large areas of the eastern and southeastern portion of Bangladesh where the Site is located, is within the East Asian-Australian Flyway. Approximately 492 migratory bird species are known to fly along this flyway, arriving in October and November and returning to their resident countries between February and April. Due to the presence of this flyway, some migratory bird species are likely to visit the AOI during the winter season.

The map of the East Asian-Australasian Flyway and Flyway site in Bangladesh has been presented in **Figure 4-47** and **Table 4-22**.

Figure 4-47: Map of East Asia-Australasia Flyway



Source: BirdLife International

Table 4-22: East Asian-Australasian Flyway Site of Bangladesh

Sl. No.	Name of the Flyway site	Location	Area (ha.)	Date of Notification	Remarks
1.	Tanguar Haor	Sunamganj (Tahirpur and Dharmapasha)	9727	2011	Wetland
2.	Hakaluki Haor	Moulvibazar (Kulawara and Boralekha), Sylhet (Fensugonj and Golapgonj)	18115	2011	Wetland
3.	Hail Haor	Moulvibazar (Srimongal)	12490	2011	Wetland
4.	Sonadia	Cox's Bazar	1175	2011	Coastal Island
5.	Nijhumdeep	Noakhali (Hatia)	16352	2011	Coastal Island

Source: Zoological Society of Bangladesh 2023

4.6.2.3.2 Herpetofauna (Amphibians and Reptiles)

Amphibians and reptilian groups are known as herpetofauna. Visual Encounter Surveys (VES) were conducted mainly for reptile fauna over a wider area. These surveys generally comprised walking through various habitats, such as bushy areas, along the riverside, agricultural areas, looking for active reptiles, disturbing logs, and other ground debris to check for sheltering animals. In addition, Informal consultation with local people help us to get information about the local species available in the study area.

During the field visit of October 2022, and February 2023, a total of Seven (07) species of amphibians belonging to four (04) families and Twelve (12) species of reptiles belonging to Seven (07) families were listed from the project AOI based on primary and secondary data (**Appendix E-5**).

All the amphibian species are included in the Bangladesh Wildlife (Conservation and Security) Act, 2012, under Schedule-II, which protects them from hunting, killing, and capturing. Amphibians recorded or reported to be present in the AOI are found to be Least Concerned species. According to the IUCN Bangladesh Red-list (2015) and Global IUCN Red List Status (Version 2022-2), One (01) Near Threatened (NT) reptile species, Bengal Monitor Lizard (*Varanus bengalensis*) were found in the study area. Photographs of observed herpetofauna species are given in **Figure 4-48**.

Figure 4-48: Observed Herpetofauna in the Project AOI

		
Asian common toad (*Duttaphrynus melanostictus*)	Indian skipper frog (*Euphlyctis cyanophlyctis*)	Checkered Keelback (*Xenochrophis piscator*)

Source: EQMS Field Survey, October 2022, and February 2023

4.6.2.3.3 Terrestrial Mammal

Visual Encounter Survey was followed for observing and counting the wild mammalian species. These surveys generally comprised walking through a vegetation trail or specific transect line to check for sheltering animals. Informal consultation and discussion with local people were also carried out to collect information regarding the mammalian species found in the proposed project AOI.

During the field survey, nine (09) terrestrial Mammal species belonging to Eight (08) families were reported to be observed in the AOI. All mammalian species found are Least Concern (LC) both locally and globally according to IUCN Red List. A detailed checklist of reported terrestrial mammals has been provided in **Appendix E-6.**

4.6.3 Aquatic Ecosystem

4.6.3.1 Habitats

Aquatic ecosystem within the AOI comprises the Riverine Habitat of Kohelia River, shrimp culture ponds (locally called 'Ghona'), lentic waterbodies (Ponds), coastal ecosystem (Salt Pans, Sandy beaches, and Mudflats), and the marine habitat of Kutubdia Channel. Rivers and Channel comprises 42.30% within the AOI. Different types of aquatic habitats within the AOI have been presented in **Appendix F-3**.

4.6.3.1.1 Riverine Habitat of Kohelia River

Kohelia River is located adjacent to the project site (north-eastern and south-eastern). It is approximately 14 km long and connects with Matamuhuri River in Ujantia. It falls into Bay of Bengal near Hasher Char. Fishermen do their fishing activities in the river in dry and wet seasons.

4.6.3.1.2 Riverine Habitat of Matamuhuri River

Matamuhuri River is in the northern side of the project area. It falls into the Bay of Bengal (Kutubdia Channel) near Ujantia, forming a broad delta, consisting of islets intersected by a network of tidal creeks, and covered by mangrove vegetation. Small scale fishermen do their fishing in wet season by non-mechanized fishing boat with set bag net, cast net etc.

4.6.3.1.3 Kutubdia Channel

Kutubdia Channel lies in between the mainland of the country (Cox's Bazar) and Kutubdia Island. The length of the channel is 24 km. The channel relates to the Bay of Bengal at both ends. The project site is situated on the eastern side of the channel. According to local fishermen and the Marine Fisheries Officer of Kutubdia Upazila, the Kutubdia channel seemed to be breeding and fishing ground for shrimp, mud skipper fish (Chiring). Fishermen community uses different type of nets for near-shore fishing in the channel, such as Trawl net, Gill net, large mesh drift gill net, and set bag net.

4.6.3.1.4 Shrimp Culture Ponds (Ghona/Gher)

Shrimp culture pond (Ghona/Gher) is a key feature of Matarbari union of Maheshkhali. Consultation with local group and Senior Upazila Fisheries Officer of Maheshkhali Upazila revealed that shrimp cultivation is done in the rainy season (Middle of May to middle of November). In the rainy season, workers plough the land as preparation for the shrimp culture. They then collect the Post Larvae (PL) from the river and transfer them into the prepared ponds. The dominant shrimp species cultured in the Ghona/Gher include Bagda (*Penaeus monodon*), Harina Chingri (*Metapenaeus monoceros*) and Chaka Chingri (*Penaeus indicus*). The average shrimp production is 60-70 kg/acre. Once shrimp cultivation is complete, the land is used for salt production.

4.6.3.1.5 Ponds

Ponds are largely located at roadside area and associated with individual houses or Mosques. Ponds are maintained often to fulfill the requirement of water for household use and fish culture purpose. In the study area, many homestead ponds and roadside ponds are available for extensive, semi-intensive, intensive aquaculture. Major species culture in the ponds are Rui (*Labeo rohita*), Koi (*Anabas testudineus*), Katol (*Catla catla*), Silver carp (*Hypophthalmichthys molitrix*), and Tilapia (*Oreochromis niloticus*).

4.6.3.1.6 Salt Pans

Saltpans are commonly found in Matarbari union of Maheshkhali. Salt pans habitat contributes about 27.14% of the AOI. It is observed that entire project site and major portion adjacent area fall in the salt pans area. Salt pans are mostly devoid of floral species but comprised of some intertidal rooted vegetation periodically inundated by tidal saline water. Based on consultation with local people, it was found that shrimp species (*Penaeus monodon*) is traditionally cultured during pre-monsoon post-monsoon season (December to May of each year). The average salt production is 25-30 MT/acre.

4.6.3.1.7 Sandy Beaches

Sandy beaches are observed in the western and southwestern part of Matarbari union and eastern coast of Kutubdia near Kutubdia channel. These areas are mostly devoid of major floral taxa. Some predominant species observed in this area are *Ipomoea pes-caprae*, *Tamarix indiaca* and *Pandanus fascicularis*.

4.6.3.1.8 Mudflats

Some mudflat area is located at the north side near Ujantia and north-western side of the project site within the intertidal zone comprising 1.16% within the AOI. Rich assemblage of marine invertebrates found here make it an important foraging area for shorebirds. In addition, low levels of human activity in the north and north-western part of the AOI have made the mudflat area increasingly important for birds.

4.6.3.2 Aquatic Flora (Aquatic Macrophytes)

Aquatic vegetation (macrophytes) is mainly recorded in the ditches, rivers, canals and aquacultural ponds within the AOI. It provides cover for fish, substrate for aquatic invertebrates, produces oxygen, and act as food for some fish and wildlife. Diversified macrophytes were found in the study area due to the enriched presence of different water habitats (Freshwater and brackish water).

Major species observed in these habitats are Water fern (*Azolla filiculoides*), Common water hyacinth (*Eichhornia crassipes*), Water spinach (*Ipomea aquatic*), Pink morning glory (*Ipomoea carnea*), Red Water Lily (Nymphaea rubra), Blue lotus (*Nymphaea nouchali*), Dwarf copperleaf (*Alternantha sessilis*), Sedges (*Cyperus sp.*), Helencha (*Enhydra fluctuens*), Narrowleaf cattail (*Typha angustata*), Alligator weed (*Alternanthera phyloxeroides*), Water lettuce (*Pistia stratiotes*), Taro (*Colocasia esculenta*), Asian watergrass (*Hygroryza aristate*), Water Primrose (*Jussiaea repens*), Greater duckweed (*Spirodela polyrhiza*), and Water chestnut (*Eleocharis sp.*), etc. Some pictures of Aquatic Macrophyte of the study area are presented in **Figure 4-49**.

Figure 4-49: Some Pictures of Aquatic Macrophytes of the Study Area

		
Water spinach (*Ipomea aquatic*)	Common water hyacinth (*Eichhornia crassipes*)	Water lettuce (*Pistia stratiotes*)

		
Alligator weed (*Alternanthera phyloxeroides*)	Pink morning glory (*Ipomoea carnea*)	Taro (*Colocasia esculenta*)

Source: EQMS Field Survey, October 2022, and February 2023

4.6.3.3 Aquatic Fauna

4.6.3.3.1 Ichthyofauna

The prime objective of the fisheries study is to examine and evaluate the overall fisheries status (capture and cultured fish species) in the study area. The project area is situated adjacent to the Kohelia River (eastern and south-eastern sides). Fish market survey, consultation with local people, focus group discussion with fishermen, KII with Senior Upazila Fisheries Officer of Maheshkhali Upazila and Kutubdia Upazila and Marine Fisheries Officer of Kutubdia Upazila was employed to know the fish species composition (**Figure 4-51**).

Three basic kinds of fishing activities were observed in Matarbari Island- aquaculture, deep Sea fishing, estuarine and near shore fishing. In case of deep-sea fishing, fishermen used mechanized larger boats and stayed 5 to 10 days or even more depending on the distance. Smaller boats or non-mechanized boats is usually used for near shore fishing.

Pond and Gher based aquaculture practice is very common in project adjacent areas. Common fish species cultured in the ponds are Rui (*Labeo rohita*), Catla (*Catla catla*), Nile Tilapia (*Oreochromis niloticus*), Silver Carp (*Hypophthalmichthys molitrix*), Big head (*Hypopthalmicthys nobilis*), Koi (*Anabas testudineus*), Tengra (*Mystus tengra*), Baila (*Glossogobius giuris*), Chapila (*Gadusia chapra*), Mola (*Amblypharyngodon mola*) etc.

Shrimp culture in ghona/ghers are very common practice in the project adjacent area of Matarbari union. The average production is 60-70 kg/acre. Common cultured shrimp species are Bagda Chingri (*Penaeus monodon*), Chaka Chingri (*Penaeus indicus*), Harina Chingri (*Metapenaeus monoceros*), Saga Chingri (*Metapenaeus brevicornis*) etc.

Estuarine and near shore fishermen used non-mechanized and small mechanized boat with Marine Set Bag Net (MSBN) for fishing in Kutubdia channel. According to the consultation with local fishermen and Marine Fisheries Officer of Kutubdia Upazila, common fish and shrimp species found in the Kutubdia Channel are Bombay Duck (*Harpadon nehereus*), Asian sea bass (*Lates calcarifer*), Paradise threadfin (*Polynemus paradiseus*), Yellowfin Sea bream (*Acanthopagrus morrisoni*), Poa (*Argyrosomus amoyensis*), Largehead hairtail (*Trichiurus lepturus*), Grenadier anchovy (*Coilia* sp.) etc. Commercially important fish like Hilsha (*Tenualosa ilisha*) were occasionally found in the Kutubdia channel during monsoon period.

A handsome amount of Wild shrimp Post Larvae (PL) and some shrimp species is collected by local fishermen from Kutubdia channel and adjacent estuary of Matamuhuri River. Different types of net such as set bag net, push net, and drag net is used to collect shrimp Post larvae (PL) and shrimp species. Common shrimp and prawn species found in the estuary are Bagda Chingri (*Penaeus monodon*), Harina Chingri (*Metapenaeus monoceros*), Saga Chingri (*Metapenaeus brevicornis*), Dhania chingri (*Acetes indicus*), Saga Chingri (*Metapenaeus brevicornis*), Giant freshwater prawn (*Macrobrachium rosenbergii*) etc. Different types of fishing gears are being used by the fishermen of Matarbari union.

Most fishermen used Ilish jal (Gill net), Maitya jal (Large meshed drift net) and Undara jal (Set bag net) for deep sea fishing while Behundi jal (Estuarine set bag net) for estuarine and nearshore fishing.

During the field visit, fishery study was also undertaken through six (6) Fish markets were survey located in the project adjacent area. The names of the surveyed fish market are presented in **Table 4-23**.

Table 4-23: A list of Fish market surveyed in Project AOI

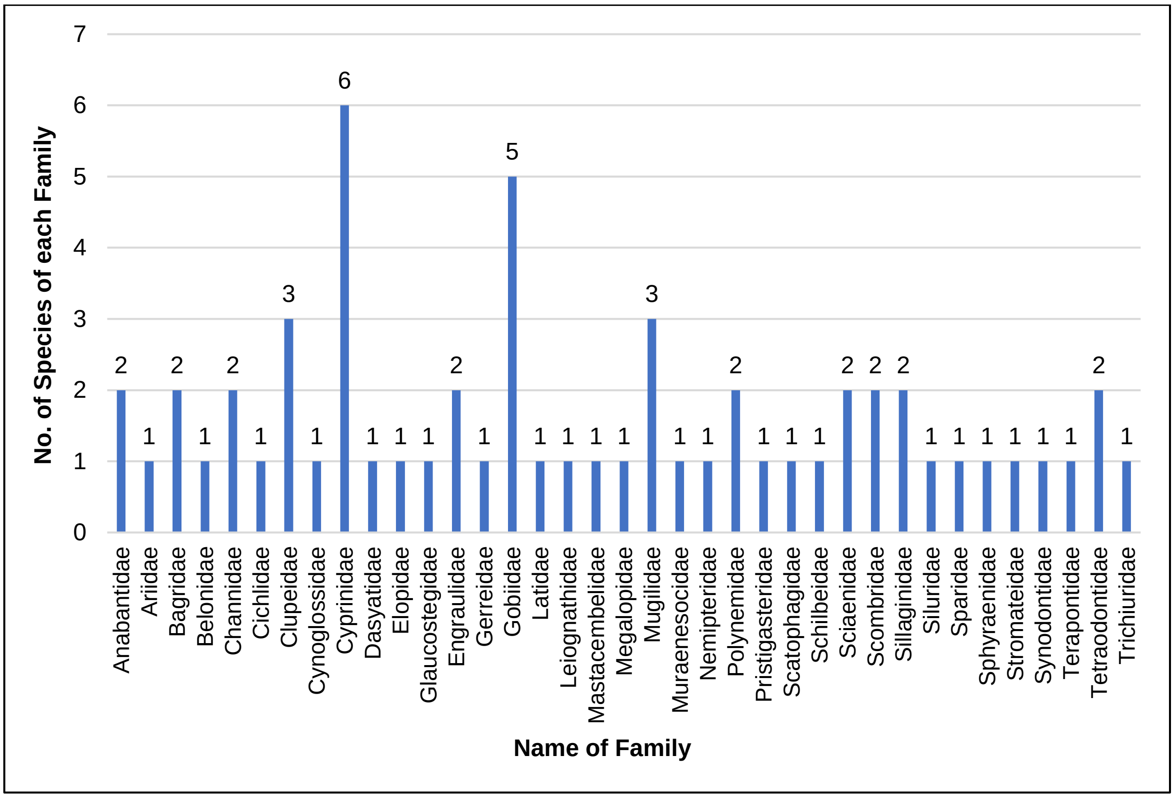
Sl. No.	Name of Fish Market	Address	GPS Coordination
1.	Notun Bazar Fish Market	Notun Bazar, Matarbari	21°43'59.75" N and 91°53'52.07" E
2.	Puran Bazar Fish market	Puran Bazar, Matarbari	21°43'43.99" N and 91°53'30.39" E
3.	Uttor Rajghat Fish Market	Uttor Rajghat, Matarbari	21°44'0.38" N and 91°54'18.51" E
4.	Mogdale Fish Market	Mogdale, Matarbari	21°43'18.60" N and 91°53'9.87" E
5.	Bangla Bazar Fish Market	Bangla Bazar, Matarbari	21°43'35.59" N and 91°53'14.16" E
6.	Shantipur Fish Market	Shantipur, Matarbari	21°42'52.63" N and 91°52'33.70" E

Source: EQMS Field Survey, October 2022, and February 2023

A total of Fifty-Nine (59) species of fish and Fifteen (15) species of crustaceans were recorded from the study of October 2022, and February 2023. Most of the fish found in the study area were capture species. The recorded fifty-Nine (59) fish species are covered under Thirty-seven (37) families. The highest number of fish species belong to the family Cyprinidae (6 species) followed by Gobiidae (5 species).

According to the IUCN Red List of Bangladesh, one (1) Vulnerable (*Gudusia chapra*), one Near Threatened (NT) (*Mystus gulio*), and one Endangered (*Ompok pabda*) species was recorded. According to Global IUCN Red List status (Version 2022-2), One Critically Endangered (CR) (*Glaucostegus typus*) and Three (3) fish species namely *Ompok pabda*, *Harpadon nehereus*, and *Brevitrygon walga*) was reordered as Near Threatened (NT). Family-based fish species diversity has been presented in **Figure 4-50**.

Figure 4-50: Family-Based Fish Species Diversity in the AOI



Source: EQMS Field Survey, October 2022, and February 2023

During the field visit, fifteen (15) species crustaceans under Six (6) families were recorded in the AOI. In addition, three species of crab were observed dominant in the AOI, which are Giant mud crab (*Scylla serrata*), Red Ghost crabs (*Ocypode macrocera*) and Horned Ghost Crab (*Ocypode brevicornis*) Traditionally, crab harvester caught crabs (*Scylla serrata*) by a metal pole (iron hook) with a twisted tip. This metal pole is inserted into the burrow by the catcher and used to pull the crab out. Red Ghost crab and Horned Ghost Crab are observed in the sandy beach area (western side) adjacent to the project site.

A detailed checklist of different fish, and crustacean species observed from the study area have been presented in **Appendix E-7** and **Appendix E-8.** Also, a Photo plate of observed fish and crustacean species have been provided in **Appendix F-4**. Fisheries survey and consultation activities have been presented in **Figure 4-51.**

Figure 4-51: Consultation and Fisheries Survey activities in the Study area

		
KII with Senior Upazila Fisheries Officer, Maheshkhali	KII with Marine Fisheries Officer, Kutubdia	KII with Forest Range Officer, Kutubdia

		
Consultation with Local fishing community, Bandi Shikdarpara	FGD with Fishermen in Jaliapara, Kutubdia	Informal interview with salt pan workers
		
Fishermen repairing their fishing net	Fishing with barrier net (Char Pata Jal) in the north western side of Project AOI	Dried Fish (Shutki) Preparation in Matarbari Sea Beach
		
Fishing activity with Push net in adjacent canal of Kohelia River	Fishing activity with cast net in Kohelia River	Fishing Activity with hooks and Line in Kutubdia Channel
		
Listing of Fish species at Puran Bazar Fish Market, Matarbari	Fish market survey at Bangla Bazar Fish Market, Matarbari	Fish Market Survey at Mogdale Fish Market, Matarbari

Source: EQMS Field Survey, October 2022, and February 2022

4.6.3.3.1.1 Hilsa Breeding and Migration Route

Hilsa (*Tenualosa ilisha*) comprises the largest and most valuable single fishery of Bangladesh. Hilsa shad is largely anadromous and fast swimming euryhaline pelagic fish, occurring in brackish water and marine environment of the Bay of Bengal. Its marine distribution extends to 200–250 km in the Bay of Bengal off the coast of Bangladesh. Hilsa contributes 12.22 percent of the total fish production of

Bangladesh. Hilsha constitutes 1 percent of the Gross Domestic Product (GDP) of Bangladesh and provide a good support to the economy of the country by earning foreign exchange[17].

The spawning of hilsa takes place almost around the year, but the major spawning appears to take place in October- November, with subsidiary spawning in June-July and February-March based on the full moon phase and most of the brood hilsa has been caught during this period from the spawning grounds of the country[18].

Six Hilsa sanctuaries and four major spawning grounds in the coastal and freshwater areas of the country have been established under the "Protection and Conservation of fish Act-1950" for the effective conservation of Jatka and brood Hilsa in the major nursery and spawning areas (**Table 4-24** and **Figure 4-52**).

Table 4-24: Hilsa Sanctuary and Ban Period in Bangladesh

Sl. No.	Hilsa Fish Sanctuary Area	Boundary Points	Fishing Ban Period
1	From Shatnol of Chandpur to Char Alexander of Laxmipur (100 km stretch of lower Meghna River)	Shatnol Point (90°37.12' E and 23°28.19' N) and Char Alexander point (90°49.30' E and 22°40.92' N)	From March to April each year
2	Char Ilisha to Char Pial of Bhola district (90 km stretch of Shahbazpur channel, a tributary of Meghna River)	Char Ilisha Mosque Point (90°38.85' E and 22°47.30' N) and Char Pial Point (90°44.81' E and 22°5.10' N)	From March to April each year
3	Bheduria of Bhola district to Char Rustam of Patuakhali (100 km stretch of Tetulia River).	Bheduria Ferryghat Mosque Point (90°33.89' E and 22°42.31' N) and Mandolbazar (Char Rustam) (90°31.40' E and 21°56.32' N).	From March to April each year
4	Whole 40 km stretch of Andhermanik River in Kalapara Upazila of Patuakhali.	Bheduria Ferry ghat Mosque Point (90°33.89' E and 22°42.31' N) and Mandolbazar (Char Rustam) (90°31.40' E and 21°56.32' N).	From November to January each year
5	20 km stretch of Lower Padma River between Naria-Bhedorganj Upazila of Shariatpur in the north and Matlab Upazila of Chandpur and Bhedorganj Upazila of Shariatpur in the south.	The confluence of the Bay of Bengal and Andhermanik River (90°3.91' E and 21°49.43' N). Kachikata Point of Bhedorganj Upazila of Shariatpur district in the northeast (90°32.6' E and 23°19.8' N). Bhomkara point of Naria Upazila of Shariatpur District in the northwest (90°28.8' E and 23°18.4' N). Banaripara Point of Matlab Upazila of Chandpur. District in the southeast (90°37.7' E and 23°15.9' N) and Tarabunia Point of Bhedorganj Upazila of Shariatpur District in the southwest (90°35.1' E and 23°13.5' N).	From March to April each year
6	Total Length of 82 km between three different river points of Barisal district. Three points are: a) Total 13.70 km stretch of the Kalabadar River	i. Habinagar point: (22°45'1.08" N and 90°25'10.2" E) ii. Bamnar Char point: (22°49'22.44" N and 90°28'5.16" E)	From March to April each year

[17] DoF2022. National Fish Week 2022 Compendium (*in Bangla*). Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh.160p.

[18] Sunny, A. R., Hassan, M. N., Mahashin, M., & Nahiduzzaman, M. (2017). Present status of hilsa shad (Tenualosa ilisha) in Bangladesh: A review. *Journal of Entomology and Zoology Studies*, 5(6), 2099-2105.

Sl. No.	Hilsa Fish Sanctuary Area	Boundary Points	Fishing Ban Period
	between Habinagar point, Barisal Sadar Upazila and Bamnar Char point, Mehendigonj Upazila of Barishal.		
	b) Total 8.81 km stretch of the Gajaria River between Bamnar Char point of Mehendigonj Upazila and Hizla Launch Ghat point, Hizla Upazila of Barishal	iii. Bamnar Char point: (22.8229° N and 90.4681° E) iv. Hizla Launch Ghat point: (22.9067° N and 90.5308° E)	
	c) Total 59.51km stretch of the Meghna River between Hizla Launch Ghat point of Hizla Upazila and Dashkim-Paschim Jangalia point, Mehendigonj Upazila of Barishal	v. Hizla Launch Ghat point: (22.9067° N and 90.5308° E) vi. Dashkim-Paschim Jangalia point: (22.7333° N and 90.4917° E)	

Source: MoFL, 'Circular SRO No 301 Law/2011' and 'Circular SRO No 107 Law/2018'

According to the Bangladesh Gazette (13th September 2017), Ministry of Fisheries and Livestock (MoFL) has been extended the spawning period as 22 days. As per Law, No person shall catch, carry, transport, offer, sell, barter, expose or possess Hilsa fish only throughout the country during the peak spawning period[19] .The details of the established spawning ground and period of Hilsa are presented in **Table 4-25** and **Figure 4-52**.

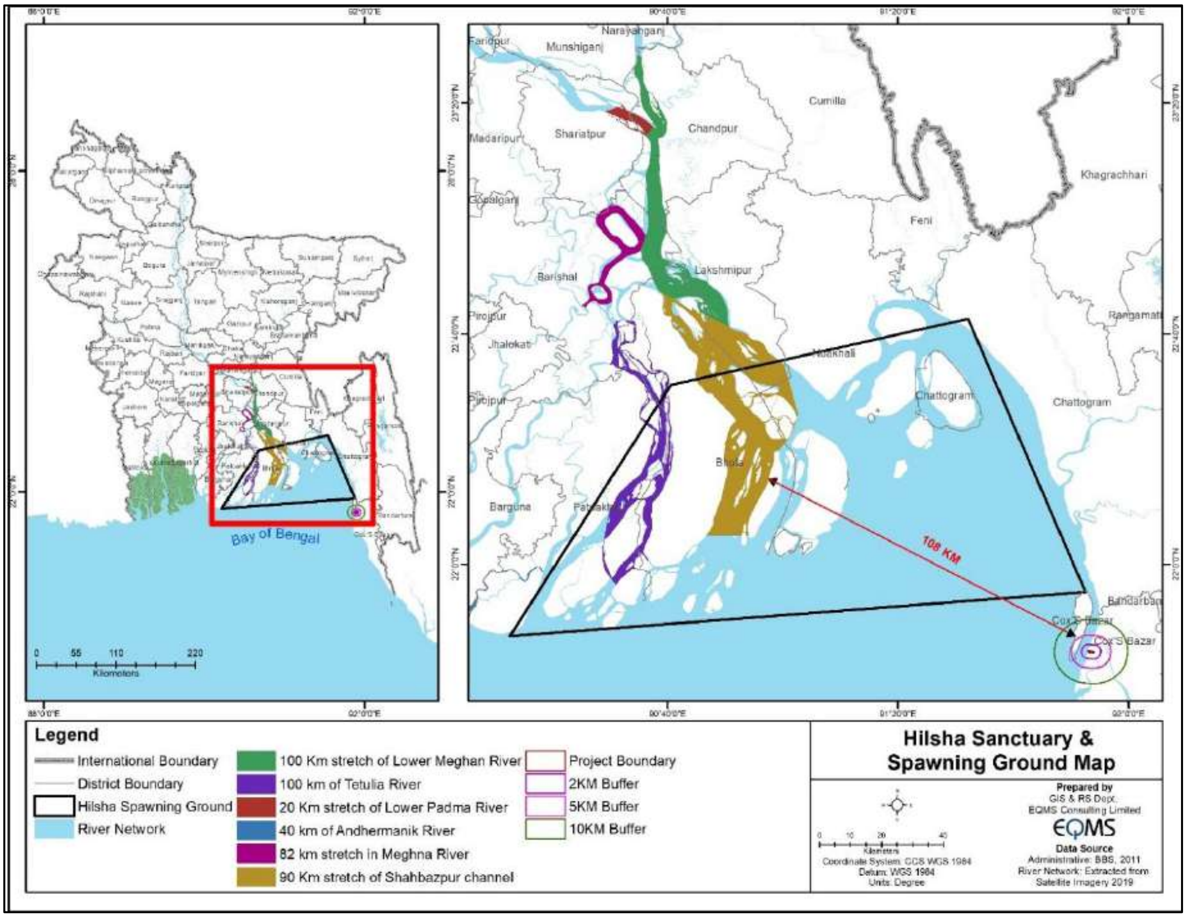
Table 4-25: Established Hilsa Spawning Ground of Bangladesh

Sl. No.	Hilsa spawning ground	Coordinates	Border length (sq. km)	Spawning Period	District
1.	Mayani point, Mirsarai	91°32.15" E 22°42.59" N	125	4 (four) days before and 17 (seventeen) days after the full moon including the day of full moon, that is, total 22 (twenty-two) days of the moon, which will be first appeared in the Bengali month of Ashwin each year	Chattogram
2.	Paschim Syed Awlia point, Tajumuddin	90°40.58" E 22°31.16" N	80		Bhola
3.	North Kutubdia point, Kutubdia	90°40.58" E 22°31.16" N	120		Cox's Bazar
4.	Lata Chapali point, Kalapara	90°12.59" E 21°47.56" N	194		Patuakhali

Source: Bangladesh gazette 28 May 2014, MoFL

[19] Bangladesh gazette 28 May 2014, MoFL

Figure 4-52: Hilsa Spawning Ground and Sanctuary

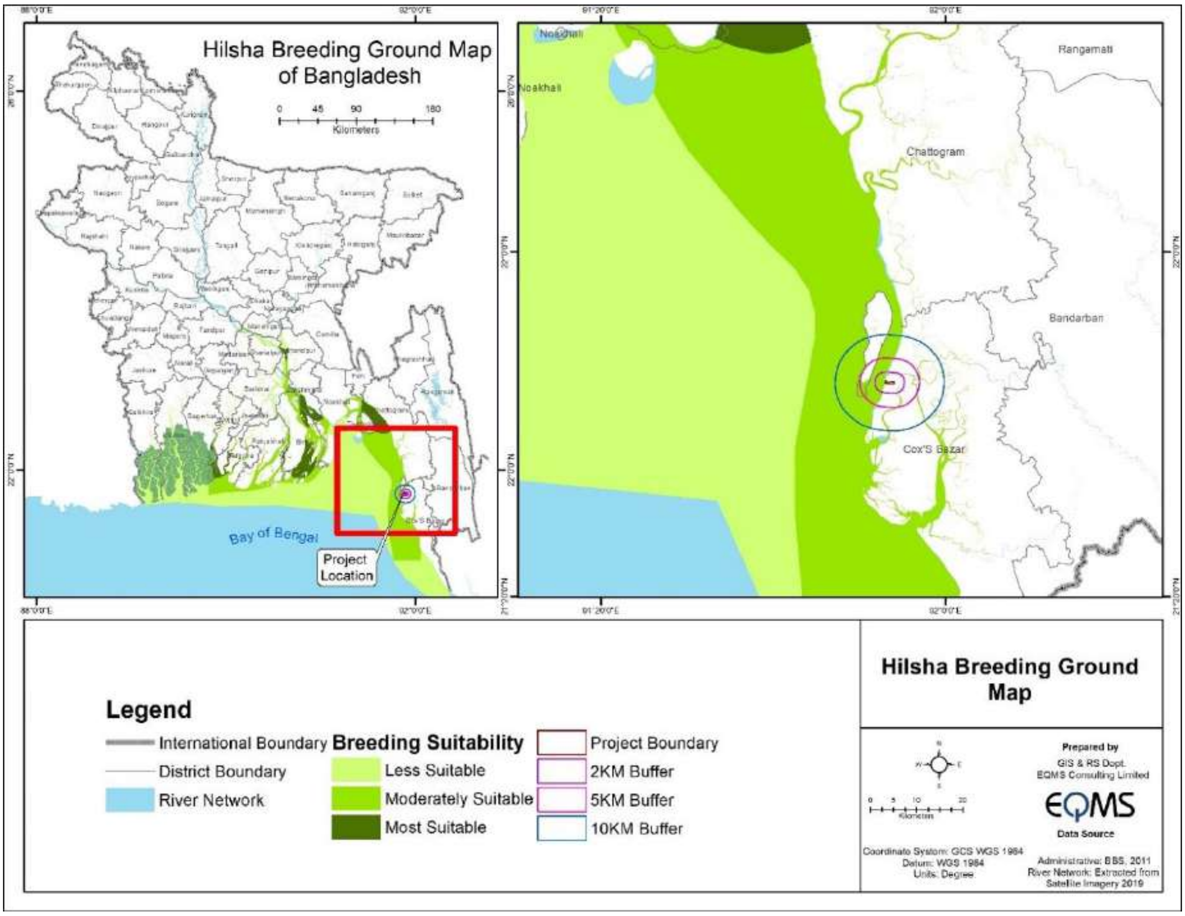


Source: Ministry of Fisheries and Livestock (MoFL)

The proposed project site in not located inside or near to any Hilsa sanctuary and spawning ground. The nearest Hilsa sanctuary is the Char Ilisha to Char Pial (90 km stretch of Shahbazpur channel, a tributary of Meghna River), which is located approximately at an aerial distance of 108 km North-west from the site.

During the consultation with local fisherman, Literature review, FGD and KII with Senior Upazila Fisheries Officers of Maheshkhali and Kutubdia Upazila, revealed that, Hilsa were hugely found in the Kutubdia Channel before 2000s but now-a- days due to the presence of high anthropogenic activities and local fishing Hilsa population changed the route of migration. According to consultation, it was revealed that Hilsa migrate from deep sea towards Gandamara Point (21º 55' 19.00 N and 91º 52' 51.60" E) at Bashkhali where they breed and then the school begin its journey to enter Meghna River system. The Gandamara Point is located at the 7 km North of the Kutubdia Island. The study area falls in 'moderately suitable' habitat for Hilsa breeding (**Figure 4-53**). As mentioned above, the main school of migratory hilsa fish travel from deep sea to the spawning ground at Gandamara. Due to this reason some sporadic occurrence of hilsa may be presented at the rivers including the Matamuhuri River and Kutubdia Channel.

Figure 4-53: Hilsha Breeding Ground Map of Bangladesh



Source: Hossain *et al.* (2014)[20]

4.6.3.3.2 Plankton and Benthos Profile of AOI

For the qualitative study, plankton was collected by plankton net (No. 20 silk bottling cloth, mesh size: 45 µm) at predefined six (6) sample collection points (**Table 4-26** and **Figure 4-54**). After collection, they were preserved in 3% formalin and a few drops of Glycerin and Lugol's solution. After adding preservatives, they were brought to the laboratory for species identification and numerical abundance. Pictorial views of plankton sample collection are shown in **Appendix F-5.**

Benthos samples were collected by Ekman bottom grab sampler from predefined Six (6) selected points of proposed project AOI (**Table 4-26** and **Figure 4-54**), and sediment from the sampler was taken into plastic bucket and mixed with water. Then the mixed water passed through a 0.5 mm mesh-sized hand-sieve to remove the waste particles, and the separated macro-benthos with other residue were preserved in labeled plastic containers with 10% buffered formalin and transferred to the laboratory for further analysis. Organisms were sorted and enumerated under major taxa. An electric microscope was also used to identify benthos. A pictorial presentation of benthos sampling is given in **Appendix F-6**.

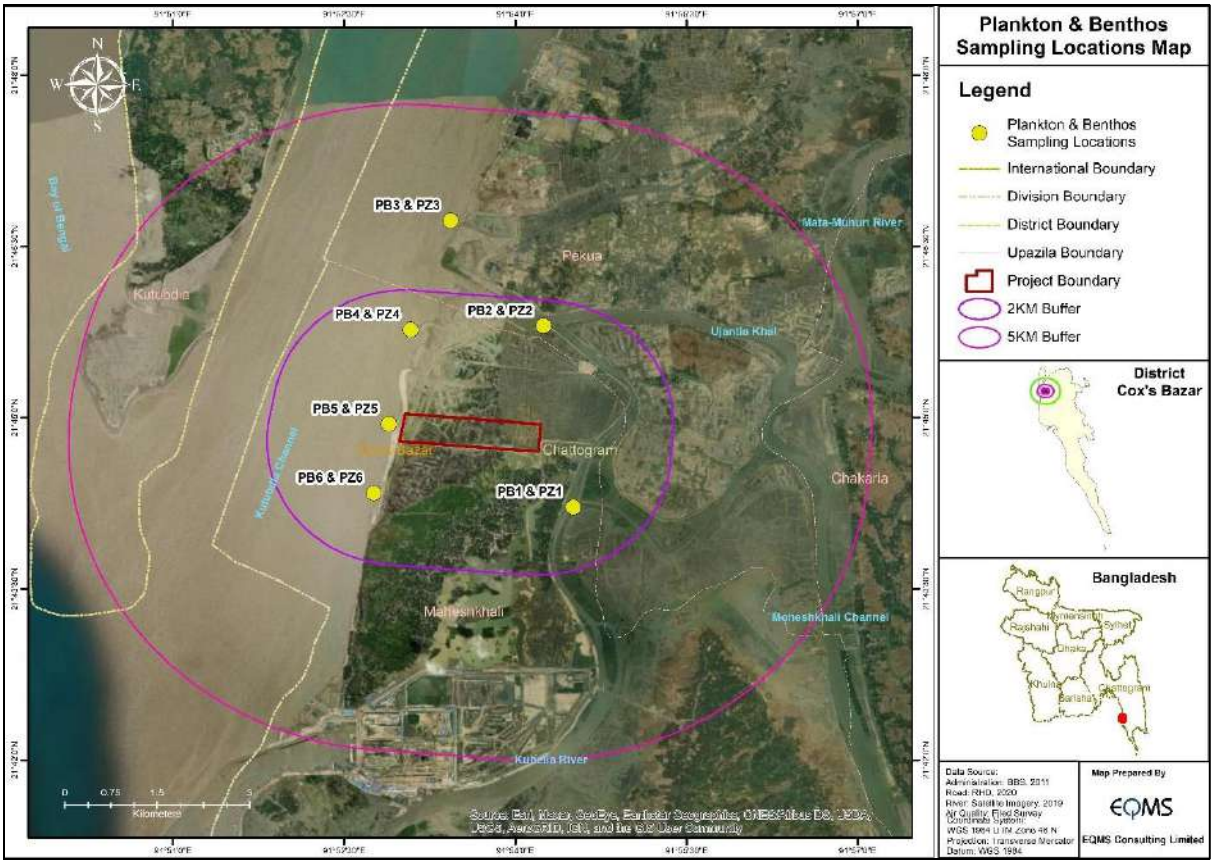
[20] Hossain, M. S., Sarker, S., Sharifuzzaman, S. M., & Chowdhury, S. R. (2014). Habitat modelling of juvenile Hilsa Tenualosa ilisha (Clupeiformes) in the coastal ecosystem of the northern Bay of Bengal, Bangladesh. Journal of ichthyology, 54, 203-213

Table 4-26: Sampling Points for Plankton and Benthos survey

Sl. No.	Sample Location	distance and direction from Project area	Plankton Sample Code	Benthos sample code	GPS coordinates
1.	Kohelia River	Approximately 1055-meters South-east side from Proposed project site	PZ1	PB1	21°44'12.91"N 91°54'30.48"E
2.	Matamuhuri River	Approximately 1700-meters north-east from proposed project site	PZ2	PB2	21°45'48.11"N 91°54'14.76"E
3.	Kutubdia Channel (Upstream)	Approximately 3100-meters north-west from Proposed project site	PZ3	PB3	21°46'43.48"N 91°53'26.05"E
4.	Kutubdia Channel (Confluence)	Approximately 1347-meters North from Proposed project site	PZ4	PB4	21°45'46.18"N 91°53'4.92"E
5.	Kutubdia Channel (Downstream-1)	Approximately 200-meters West from Proposed project site	PZ5	PB5	21°44'56.59"N 91°52'53.44"E
6.	Kutubdia Channel (Downstream-2)	Approximately 900-meters South-west from Proposed project site	PZ6	PB6	21°44'20.31"N 91°52'45.53"E

Source: EQMS Field Survey, October 2022

Figure 4-54: Map Showing Plankton and Macrobenthos Sampling Locations



Source: EQMS Field Survey, October 2022

4.6.3.3.2.1 Phytoplankton

A total of Eleven (11) species of phytoplankton were identified by sample analysis from six predefined sample collection locations. The phytoplankton in the study area was represented by three groups and the dominant phytoplankton class was the Bacillariophyceae. In the case of species, *Navicula sp*. was dominant under Bacillariophyceae. Species composition and numbers of phytoplankton per liter have been presented in **Table 4-27**.

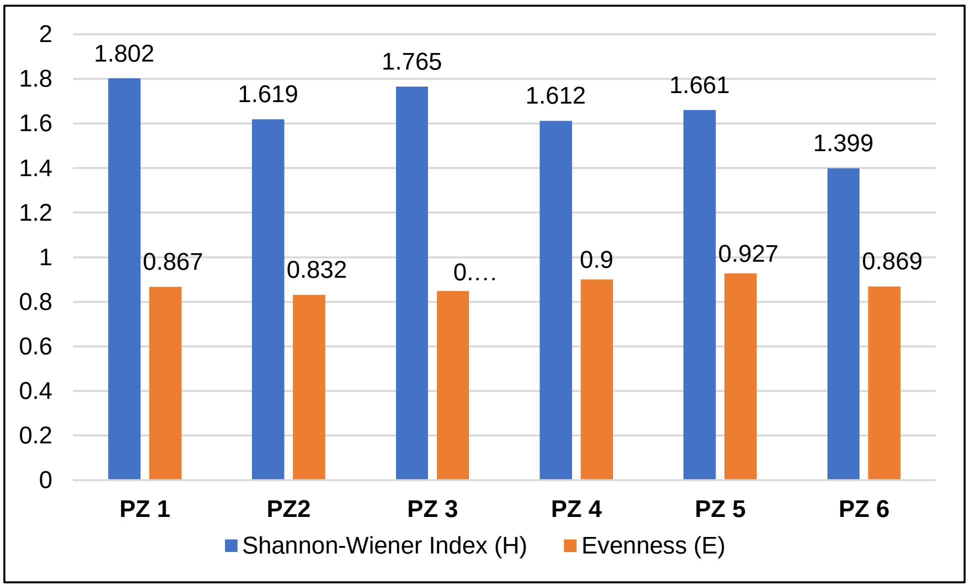
Table 4-27: List of Phytoplankton found in the Study Area

Sl. No	Class	Genus	Number (individuals/ L)					
			PZ1	PZ2	PZ3	PZ4	PZ5	PZ6
1.	Bacillariophyceae	*Amphora* sp.	1	2	0	2	0	1
2.		*Melosira* sp.	3	0	1	0	1	0
3.		*Navicula* sp.	8	18	5	9	0	0
4.		*Synedra* sp.	12	3	8	0	0	3
5.		*Nitzschia* sp.	7	3	2	0	1	0
6.		*Chaetoceros* sp.	0	0	1	3	3	2
7.		*Volvox* sp.	2	16	11	5	0	0
8.		*Odontella* sp.	0	3	0	0	0	5
9.		*Rhizosolenia* sp.	1	7	0	2	3	0
10.	Dinophyceae	*Ceratium* sp.	7	0	2	0	1	8
11.		*Gonyaulax* sp.	0	0	3	9	3	0

Source: EQMS Laboratory Analysis, October 2022

The Shannon-Wiener diversity indices by sampling location have been presented in **Figure 4-55**. The graph indicates that the diversity of Phytoplankton is higher in the Kohelia River adjacent to the Rajghat Bridge (PZ1) and lower in the sampling point PZ6 (Downstream of Kutubdia Channel). Evenness is higher in the sampling point PZ5 and Lower in PZ2. Higher Evenness value of PZ5 indicate that the number of Phytoplankton class is more evenly distributed followed by PZ4, PZ6, PZ1, PZ3 and PZ2, respectively.

Figure 4-55: Diversity Indices of Phytoplankton



Source: EQMS Field Survey, October 2022

4.6.3.3.2.2 Zooplankton

A total of Nine (09) species of zooplankton were identified by sample analysis from six predefined sample collection locations. *Acetes indicus* was the highest abundant zooplankton species. The location of species composition and the number of zooplankton per liter has been presented in **Table 4-28**.

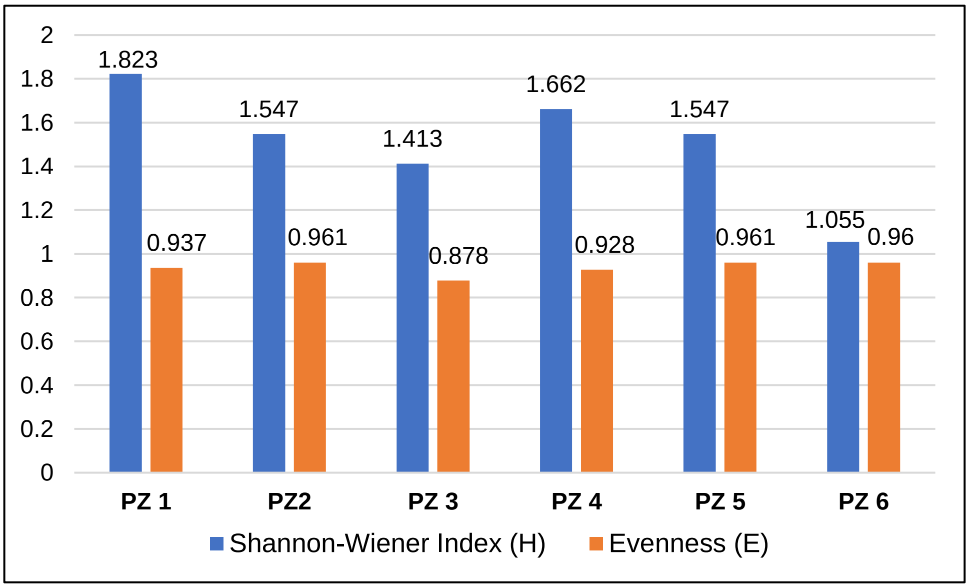
Table 4-28: A Checklist of Zooplankton found in the Study Area

Sl. No.	Group/Order	Genus	Number (individuals/ L)					
			PZ1	PZ2	PZ3	PZ4	PZ5	PZ6
1.	Copepoda	*Calocalanus* sp.	3	2	0	5	3	1
2.		*Calanus* sp.	4	2	1	0	0	2
3.	Decapoda	*Acetes indicus*	6	3	0	4	1	0
4.		Crab zoea	3	0	5	0	2	0
5.		*Penaeus* sp.	0	1	4	9	5	0
6.	Calanoida	*Calanopia* sp.	1	3	0	2	0	2
7.	Aphragmophora	*Sagitta* sp.	5	2	5	0	2	0
8.	Anomopoda	*Moina* sp.	4	3	1	1	3	0
9.		*Daphnia* sp.	9	2	5	3	0	0

Source: Laboratory Analysis, October 2022

The Shannon-Wiener diversity indices by sampling location have been presented in Figure 4-56. The graph indicates diversity is higher in the Kohelia River adjacent to the Rajghat bridge (PZ1) and lower in the sampling point PZ6. Evenness value is higher in the sampling points PZ2 and PZ5. Lower evenness is shown in PZ3. Higher Evenness value of PZ2 and PZ5 indicates that the number of Zooplankton class is more evenly distributed among the other sampling points.

Figure 4-56: Diversity Indices of Zooplankton



Source: EQMS Field Survey, October 2022

4.6.3.3.2.3 Benthos

Fourteen (14) genera were identified from six sampling locations. These genera belong to Crustaceans, Annelids, Polychaetas, Oligochaetes, Gastropoda and Bivalvia etc. In the present study, Macrobenthos abundance varied between 622 and 45 individuals per square meter (indv. /m2). The location of species composition and the number of individuals per square meter have been presented in **Table 4-29**.

Table 4-29: A Checklist of Benthos organisms Identified in the Study Area

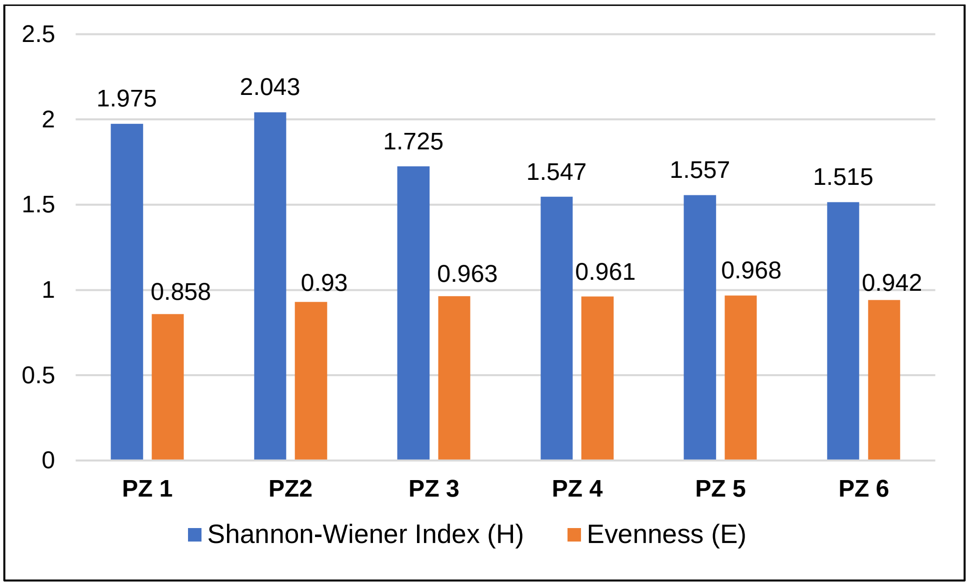
Sl. No.	Groups	Taxa/ Species	PB1		PB2		PB3		PB4		PB5		PB6	
			n	N	n	N	n	N	n	N	n	N	n	N
1.	Gastropoda	*Architectonica laevigata*	2	89	0	0	0	0	0	0	2	89	0	0
2.	Gastropoda	*Anachis miser*	1	44	2	89	0	0	1	44	0	0	0	0
3.	Gastropoda	*Indoplanorbis exustus*	3	133	2	89	4	178	0	0	0	0	0	0
4.	Gastropoda	*Cerithidea* sp.	0	0	2	89	2	89	0	0	0	0	2	89
5.	Gastropoda	*Bellamya* sp.	2	89	0	0	0	0	2	89	0	0	0	0
6.	Polychaeta	*Lumbrineris* sp.	2	89	0	0	5	222	0	0	1	44	0	0
7.	Polychaeta	*Nereis* sp.	14	622	7	311	3	133	0	0	0	0	0	0
8.	Bivalvia	*Anadara* sp.	0	0	0	0	2	89	3	133	0	0	6	267
9.	Bivalvia	*Trachycardium* sp.	0	0	1	44	0	0	0	0	2	89	3	133
10.	Bivalvia	*Donax* sp.	0	0	0	0	0	0	3	133	0	0	0	0
11.	Bivalvia	*Mactra* sp.	2	89	2	89	0	0	0	0	3	133	2	89
12.	Insecta	Chironomus larvae	3	133	2	89	0	0	2	89	0	0	0	0
13.	Crustacea	Shrimp larvae	4	178	3	133	0	0	0	0	2	89	3	133
14.	Annelida	*Tubifex* sp.	3	133	4	178	5	222	0	0	0	0	0	0

Source: Laboratory Analysis, October 2022

*n= Number of individuals per sample (Grab area= 0.0225 m^2); N= Number of individuals/m^2

The Shannon-Wiener diversity indices by sampling location have been presented in **Figure 4-57**. The graph indicates macrobenthos diversity is higher in the Ujantia canal (PB2) and lower in the sampling point PB6.Evenness value is higher in the sampling point PZ5, and Lower evenness is shown in PZ1. Higher Evenness value of PZ5 indicates that the number of Benthos class is more evenly distributed among the other sampling points.

Figure 4-57: Diversity Indices of Benthos



Source: EQMS Field Survey, October 2022

4.6.3.3.3 Marine Mammals

Among the cetacean, the Dolphin is the common name of marine mammals which deserves not only an attention but also a good care and respect to survive because stability of their societies is integrally tied to the health of the planet Earth. The aquatic mammalian species is the best indicator for the health of water specially dolphins.

There was no direct sighting of dolphin occurrences during the field study in October 2022 and February 2023. Consultation with local community, fishermen and local staff of the Bangladesh Forest Department revealed that, Irrawaddy dolphin (*Orcaella brevirostris*) and Indo-pacific humpback dolphin (*Sousa chinensis*) are rarely seen at the Kutubdia Channel during the monsoon season.

In the study area team have not observed any dolphin species. However, consultation with the local people and relevant secondary sources suggested that a total of four (04) dolphin species can be found in the fishing zone (10-15 km) far from Kutubdia Island and in the surrounding offshore areas (**Table 4-30**).

Table 4-30: Marine Mammal Species in the Study Area

Sl. No.	Common Name	Local Name	Scientific Name	IUCN Red List of Bangladesh, 2015*	IUCN Red List Version 2022-2**	Wildlife conservation and security Act, 2012
1.	Irrawaddy Dolphin	Iraboti	Orcaella brevirostris	NT	EN	Sch-I
2.	Indo-pacific Humpback Dolphin	Golapi Dolphin	Sousa chinensis	LC	VU	Sch-I
3.	Indo-Pacific Bottlenose Dolphin	Botolnaak Samudrik Shishu	Tursiops aduncus	LC	NT	Sch-I
4.	Indo-Pacific Finless Porpoise	Paknahin Choto Shishu	Neophocaena phocaenoides	NT	VU	Sch-I

Source: EQMS Field Survey, October 2022, and February 2023

*IUCN Bangladesh. 2015. Red List of Bangladesh Volume 2: Mammals. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. xvi+232; **IUCN 2022. The IUCN Red List of Threatened Species. Version 2022-2. (*https://www.iucnredlist.org/*). Status Code: LC= Least Concern; VU=Vulnerable, EN= Endangered; DD=Data Deficient

4.6.3.3.4 Sea Turtles

Sea turtles occupy a special niche in the marine ecosystem and have survived millions of years in this environment. Seven species of sea turtle live in the world's oceans. Five species of sea turtles are found in the territorial water of Bangladesh, namely Olive Ridley turtle (*Lepidochelys olivacea*), Green turtle (*Chelonia mydas*), Hawksbill turtle (*Eretmochelys imbricata*), Loggerhead turtle (*Caretta caretta*) and Leatherback turtle (*Dermochelys coriacea*)[21]. Two species of sea turtle have been recorded to nest regularly in Bangladesh, Olive Ridley turtles in greater numbers than Green Sea turtles[22]. Sea turtles that nest in Bangladesh is included in Schedule-I of the Bangladesh Wildlife (Conservation and Security) Act, 2012.

Table 4-31: List of Sea Turtle Present in Bangladesh and Status

Sl. No.	Common Name	Local Name	Scientific name	IUCN Red List of Bangladesh, 2015*	IUCN Red List Version 2022-2**
1.	Olive Ridley turtle	Jolpaironga Kachim	*Lepidochelys olivacea*	VU	VU
2.	Green Sea turtle	Sabuj Kachim	*Chelonia mydas*	CR	EN
3.	Hawksbill turtle	Bajthuti Kachim	*Eretmochelys imbricata*	CR	CR
4.	Loggerhead turtle	Mugurmatha Kachhim	*Caretta caretta*	DD	VU
5.	Leatherback turtle	Baro Kachhim	*Dermochelys coriacea*	CR	VU

Source: EQMS Field Survey, October 2022, and February 2023

*IUCN Bangladesh. 2015. Red List of Bangladesh Volume 4: Reptiles and Amphibians; **IUCN 2022. The IUCN Red List of Threatened Species. Version 2022-2. (*https://www.iucnredlist.org/*). Status Code: CR= Critically Endangered; VU=Vulnerable, EN= Endangered; DD=Data Deficient

The primary survey was conducted in the project AOI, the sandy beaches of Matarbari Island, sandy beach of Dhalghata union, Kutubdia Island and Hasher Char area. Sea Turtle survey aims to grasp the information of landing of sea turtle for laying eggs at sandy beaches of Matarbari, Sandy beach of Dhalghata, and Kutubdia Island.

During the study period, the team found six carcasses of Olive Ridley turtles (*Lepidochelys olivacea*) weighing approximately 25-35 kg each (**Figure 4-58**). Three of them found in the adjacent sandy beach of Hacher char (Dhalghata Union). Majority of local people and Fishermen of this area complained that those turtles came to the beach for laying eggs but attacked and killed by the stray dogs. The study team did not find any sign of nesting or laying eggs in this area.

Other three carcasses were found in the Matarbari Sandy Beach area (with in the project AOI). One of the carcasses is fresh. No sign of injury was seen in this carcass. Local people of adjacent settlements (Sairer Dale, Shantipur bazar, and Sagor Para) and fishermen told that, those sea turtles get entangled

[21] Sarker, M., Haque, A. B., Islam, M. N., & Jakariya, M. (2021). Climate Change Impact and the Conservation of Marine Turtles: A Case Study from Teknaf, Bangladesh. *Climate Change in Bangladesh: A Cross-Disciplinary Framework*, 205-234.

[22] Islam, M. Z. (2002). Marine turtle nesting at St. Martin's Island, Bangladesh. *Marine Turtle Newsletter*, 96, 19-21.

in the fishing nets, drown, and die of suffocation. Then the carcasses of turtle had been floated and carried toward the seashore area by the wave action.

During field survey, the study team did not find any nesting of turtles as their spawning and oviposition is controlled by tidal behavior. Consultation with a Local Marine Turtle Conservation Worker of Marinelife Alliance (an NGO worked for Turtle conservation) confirms that, sea turtles used to come to lay their eggs in Dhalghata Sea Beach (Adjacent to Sutaria Bazar of Dhalghata) and Hacher Char area frequently. But in 2022 and 2023, frequency of turtle nesting and breeding is lower than the previous year due to the predation activities of homeless dogs.

Figure 4-58: Carcasses of Olive Ridley Turtle (*Lepidochelys olivacea*) and Consultation with Local People



Carcasses of three Olive Ridley turtle (*Lepidochelys olivacea*) in Dhalghata Sandy beach (21°39'59.00"N, 91°51'24.68"E; 21°39'42.03"N, 91°51'21.66"E; and 21°39'29.67"N, 91°51'14.09"E)



Carcasses of three Olive Ridley turtle (*Lepidochelys olivacea*) in Matarbari Sandy beach (21°42'51.86"N, 91°52'29.65"E; 21°43'23.88"N, 91°52'35.59"E; and 21°44'6.46"N, 91°52'43.54"E)

Discussion with local people about Turtle carcasses in Matarbari Sandy beach

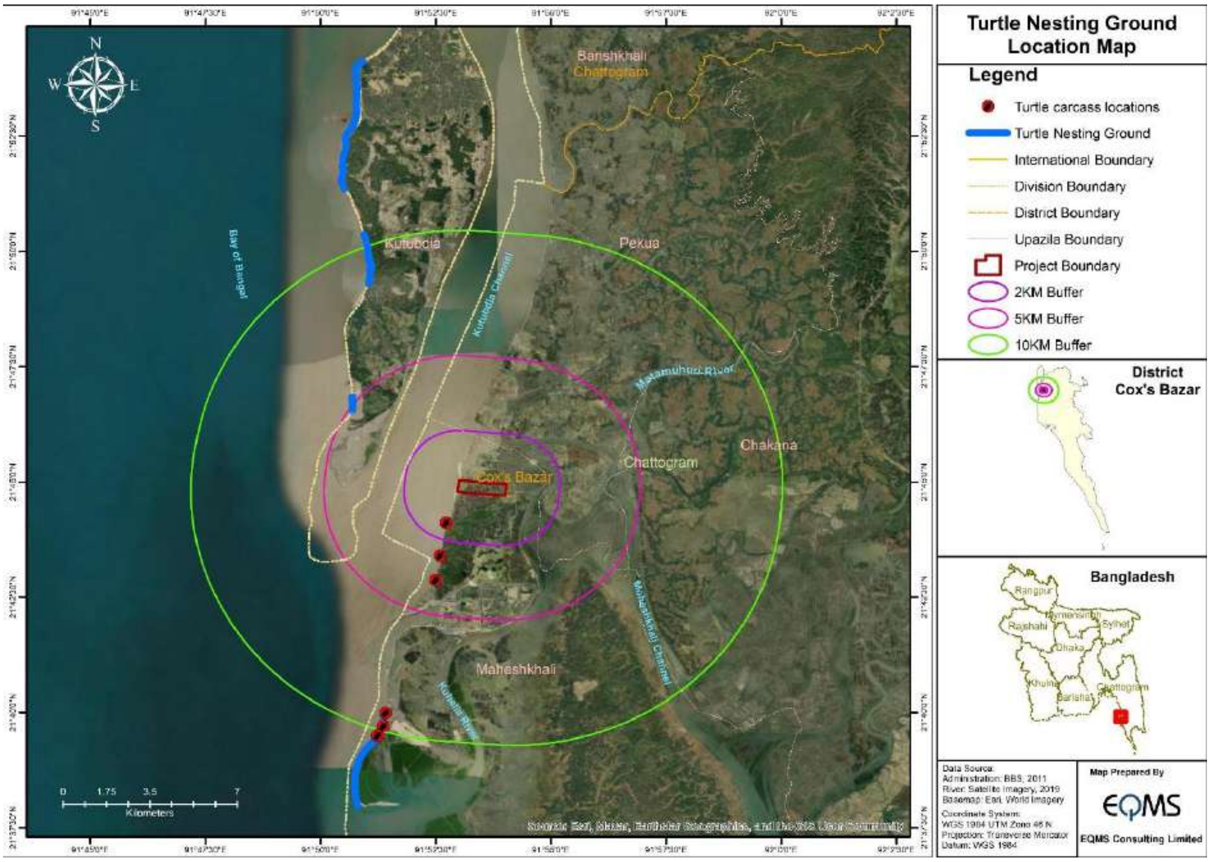
Signage of Nesting of Turtles at beach of Dhalghata (Hasher char)

Consultation with a Local Marine Turtle Conservation Worker of *Marinelife Alliance*, Dhalghata

Source: EQMS Field Study, February 2023

The nesting beach preference of sea turtles is influenced by various factors, including beach elevation, accessibility, height, sediment type (sandy or muddy), grain size of sand, compressibility of sand, and thermal variations in sandy beaches[23]. Sea turtles do not usually come to the Matarbari Sea beach and adjacent area for nesting due to the presence of intense disturbance from activities of the local communities such as light from settlements, cattle movement, fishing net (Char Pata Jal), fishing activities and boats movement in the Kutubdia Channel and adjacent areas reduces the suitability of these areas for turtle nesting. However, from the local community consultation, and stakeholder consultation such as Forest Range Officer of Chittagong Coastal Forest Division, Forest Range Officer of Kutubdia Upazila, Olive Ridley Turtles (*Lepidochelys olivacea*) and Green Sea Turtle (*Chelonia mydas*) used to nest on Hasher Char, under Dalghata Union and the Southernmost tip of Ali Akbar Deil Union and western side beach of the Kutubdia Island. A map of Potential location of Turtle Nesting (prepared based on consultation of local people, fishermen and different stakeholders) in Matarbari Union, Dhalghata Union and Kutubdia Island) has been presented in **Figure 4-59**.

Figure 4-59: Turtle Nesting Ground



Source: EQMS Field Study, October 2022, and February 2023

In addition, Olive Ridley turtle (*Lepidochelys olivacea*) and Green Sea Turtle (*Chelonia mydas*) also nest in the west coast of entire Cox's Bazar District and their nesting is reported in close by sandy beaches of Sonadia Island and Kutubdia Island[24].

[23] Stoneburner, D.L., & Richardson, J.I., (1981). Observations on the Role of Temperature in Loggerhead Turtle Nest Site Selection. Copeia, 1981 (1), 238 – 241 pp

[24] Hossain, M. A., Mahfuj, M. S. E., Rashid, S. M. A., & Ahsan, M. N. (2013). Present status of conservation and management of sea turtle in Cox's Bazar district, Bangladesh. Mesopotamian Journal of Marine Sciences, 28(1), 45-60.

4.6.4 Ecologically Sensitive Areas

4.6.4.1 Protected area (PAs)

Protected areas (PA) are generally declared and designated by government of the country, and these areas receive protection by the Countries' laws because of their recognized natural, ecological, or cultural values. The Bangladesh Wildlife (Conservation and Security) Act, 2012 defines and designates several "Protected Areas," i.e., Wildlife Sanctuary, National Park, Safari Park, Ecopark, Botanical Garden, Wild Animal Breeding Centre, Special Biodiversity Conservation Area, National Heritage, Memorial Tree, Sacred Tree and Kunjaban. There are 61 (Sixty-one) PAs in total, according to the Forest Department (31 October 2022) of Bangladesh and 51 (Fifty-one) of them are managed by them.

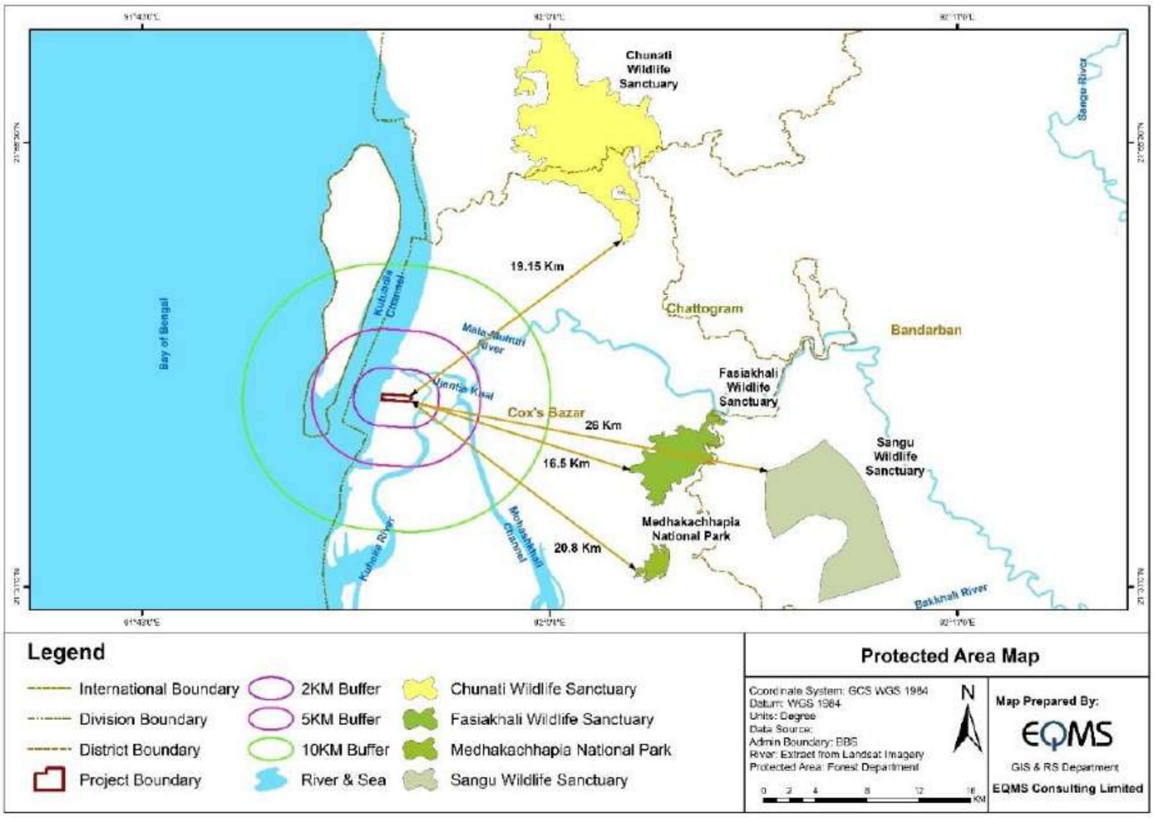
There are a total of six (6) PAs in the Cox's Bazar region as described in **Table 4-32**. There is no protected area present within the AOI. The nearest PA from the site is the Fasiakhali Wildlife Sanctuary, which is approximately at an aerial distance of 16.5 km South-East from the site. The map of the PAs is shown in **Figure 4-60**.

Table 4-32: Protected Areas in the Cox'sBazar Region

Sl. No.	Protected Area	Location	Area (km^2)	Distance from Project site (Km)
1.	Himchari National Park	Cox's Bazar	17.29	46.62
2.	Medhakachhapia National Park	Cox's Bazar	3.95	20.8
3.	Chunati Wildlife Sanctuary	Cox's Bazar and Chattogram	77.63	19.15
4.	Fasiakhali Wildlife Sanctuary	Cox's Bazar	13.02	16.5
5.	Teknaf Wildlife Sanctuary	Cox's Bazar	116.14	70.10
6.	Sheikh Jamal Inani National Park	Cox's Bazar	70.85	69.59

Source: Forest Department, GoB, 31 October 2022

Figure 4-60: Protected Area Map



Source: Forest Department, GoB, 31 October 2022

4.6.4.2 Ecologically Critical Area (ECAs)

In 1995, after the enactment of the Ecologically Critical Area (ECA), the Bangladesh government was empowered to declare an area which is enriched with unique biodiversity and environmental significance and therefore requires protection or conservation from destructive activities. In this regard, after considering human habitat, ancient monuments, archaeological sites, forest sanctuaries, national parks, game reserves, wild habitats, wetlands, mangroves, forest areas, biodiversity and other relevant factors of the area, the GoB can declare an area as ECA. As per the legal mandate the MoEFCC has declared 13 (thirteen) areas as ECAs since its enactment[25].

Ecologically Critical Area has restriction on-

- Natural forest and trees cutting
- Any type of wild animal killing
- Oysters, corals, turtles, and other wildlife hunting
- Any type of activities which may destroyed the flora and faunal residence.
- Any type of activities which may destroyed/changed the quality of land and water.
- Construction of industry/plant which produce soil, water, and noise pollution.
- Any functions which is bad for fish and aquatic species
- Any functions which can produce solid and liquid waste.
- Stone or Mineral resource extraction using Auto or Manual or other methods.

There are three ECAs in the Cox's Bazar Region: Sonadia Island, Cox's Bazar and Teknaf Peninsula and St. Martin's Island (**Table 4-33**). No ECA is located within the AOI. The nearest ECA from the site

[25] Department of Environment, GoB (31 October 2022)

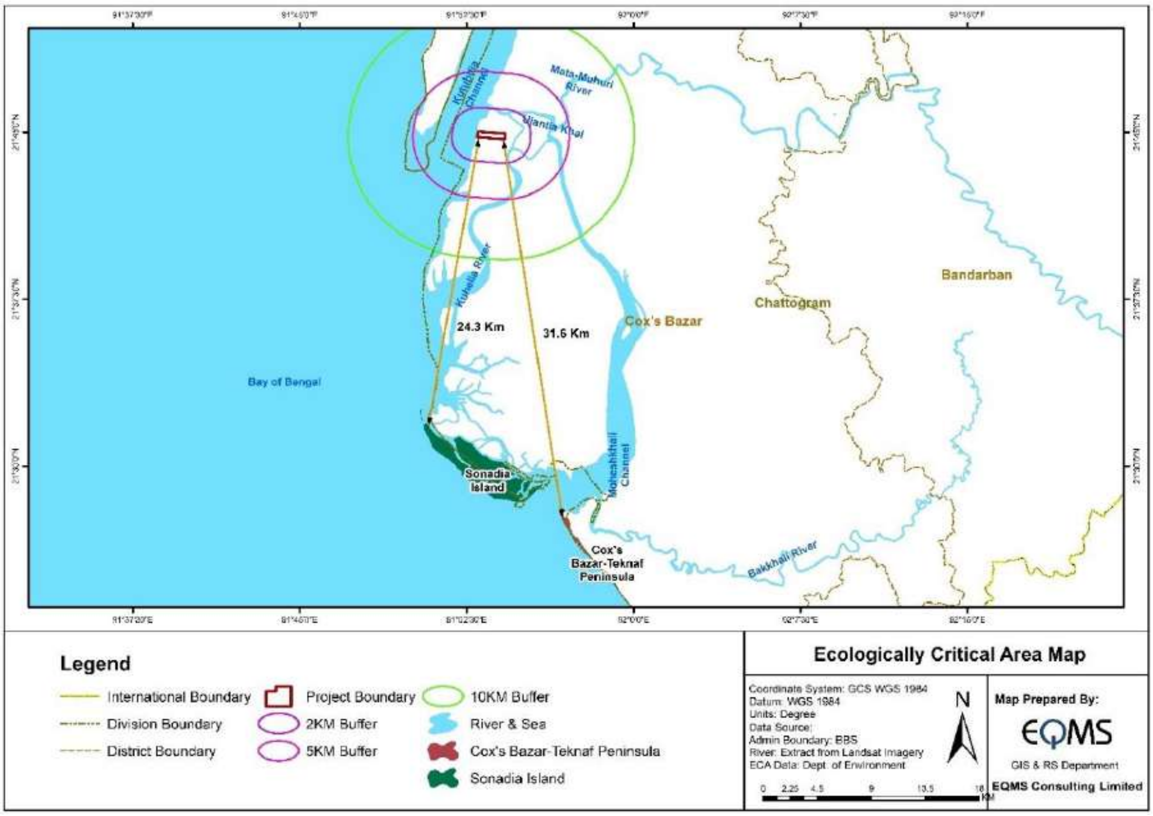
is Sonadia Island which is at an aerial distance of 24.3 km. The map of the ECAs is shown in **Figure 4-61**.

Table 4-33: Ecologically Critical Areas (ECAs) in Cox's Bazar Region

Sl. No.	Ecologically Critical Area	Location	Year of Declaration	Distance from Project site (Km)
1.	Sonadia Island	Maheshkhali, Cox's Bazar	1999	24.3
2.	Cox's Bazar and Teknaf Peninsula	Cox's Bazar Sadar, Ramu, Ukhia, and Teknaf Upazila of Cox's Bazar	1999	31.6
3.	St. Martin's Island	Teknaf, Cox's Bazar	1999	131.81

Source: Department of Environment, GoB, 31 October 2022

Figure 4-61: Ecologically Critical Area (ECA) Map



Source: Department of Environment, GoB, 31 October 2022

4.6.4.3 Marine Protected Areas (MPAs)

Marine protected areas (MPA) are protected areas of seas, oceans, and estuaries. These marine areas can come in many forms ranging from wildlife refuges to research facilities. MPAs restrict human activity for a conservation purpose, typically to protect natural or cultural resources. Such marine resources are protected by local, state, territorial, native, regional, national, or international authorities and differ substantially among and between nations. Bangladesh currently has three Marine protected areas (Saint Martin Marine Protected Area, Swatch of No-Ground Marine Protected Area, and Nijhum Dwip Marine Protected Area) (**Table 4-34**). The government has declared total 7,367 sq-km Marine Protected Area which covers about 8.8% of total exclusive economic zone of Bangladesh.

However, there are no MPA present in the project AOI. The nearest MPA from the site is Middle Ground and South Patches, which is at an aerial distance of 36.17 km from the Site in the West direction.

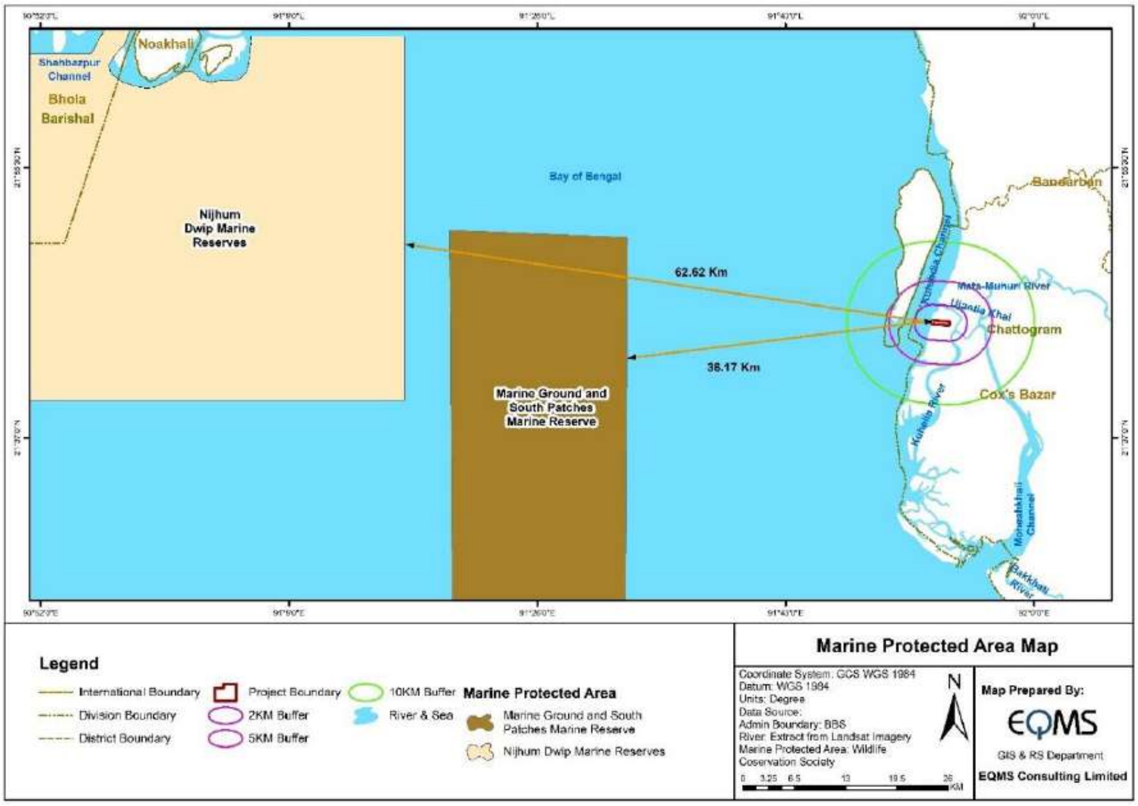
Nearest marine protected area is Nijhum Dwip marine protected area which is 62.62 km far from the project site. The map of the MPAs is shown in **Figure 4-62**.

Table 4-34: Marine Protected Areas (MPAs) and Marine Reserve of Bangladesh

Sl. No.	Name of the MPA	Type of ecosystem	Location	Area (sq. km)	Distance from Project site (Km)	Managed By
1.	Saint Martin's Island MPA	Marine island & coral reef	Teknaf Upazila, Cox's Bazar	1743	131.23	Department of Environment, GoB
2.	Swatch of No-Ground Marine Protected Area	Conserve Cetacean Species	South of Dublar Char, Bay of Bengal	1738	256.57	
3.	Middle Ground and South Patches	Marine Reserve	Marine Reserve	698	36.17	Department of Fisheries, GoB
4.	Nijhum Dwip Marine Protected Area	Conserving Marine Biodiversity	Nijhum Dwip adjacent area, Hatiya	3188	62.62	

Source: Department of Fisheries and Department of Environment, GoB, 31 October 2022

Figure 4-62: Marine Protected Areas (MPA) Map



Source: Department of Fisheries and Department of Environment, GoB, 31 October 2022

4.6.4.4 Important Bird & Biodiversity Areas (IBAs)

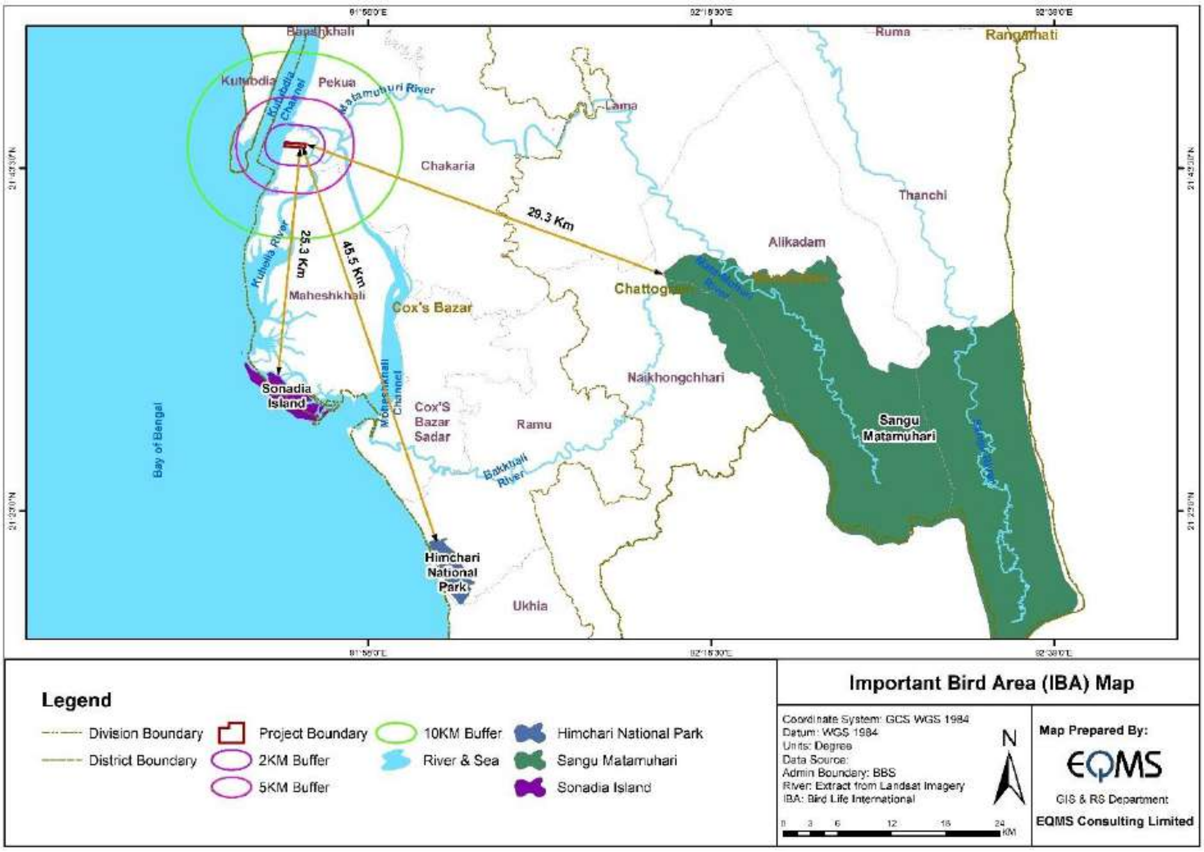
According to BirdLife International (2022)[26], there are 20 (twenty) Important Bird & Biodiversity Areas (IBAs) in Bangladesh in which three (3) IBAs is in the Cox's Bazar region (**Table 4-35**). There are no IBAs in the project AOI, and the nearest IBA, Sonadia Island, is at an aerial distance of more than 25.3 km away from the Site (**Figure 4-63**).

Table 4-35: Important Bird & Biodiversity Areas (IBAs) in the Cox's Bazar Region

Sl.	Important Bird Area	Year of Declaration	Area (sq. km)	Distance from Project site (km)
1.	Sonadia Island	2013	49.16	25.3
2.	Himchari National Park	2004	17.29	45.5
3.	Teknaf Game Reserve	2004	116.15	67.8

Source: BirdLife International (2022)[26]

Figure 4-63: Important Bird & Biodiversity Areas Map



Source: BirdLife International (2022)

[26] BirdLife Data Zone. (n.d.). BirdLife International. Retrieved October 31, 2022, from http://datazone.birdlife.org/country/bangladesh/ibas.

4.7 Socio-economic Environment

The present socio-economic conditions of the people of the project area will provide sound reference and assess probable socio-economic impact of the proposed interventions. This will enable to compare the changes and impacts of the project interventions in future. The socio-economic baseline scenario describes the socio-economic characteristics of the project area. The socio-economic characteristics include administrative area, demographic, household size, education, occupation, housing, employment opportunity, access to water and sanitation status etc.

4.7.1 Study Area for Socio-economic Environment

The 10 km study area (Buffer area) has been selected to grab the holistic insights of diverse social aspect in the study area. Secondary data from different sources has been used for 10 km buffer area analysis. Population and Housing Census data for 2021 not yet published. Hence, secondary data has been gathered from Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS).

Based on the field observation, it is deemed that the magnitude of social impact might be limited to 5 km radius and likely to be more visible. Therefore, 5 km study area has been considered as core area where the envisaged impacts might be manifested. To get the in-depth knowledge regarding social baseline conditions of overall area, rigorous study has been done during field visit. The socio-economic survey has been conducted within 5 km radius of the project area. **Table 4-36** depicted the 10 km study area including Buffer and Core area.

Table 4-36: Study Area of Socio-economic Study

SN	Types of Area	District	Upazila	Union
1.	Core Area (5 km)	Cox's Bazar	Maheshkhali	Matarbari
2.			Pekua	Ujantia
3.			Chakaria	Badarkhali
4.				Demusia
5.			Kutubdia	Ali Akbar Deil
6.				Baraghop
7.			Maheshkhali	Dhalghata
8.				Kalarmarchhara
9.				Saflapur
10.			Pekua	Magnama
11.				Pekua
12.	Buffer Area (10 km)		Chakaria	Bheola Manik Char
13.				Konakhali
14.				Purba Bara Bheola
15.				Paschim Bara Bheola
16.				Saharbil
17.			Kutubdia	Dakshin Dhurung
18.				Lemsikhali
19.				Kaiyarbil
20.			Maheshkhali	Hoanak

SN	Types of Area	District	Upazila	Union
21.			Pekua	Rajakhali
22.				Bara Bakia

Source: Population and Housing Census, BBS, 2011

4.7.1.1 Upazilas Adjacent to Project Site

To get the actual number of population/households of the project area adjacent villages, secondary sources such as Population and Housing Census, District Statistics and District Web Portal have been used. As per Population and Housing Census 2011, total Four (4) upazilas (Chakaria, Kutubdia, Maheshkhali, Pekua) were adjacent to the project area.

Considering upazilas as a cluster, households were finalized for simple random sampling along with specific interval. Thus, 200 households were surveyed. The tools of data collection during the survey were face to face interviews with structured questionnaire. A wide range of data, for example, demography, age/sex distribution, education, occupation, income/poverty data, types of businesses, types and ownership status of structures and other assets was collected through this survey. The data analysis and findings of both primary survey data analysis and findings of secondary source from Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS) has been portrayed hereunder.

4.7.2 Population and Demography

In the 10 km study area, there are about 1,01,945 households (HHs) including squatters with a total population of 5,54,402. The average sex ratio is 102.7 and the average household size is 5.4. The demography of the study area is shown in the following **Table 4-37.**

Table 4-37: Demography of the Study Area

District	Upazila	Union	Total Pop	Total HHs	Avg. HH size	Sex Ratio
Cox's Bazar	Chakaria	Badarkhali	30,964	5,947	5.2	103
		Bheola Manik Char	19,951	3,843	5.2	99
		Konakhali	17,919	3,548	5.0	90
		Purba Bara Bheola	28,248	5,207	5.4	107
		Paschim Bara Bheola	8,805	1,670	5.3	100
		Saharbil	19,880	3,419	5.8	104
		Demusia	12,366	2,409	5.1	96
	Kutubdia	Ali Akbar Deil	22,504	4,298	5.2	103
		Dakshin Dhurung	17,279	2,942	5.8	105
		Lemsikhali	19,028	3,347	5.7	107
		Kaiyarbil	12,945	2,423	5.3	103
		Baraghop	25,488	4,688	5.4	106
	Maheshkhali	Dhalghata	12,877	2,250	5.7	108
		Kalarmarchhara	49,268	8,930	5.5	108
		Matarbari	44,937	8,168	5.5	103
		Hoanak	51,587	9,373	5.5	106

District	Upazila	Union	Total Pop	Total HHs	Avg. HH size	Sex Ratio
		Saflapur	34,268	6,229	5.5	104
	Pekua	Magnama	22,088	3,982	5.5	100
		Pekua	45,293	8,475	5.3	101
		Rajakhali	25,883	4,551	5.7	103
		Bara Bakia	18,430	3,640	5.0	99
		Ujantia	14,394	2,606	5.5	104
Study Area			**554,402**	**101,945**	**5.4**	**102.7**

Source: Population and Housing Census, BBS, 2011

4.7.2.1 Demographic Profile of the Core Area (5km)

In the core area, total number of 1052 populations are living in the 200 households that has been surveyed for socio economic study. Among the surveyed population, about 53.6% males and 46.4% females were identified. Moreover, 43.2% of total population are found married while 51.5% of them are unmarried during survey of the core area. A total of 5.3% identified as widow/widower/separated /divorced.

All over health status among the households has been found quite well. Around 98.3% populations are found physically normal, only 1.7% are found physically challenged. **Table 4-38** shows the Demographic Profile of the Core Area.

Table 4-38: Demography of the Core Area

S/N	Demography		Population	
			No	%
1	Total Population	Male	564	53.6
		Female	488	46.4
		Total	**1052**	**100.0**
2	Marital Status	Married	454	43.2
		Unmarried	542	51.5
		Widowed/Divorced/ Separated	56	5.3
		Total	**1052**	**100.0**
3	Health Status	Physically Normal	1034	98.3
		Physically Challenged	18	1.7
		Total	**1052**	**100.0**

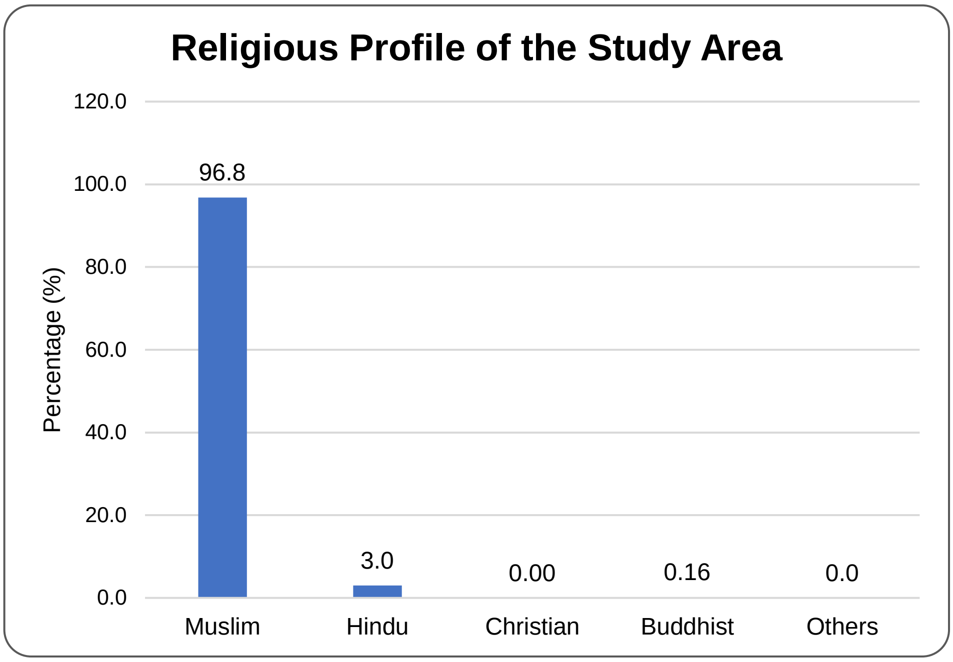
Source: EQMS Survey, October 2022

4.7.3 Religion

4.7.3.1 Religion Profile of the 10 km Study Area

According to the Population and Housing Census (2011), the population of the study area is dominated by the Muslim community constituting almost 96.8% of the total population. The remaining 3.0% is Hindu and the rest belongs to other religion. The following **Figure 4-64** indicates the various religious profile of the project study area.

Figure 4-64: Religious Profile of the Study Area



Source: Population and Housing Census, BBS, 2011

4.7.3.2 Religion profile of the Core Area (5km)

The religion composition of selected households was found to be 100% Muslim during the socioeconomic survey.

4.7.4 Ethnic Composition

4.7.4.1 Ethnic Profile of the 10 km Study Area

According to the Population and Housing Census (2011), within a 10-kilometer radius of the project site, 75 households with 307 people of different ethnicities were discovered. Majority of them belong to Rakhain ethnic group. The following **Table 4-39** indicates the various ethnic composition of the project study area.

Table 4-39: Ethnic Profile of the Study Area

Upazila	Union	HH	Ethnic Population			Ethnic Population in main groups			
			Total	Male	Female	Rakhain	Tanchaynga	Chakma	Other
Chakaria	Badarkhali	0	0	0	0	0	0	0	0
	Bheola Manik Char	1	4	2	2	0	0	4	0
	Konakhali	2	3	3	0	0	0	0	3
	Purba Bara Bheola	7	43	20	23	0	0	0	43
	Paschim Bara Bheola	0	0	0	0	0	0	0	0
	Saharbil	0	0	0	0	0	0	0	0
	Demusia	0	0	0	0	0	0	0	0
Kutubdia	Ali Akbar Deil	0	0	0	0	0	0	0	0

Upazila	Union	HH	Ethnic Population			Ethnic Population in main groups			
			Total	Male	Female	Rakhain	Tanchaynga	Chakma	Other
	Dakshin Dhurung	2	10	6	4	0	0	0	10
	Lemsikhali	0	0	0	0	0	0	0	0
	Kaiyarbil	0	0	0	0	0	0	0	0
	Baraghop	3	9	3	6	0	0	9	0
Maheshkhali	Dhalghata	0	0	0	0	0	0	0	0
	Kalarmarchhara	0	0	0	0	0	0	0	0
	Matarbari	0	0	0	0	0	0	0	0
	Hoanak	1	7	5	2	7	0	0	0
	Saflapur	21	87	43	44	87	0	0	0
Pekua	Magnama	0	0	0	0	0	0	0	0
	Pekua	8	26	14	12	0	0	16	10
	Rajakhali	0	0	0	0	0	0	0	0
	Bara Bakia	30	118	63	55	118	0	0	0
	Ujantia	0	0	0	0	0	0	0	0
Study Area		**75**	**307**	**159**	**148**	**212**	**0**	**29**	**66**

Source: Population and Housing Census, BBS, 2011

4.7.4.2 Ethnic Profile of the Core area

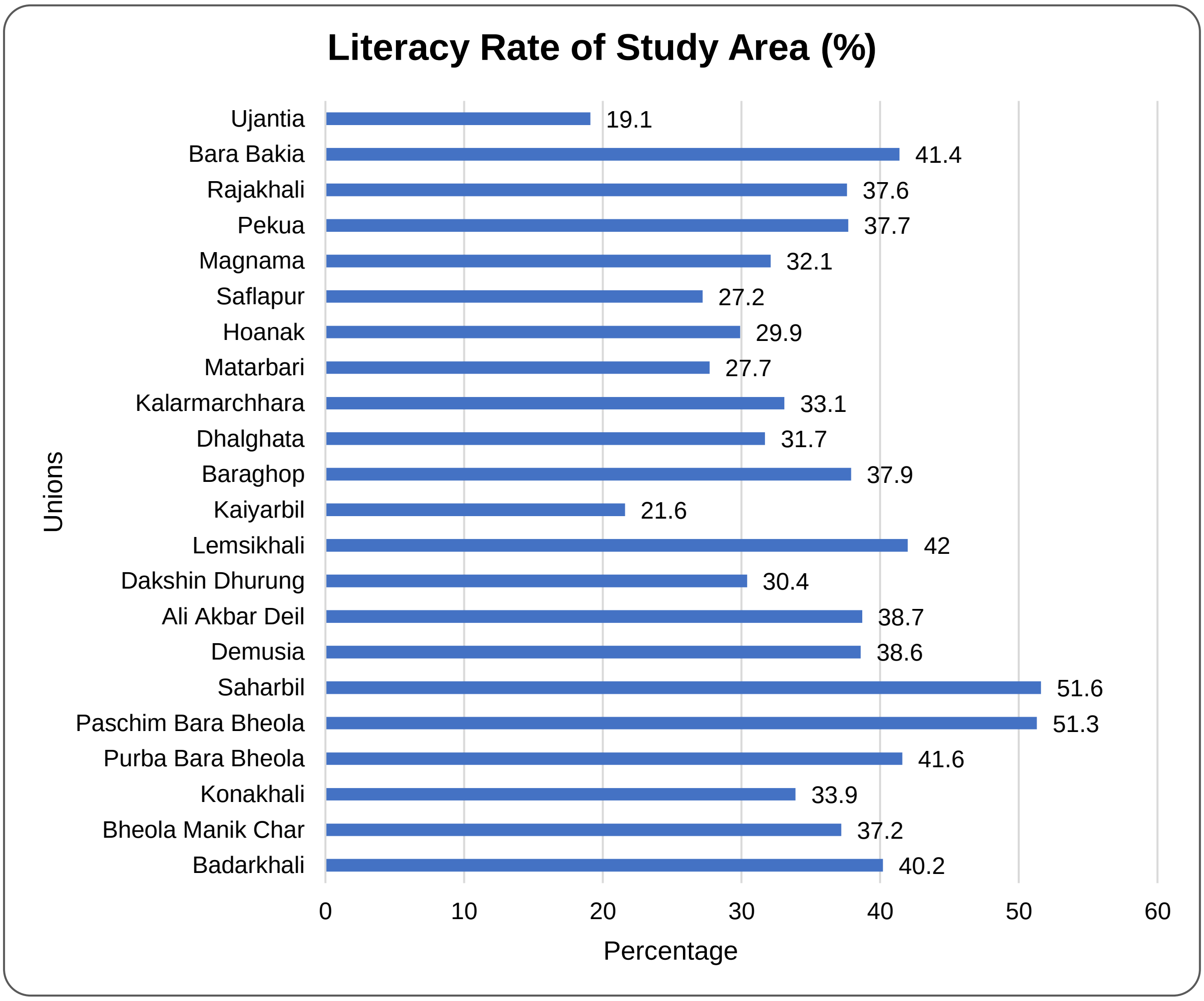
According to the socio-economic survey, no indigenous or ethnic minority populations were identified within 5 km from the project area. Although according to the Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS) data, 307 populations were ethnic within 10 km from the project area. However, consultations with local communities revealed that there are no ethnic households in the core area of influence.

4.7.5 Education

4.7.5.1 Educational Profile of the 10 km Study Area

According to the Population and Housing Census (2011), it shows that the concentration of literate people in eleven unions of selected four upazilas the average literacy rate in the study area is 35.6%. The following **Figure 4-65** shows the literacy rate of the project study area.

Figure 4-65: Literacy Rate of the Study Area

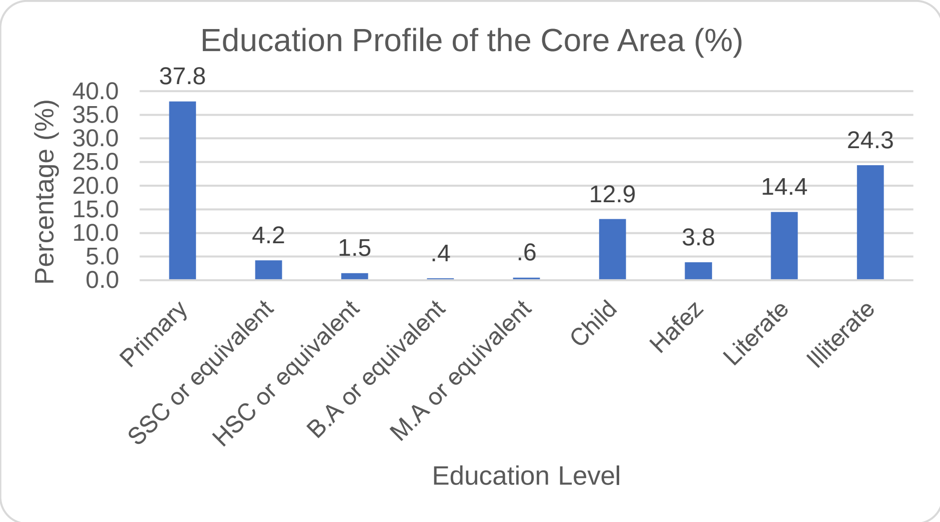


Source: Population and Housing Census, BBS, 2011

4.7.5.2 Educational Profile of the Core Area (5km)

According to socioeconomic primary data, 48.3% population in the core study area is literate. A considerable proportion of the population (37.8%) completed primary school. While 4.2% of the population had access to secondary education. Only 0.4% and 0.6% people have completed respectively B.A and M.A or equivalent degree. According to survey results, the illiteracy rate is 24.3%. Furthermore, 3.8% have completed their educational degree in Islamic study curriculum and obtained the Hafez degree. Children account for approximately 12.9% of the population. Below **Figure 4-66** depicted the education profile of the core area.

Figure 4-66: Education Profile of the core area



Source: EQMS Survey, October 2022

4.7.6 Settlement and Housing

4.7.6.1 Settlement and Housing of the 10 km Study Area

According to the Population and Housing Census (2011), total household of the project study is 1,01,657. The predominant structure of these study area is Kutcha (71.7%) followed by Jhupri (18.5%), Semi-pucka and Pucka (5.9% and 3.9%). Housing tenancy of the study area is owned by (92.5%), rented (1.1%) and rent free (6.4%). The following **Table 4-40** shows the type of structure and **Table 4-41** housing tenancy in the project study area.

Table 4-40: Types of Structure Study Area

Upazila	Union	Number of HHs	Type of Structure (%)			
			Pucka	Semi-pucka	Kutcha	Jhupri
Chakaria	Badarkhali	5920	5.3	10.9	64.9	18.9
	Bheola Manik Char	3842	3.9	7.9	79.7	8.6
	Konakhali	3526	2.8	6.7	47.4	43.2
	Purba Bara Bheola	5205	4.6	9.4	72	13.9
	Paschim Bara Bheola	1653	5.2	6.2	72.1	16.6
	Saharbil	3416	6.3	13.6	66.5	13.6
	Demusia	2405	3	4.2	85.9	6.8
Kutubdia	Ali Akbar Deil	4297	1.9	5.1	74.9	18.1
	Dakshin Dhurung	2917	2.6	3.1	81.4	12.8
	Lemsikhali	3339	3.7	1.1	59.5	35.7
	Kaiyarbil	2422	2.8	3.9	75.2	18.2
	Baraghop	4686	5.9	11.5	56.7	25.9
Maheshkhali	Dhalghata	2248	0.5	0.8	16	82.7
	Kalarmarchhara	8913	2.6	5.3	80.5	11.6
	Matarbari	8145	4.4	4.8	71.7	19.1

Upazila	Union	Number of HHs	Type of Structure (%)			
			Pucka	Semi-pucka	Kutcha	Jhupri
	Hoanak	9369	1.4	3.4	93.8	1.3
	Saflapur	6226	0.5	1.7	95.5	2.2
Pekua	Magnama	3969	3.7	6.4	82.8	7.1
	Pekua	8402	7.2	7.3	70.6	14.8
	Rajakhali	4532	4.9	7	63.3	24.8
	Bara Bakia	3621	7.6	4.8	79.4	8.3
	Ujantia	2604	4.6	3.7	88.3	3.3
Study Area		**101657**	**3.9**	**5.9**	**71.7**	**18.5**

Source: Population and Housing Census, BBS, 2011

Table 4-41: Housing Tenancy in the Study Area

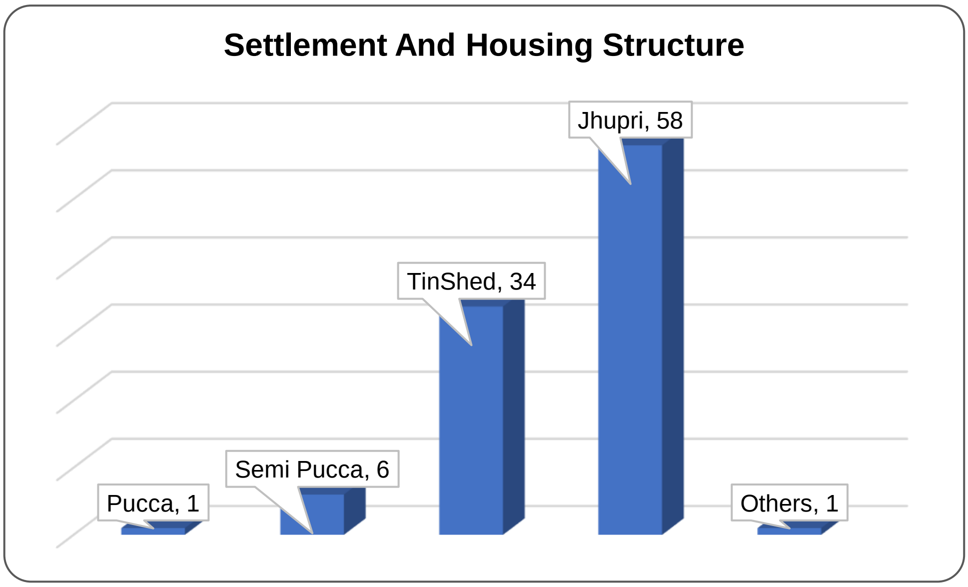
Upazila	Union	Number of HHs	Housing Tenancy (%)		
			Owned	Rented	Rent free
Chakaria	Badarkhali	5920	95.2	4.2	0.6
	Bheola Manik Char	3842	97.9	0.8	1.3
	Konakhali	3526	95.0	0.6	4.5
	Purba Bara Bheola	5205	98.9	0.2	0.8
	Paschim Bara Bheola	1653	76.9	3.6	19.5
	Saharbil	3416	97.7	1.6	0.6
	Demusia	2405	98.0	0.5	1.6
Kutubdia	Ali Akbar Deil	4297	97.6	0.1	2.3
	Dakshin Dhurung	2917	98.1	1.2	0.7
	Lemsikhali	3339	98.2	0.2	1.6
	Kaiyarbil	2422	95.0	0.2	4.8
	Baraghop	4686	96.2	2.5	1.3
Maheshkhali	Dhalghata	2248	98.4	0.6	1.0
	Kalarmarchhara	8913	95.2	0.9	3.9
	Matarbari	8145	95.2	0.5	4.3
	Hoanak	9369	98.8	0.2	1.0
	Saflapur	6226	42.1	0.4	57.5
Pekua	Magnama	3969	92.9	0.2	6.9
	Pekua	8402	92.4	4.0	3.6
	Rajakhali	4532	96.9	0.4	2.8
	Bara Bakia	3621	84.2	0.7	15.1
	Ujantia	2604	93.3	1.0	5.7
Study Area		**1,01,657**	**92.5**	**1.1**	**6.4**

Source: Population and Housing Census, BBS, 2011

4.7.6.2 Settlement and Housing of the Core Area (5km)

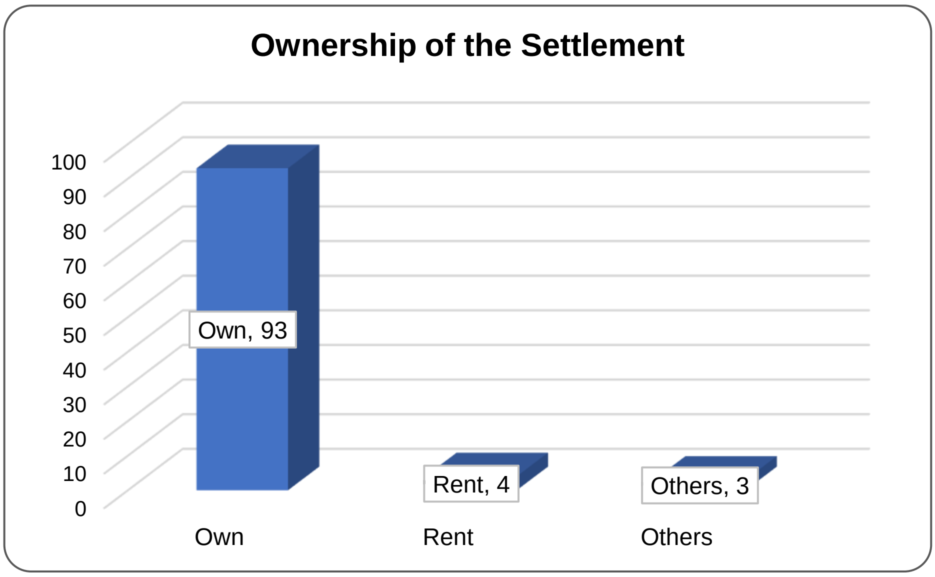
According to the primary socio-economic survey conducted in the core area, it has been found that, most of the settlement and housing are Jhupri (58%), tin-shed (34%), semi pucka are 6% and pucka buildings are 1% of total households. Furthermore, 93% HHs have the ownership of the settlement and the rest 7% are rental or others. **Figure 4-67** and **Figure 4-68** depicted the housing structure and ownership of the core area.

Figure 4-67: Settlement and Housing Structure of the Core Area



Source: EQMS Survey, October 2022

Figure 4-68: Ownership Pattern of HHs Settlement in 5 km Study Area



Source: EQMS Survey, October 2022

4.7.7 Public Utilities

4.7.7.1 Water Supply

4.7.7.1.1 Access to Water in 10 km Study Area

At the project study area, the major source of drinking water is tube-well where about 95.1% of the population use tube-well water. About 0.3% people have access to tap water. The other 4.5% people have access to neither tube-well nor tap water. An overview is depicted in below **Table 4-42**.

Table 4-42: Sources of Drinking Water in the Study Area

Upazila	Union	Number of HHs	Source of Drinking Water (%)		
			Tap	Tube-well	Other
Chakaria	Badarkhali	5920	0	97.2	2.8
	Bheola Manik Char	3842	0.3	96.9	2.9
	Konakhali	3526	0	99.8	0.2
	Purba Bara Bheola	5205	0.3	95.9	3.7
	Paschim Bara Bheola	1653	0.2	99.6	0.2
	Saharbil	3417	0.2	91.3	8.5
	Demusia	2405	0	100	0
Kutubdia	Ali Akbar Deil	4297	0.5	91.1	8.4
	Dakshin Dhurung	2917	0.1	94.5	5.3
	Lemsikhali	3339	2.3	96.4	1.3
	Kaiyarbil	2422	0.2	95.4	4.4
	Baraghop	4686	0.3	93.9	5.8
Maheshkhali	Dhalghata	2248	0.5	92.3	7.2
	Kalarmarchhara	8913	0.2	82.7	17.1
	Matarbari	8145	0.2	95	4.8
	Hoanak	9369	0.2	91.3	8.5
	Saflapur	6226	0	86.5	13.5
Pekua	Magnama	3969	0.1	99.9	0
	Pekua	8402	1.7	97.6	0.7
	Rajakhali	4532	0	96.8	3.2
	Bara Bakia	3621	0.2	99.3	0.5
	Ujantia	2604	0	99.1	0.8
Study Area		**1,01,658**	**0.3**	**95.1**	**4.5**

Source: Population and Housing Census, BBS, 2011

4.7.7.1.2 Access to Water in the Core Study Area (5km)

In the core area during survey, it was found that all households have access to safe water for drinking, cooking and other regular household usage. Below Table 4-43 shows the status of core areas access to safe water.

Table 4-43: Access to Water in the Core Area

SL	Sources of Water	Drinking Purpose		Cooking Purpose		Others HHs Purpose	
		Frequency	%	Frequency	%	Frequency	%
1	Tube-well	174	87	164	82	144	72
2	Deep tube-well	22	11	22	11	18	9
3	Supply	4	2	4	2	0	0
4	Others	0	0	10	5	38	19
Total		**200**	**100**	**200**	**100**	**200**	**100**

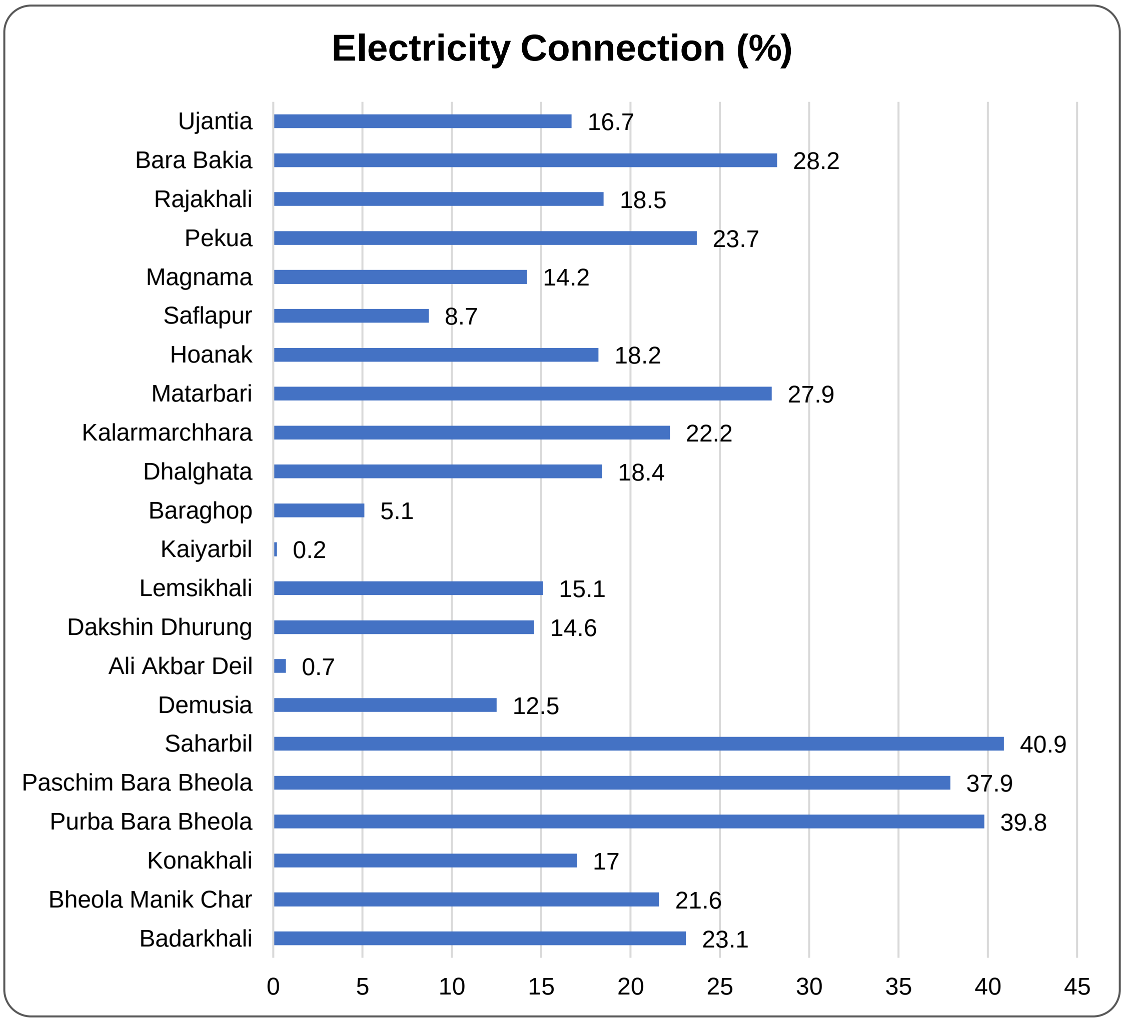
Source: EQMS Survey, October 2022

4.7.7.2 Electricity

4.7.7.2.1 Energy Access in the 10 km Study Area

Electricity is an important indicator for measuring the quality of life. In the study area, on average 19.3% of the households have grid electricity connection. The **Figure 4-69** shows the detailed electricity connection situation by union.

Figure 4-69: Electricity connection of the Study Area



Source: Population and Housing Census, BBS, 2011

4.7.7.2.2 Energy Access in the Core Area (5km)

In the core area, survey results find that majority of the households have access to electricity (94%) for lighting and fanning purposes. Besides this, 89% HHs use Firewood, crop residue and cow-dung cake for cooking purpose. The rest 11% HHs are using LPG for cooking purpose. Energy access in the Core area presented hereunder.

Table 4-44: Energy Access in the Core Area

SL#	Details		Frequency	Percent (%)
1	Lighting Source	Electricity	188	94
		Solar System	4	2
		Kerosene	8	4
Total			**200**	**100**
2	Fuel/energy used for Cooking	Firewood, Crop residue and Cow-dung Cake	178	89
		LPG	22	11
Total			**200**	**100**

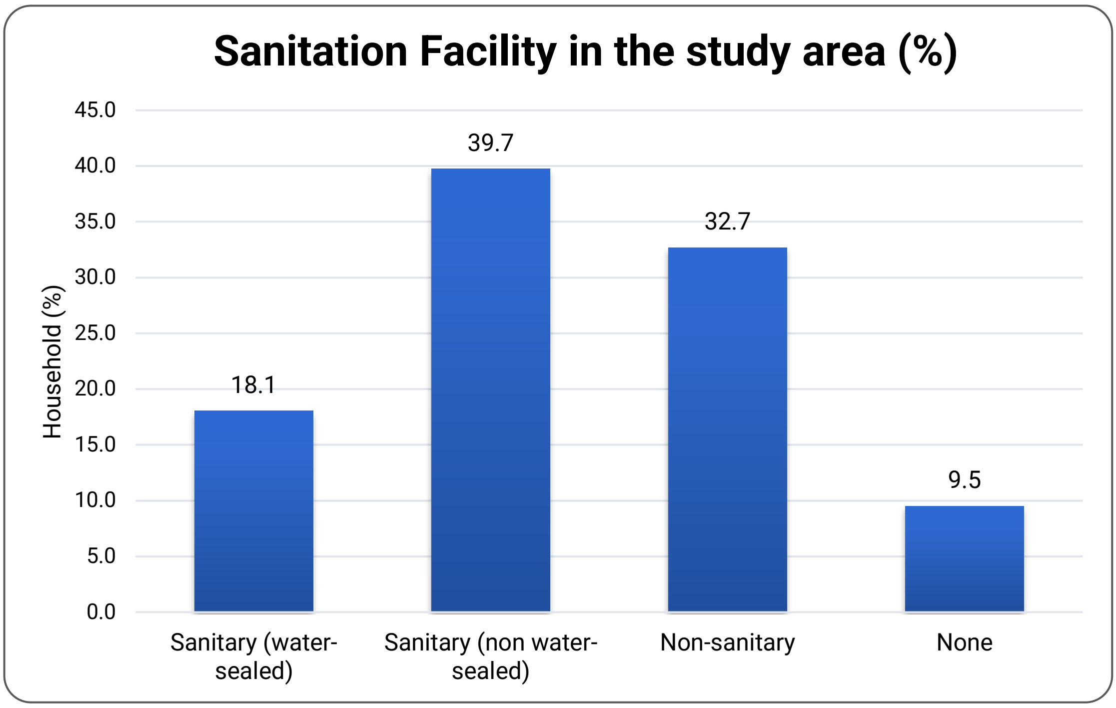
Source: EQMS Survey, October 2022

4.7.7.3 Sanitation

4.7.7.3.1 Sanitation Facilities in the 5 km Study Area

In the study area, households that use water-sealed sanitary latrine and non-water-sealed sanitary latrine facility are 18.1% and 39.7% respectively. Whereas about 32.7% households avail non-sanitary facilities. The rest 9.5% of households have no access to hygienic latrine facilities. The following **Figure 4-70** shows sanitation facility of the project area.

Figure 4-70: Sanitation Facility in the Study Area

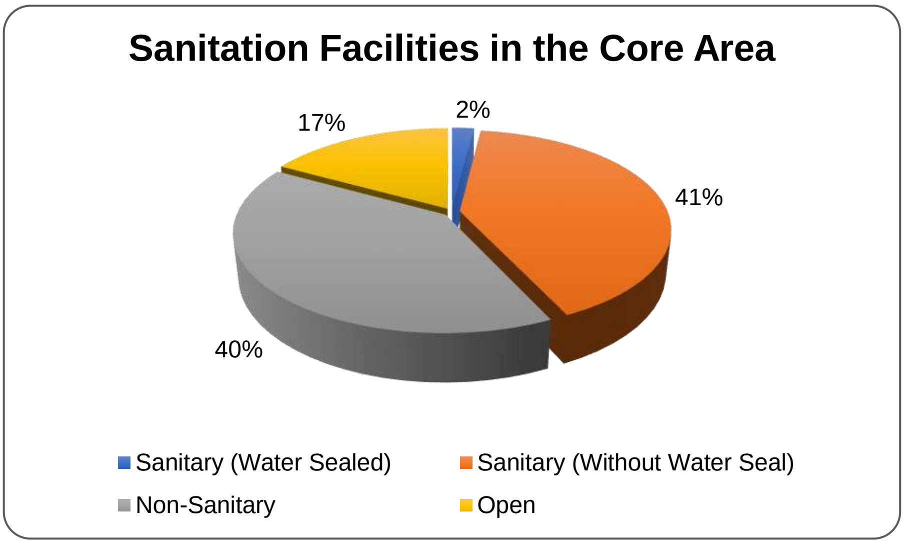


Source: Population and Housing Census, BBS, 2011

4.7.7.3.2 Sanitation Facilities in the Core Area

Primary survey results demonstrate that, 2% households of the core area are using sanitary latrine (water seal) and 41% are using Non water seal sanitary latrine. i.e., hygienic sanitation facilities. Apart from this, only 40% households have kutcha i.e., unhygienic latrine. Available sanitation facilities using by core area households is presented in below **Figure 4-71**.

Figure 4-71: Sanitation Facilities in the Core Area



Source: EQMS Survey, October 2022

4.7.7.4 Access to Social Institution

Convenient and easy access to market and medical services help households get basic needs and health services when it is necessary or urgent. Distance may create barrier from easy access to these services which ultimately leads to poor livelihood status. On the contrary, proximity and easy access to social services leads better livelihood and development.

Survey results have found that 53% households have easy access to main markets, and they lie at best within 1 km distance from the main market from where they can get all the goods, including perishable & non-perishable, for their daily life. Easy Access to Social Institution is given in **Table 4-45**.

Table 4-45: Easy Access to Social Institution

SL	Social Institutions	Distance						Total	%
		<1km	%	1 to 3km	%	>3km	%		
1.	Market Distance	106	53	34	17	60	30	200	100
2.	Hospital Distance	88	44	46	23	66	33	200	100
3.	Religious Institution Distance	188	94	8	4	4	2	200	100
4.	Primary Education	134	67	52	26	14	7	200	100

Source: EQMS Survey, October 2022

Easy access to hospitals enhances the frequency of health services taking. Higher distance may hinder taking health services which ultimately increase the health risk. Survey results have found that only 44% households are staying less than 1 km distance from the health service point. Conversely, 33% more than 3 km distance from the hospital services. But this does not describe the overall scenario of the health service availability of the studied area. For general health service most of the populations goes to Matarbari Union Health Centre and Notun Bazaar. General health services include paramedical, pharmacy services for normal or seasonal health problems.

In general, religious institutions situate very close to the local community. In this study, it is found that 94% of the studied populations have access to religious institutions less than 1 km. Moreover, study finds that 67% students go to primary education institutions less than 1km from the local community.

4.7.7.5 Health Care Facility

According to the District Statistics (2011), in the study area, there are 9 Private Hospitals in Chakaria, Kutubdia, Maheshkhali and Pekua Upazila with 45 MBBS/FCPS doctors. Also, 39 diagnostic centers are found in the proposed study area.

4.7.8 Economy and Employment

4.7.8.1 Economy and Employment of the 10 km Study Area

According to the Population and Housing Census (2011), agriculture including crops cultivation, fishing, direct farming, sharecropping, agricultural laborers etc. is the dominant source of employment in the study area. Approximately, 56539 male and 2274 females are involved in agricultural activities. Moreover, significant number of the population; 11817 male and 2142 females of the study area are employed in service sector. Also, 1458 male and 206 female are in the industrial sector. The following **Table 4-46** shows the employment status of the project area.

Table 4-46: Employment Status of the Study Area

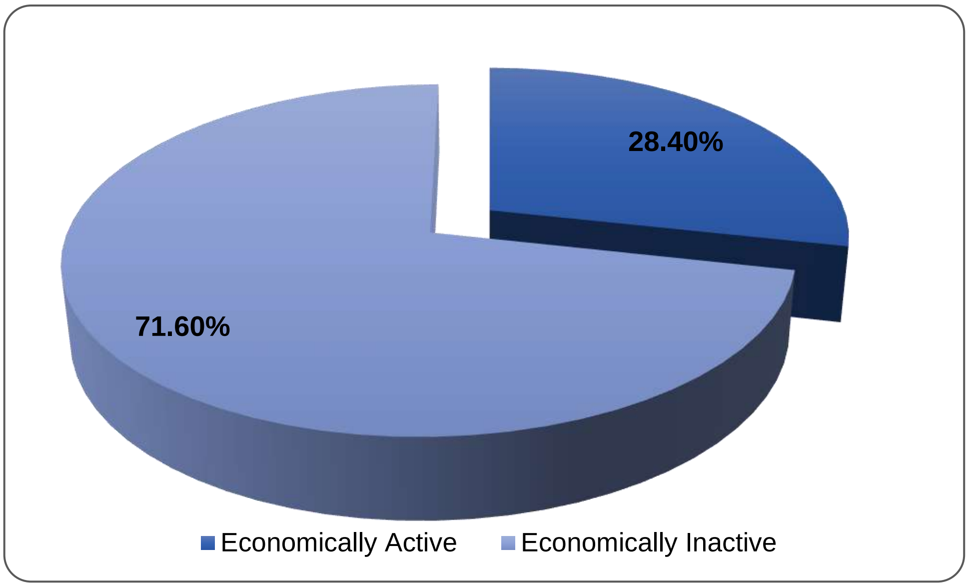
Upazila	Union	Population Aged 7+, not attending school but employed			Field of Activity					
					Agriculture		Industry		Service	
		Total	Male	Female	Male	Female	Male	Female	Male	Female
Chakaria	Badarkhali	3554	3320	234	2703	129	37	2	580	103
	Bheola Manik Char	1963	1744	219	1282	65.0	47	4	415	150
	Konakhali	871	847	24	718	9	37	2	92	13
	Purba Bara Bheola	3311	3071	240	1735	88	31	6	1305	146
	Paschim Bara Bheola	802	721	81	624	46	29	2	68	33
	Saharbil	1629	1580	49	934	17	67	2	579	30
	Demusia	1557	1510	47	1387	31	38	1	85	15
Kutubdia	Ali Akbar Deil	2718	2597	121	1608	70	148	9	841	42
	Dakshin Dhurung	2083	1896	187	942	59	6	2	948	126
	Lemsikhali	1404	1318	86	1254	59	10	0	54	27
	Kaiyarbil	1523	1420	103	944	50	11	7	465	46
	Baraghop	3155	2833	322	1336	61	72	7	1425	254
Maheshkhali	Dhalghata	2314	2207	107	2151	72	22	1	34	34
	Kalarmarchhara	7563	7174	389	6403	212	72	25	699	152
	Matarbari	6944	6666	278	5108	139	210	9	1348	130
	Hoanak	9498	8986	512	8239	323	134	29	613	160
	Saflapur	6132	5865	267	5350	154	16	8	499	105
Pekua	Magnama	3794	3310	484	2725	154	17	32	568	298
	Pekua	5407	5015	392	4102	224	261	30	652	138
	Rajakhali	3355	3153	202	2907	111	24	10	222	81
	Bara Bakia	2367	2297	70	1913	35	142	9	242	26
	Ujantia	2492	2284	208	2174	166	27	9	83	33
Study Area		**74436**	**69814**	**4622**	**56539**	**2274**	**1458**	**206**	**11817**	**2142**

Source: Population and Housing Census, BBS, 2011

4.7.8.2 Economic Engagement in the Core Area (5 km)

In the core area, 28.4% of the total surveyed population is involved in economic activities through various occupations. On the contrary, 71.6% of those polled are economically inactive. **Figure 4-72** depicted the economic engagement of core area.

Figure 4-72: Economic Engagement in the core area



Source: EQMS Survey, October 2022

4.7.8.2.1 Economically Active and Inactive Populations Occupation Profile

According to the socio-economic survey findings of the core area, only 28.4% populations are economically active. Most of the economically active populations (13.1%) are engaged in day labor. About 4% of populations engaged in fishing activities, 2.7% are in agriculture activity, 2.7% service holder, 2.1% business and 3.8% are in different services for their livelihood.

According to the survey conducted in the core area, it has found that 71.6% of populations are economically inactive for various reason which includes 11.2% unemployed for lack of opportunities, 22.1% populations are engaged with household activities, 3.2% populations considered as incapable and inactive for being elderly and physically challenged, 16.4% are child and 18.7% student are considered as future workforce and now they are economically inactive. A detail of economically active and inactive populations according to their field of engagement of core area is presented in **Table 4-47.**

Table 4-47: Economically Active and Inactive Populations Occupation Profile

Employment Status	Field of engagement	Frequency	Percent (%)
Economically Active	Agriculture	28	2.7
	Teaching	6	0.6
	Immigrant	6	0.6
	Service	28	2.7
	Business	22	2.1
	Fisherman	42	4
	Day Labor	138	13.1
	Rickshaw/ Van Puller	4	0.4

Employment Status	Field of engagement	Frequency	Percent (%)
	Mason	14	1.3
	Tailor	4	0.4
	Boatman	6	0.6
Sub-Total		**298**	**28.4**
Economically Inactive	Homemaker	234	22.1
	Unemployed	118	11.2
	Child	172	16.4
	Student	196	18.7
	Elderly	16	1.5
	Physically Challenged	18	1.7
Sub-Total		**754**	**71.6**
Grand Total		**1052**	**100**

Source: EQMS Survey, October 2022

4.7.8.2.2 Monthly Income of HHs in Core Area (5km)

Households' monthly income reveals the good economic situation of the core area. Significant number of the surveyed population (18%) have more than BDT 20,000. The largest concentration 33% and 32% has been found in 5000-10000 and 10001-15000 category respectively. About 10% population belongs to 15001- 20000 category. The monthly income of the adjacent HHs is given in below **Table 4-48**.

Table 4-48: Monthly Income of HHs in the Core Area

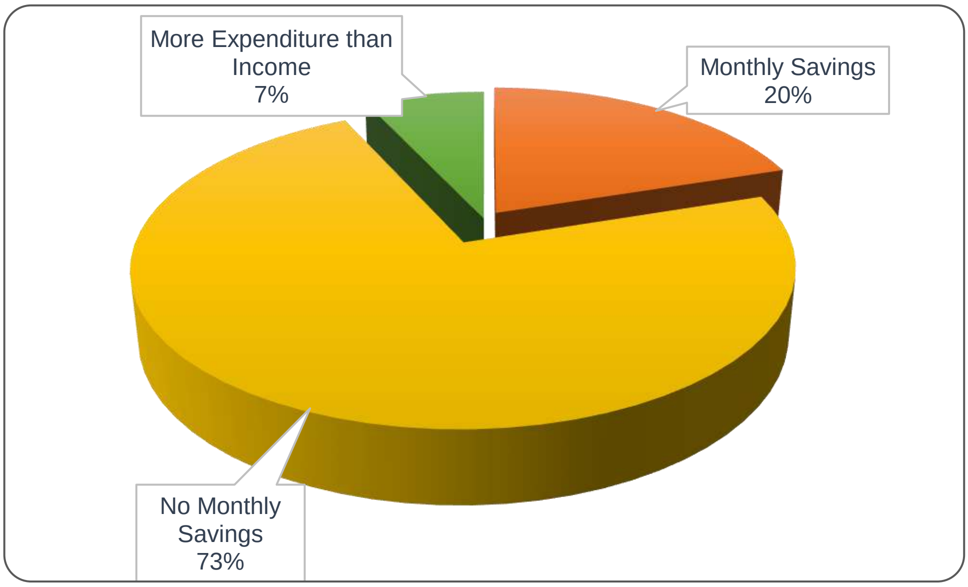
Level of Income (BDT)	Number	Percentage (%)
<5000	14	7
5000-10000	66	33
10001-15000	64	32
15001-20000	20	10
>20000	36	18
Total	**200**	**100**

Source: EQMS Survey, October 2022

4.7.8.2.3 Savings of HHs in Core Area (5km)

Status of the households' yearly savings depicts the solvency of any studied population. From the socio-economic survey conducted in the core area it has been found that only 20% population have monthly savings, whereas 73% people do not have any kind of savings. About 7% people has more expenses than their income. Following **Figure 4-73** present the saving scenario of the core area.

Figure 4-73: Monthly Savings of the Core Area (5km)

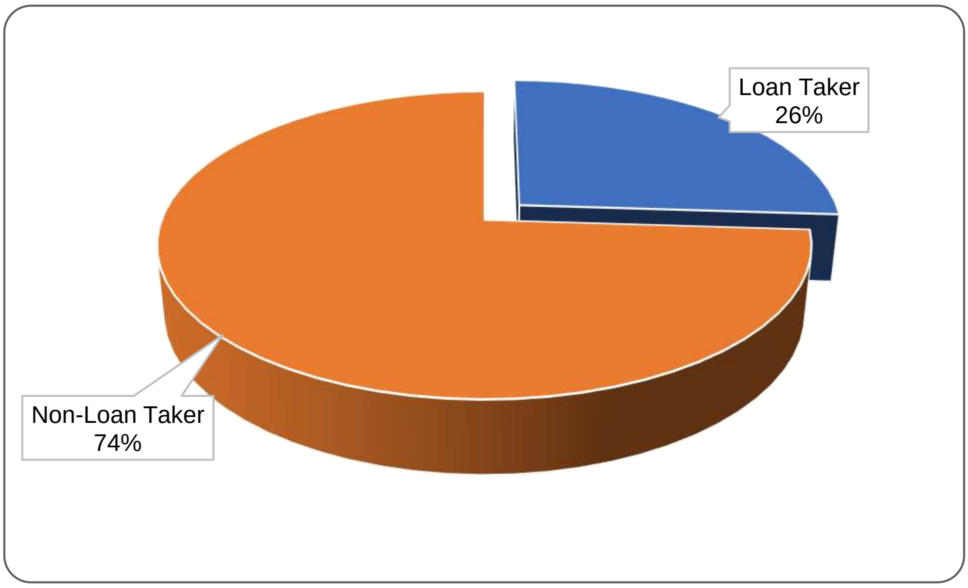


Source: EQMS Survey, October 2022

4.7.8.2.4 Loans of HHs in Core Area

Study finds that, about 26% HHs has taken loan from various NGO, Bank and other financial association within various duration. Most of the people take loan from ASHA, Prottashi and Bangla Jarman etc. Moreover, 74% people of the studied area have not taken any loan.

Figure 4-74: Loans of HHs in the Core Area

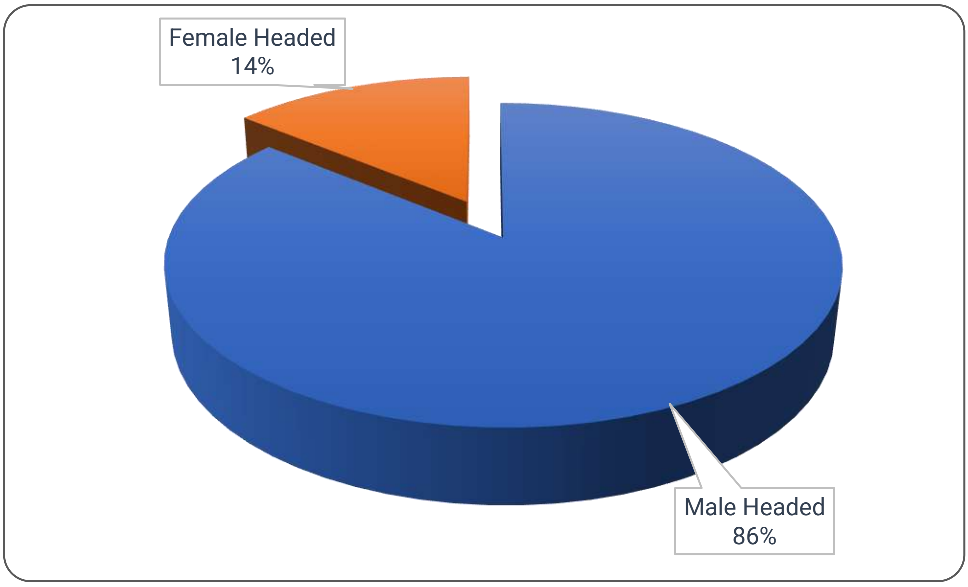


Source: EQMS Survey, October 2022

4.7.9 Gender Analysis

Study finds the common patriarchic scenario in the study area. It has been found that only 14% households are headed by women.

Figure 4-75: Gender Analysis based on Household Head

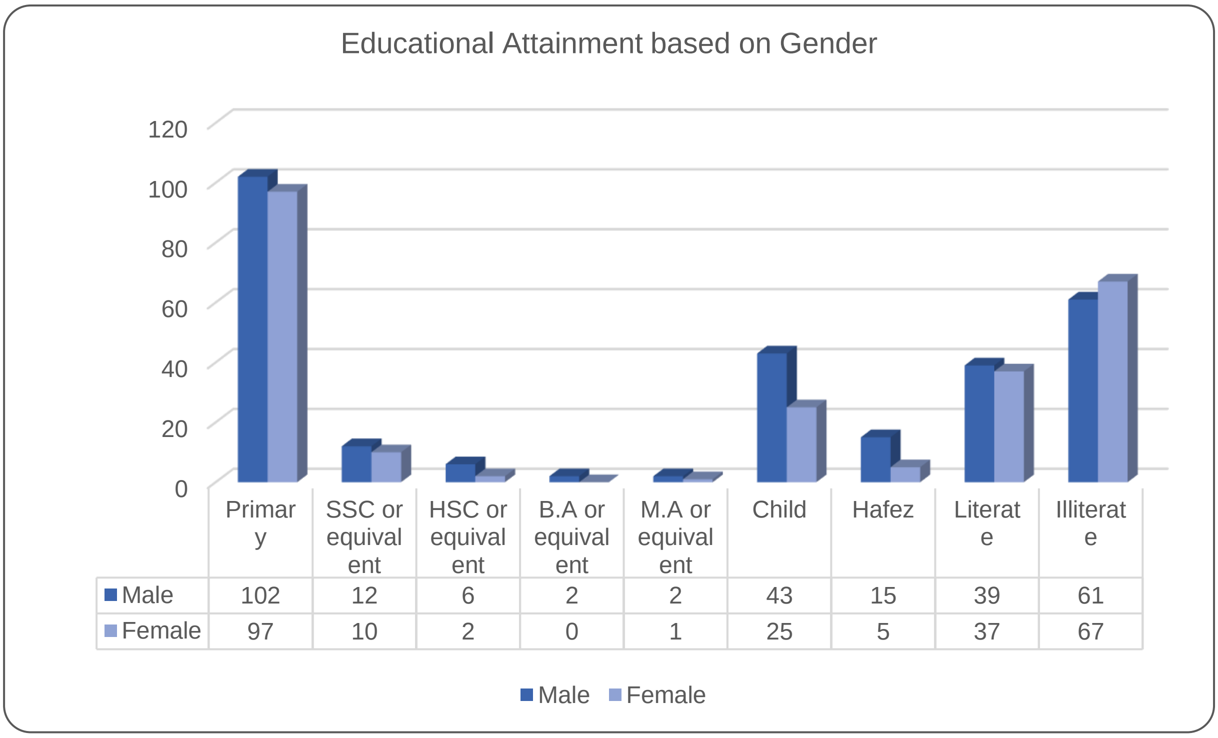


Source: EQMS Survey, October 2022

4.7.9.1 Gender Based Education and Occupation

According to the findings of the study, females are nearly as educated as their male counterparts at every level. A gender-based education status of the study area is given in **Figure 4-76 .**

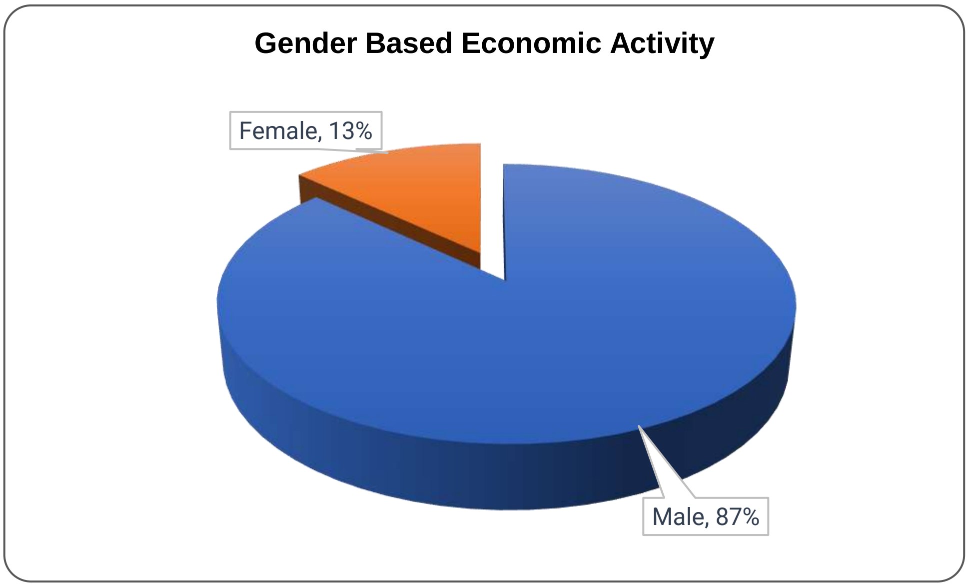
Figure 4-76: Educational Attainment based on Gender



Source: EQMS Survey, October 2022

Like the education attainment, female population are also found lagging in economic activities. It is found that, only 13% female of total economically active population are engaged in different economic activities.

Figure 4-77: Gender based Economic Activity

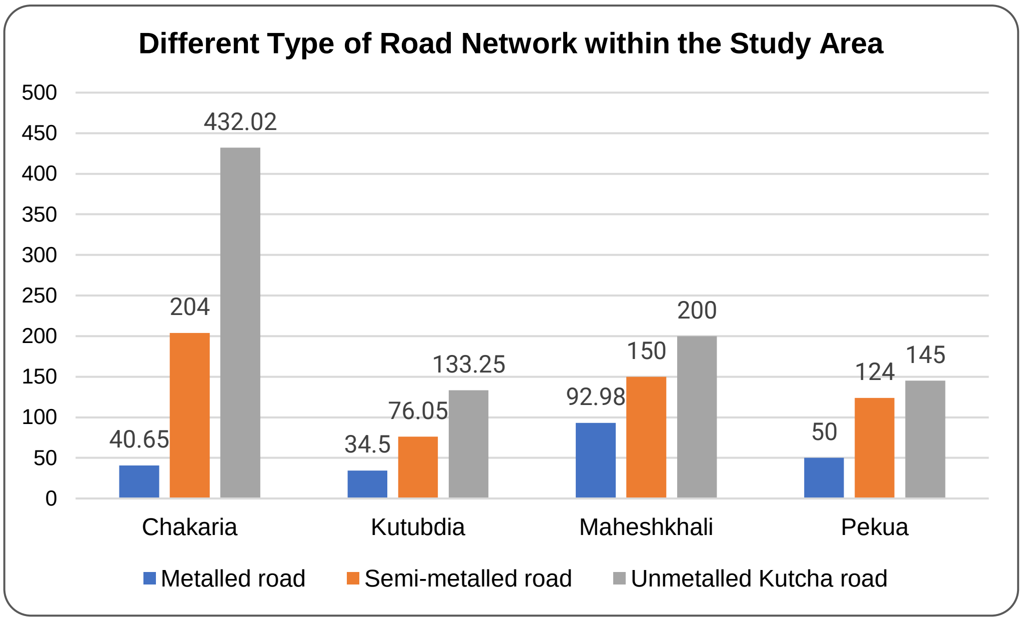


Source: EQMS Survey, October 2022

4.7.10 Traffic and Transport

Cox's Bazar District has a total road network of 4,144.77 km. Out of this, the Metalled Road (pucca network) or concrete road with bituminous top is 562.98 km long, the total Semi metalled road (semi-pucca) is 856 km long and the Unmetalled (kacha) or mud road is 2,751.45 km long. The following figure provides the percentage of different types of roads in the project area.

Figure 4-78: Different Type of Road Network within the Study



Source: District Statistics 2011, Bangladesh Bureau of Statistics (BBS)

Waterways: The Cox's Bazar District has 1,633 km of navigable waterways that are available all year. Small trawlers, transportation boats, and ferries are the primary users of the waterway. The project area contains 11.94% of these waterways, with 60 km in Chakaria Upazila, 65 km in Kutubdia Upazila, and 70 km in Maheshkhali.

Railways: As of now, Cox's Bazar District is not connected to the railway network of Bangladesh.

4.7.11 Social Issues

Social problem is an unexpected situation which hinders to lead a normal life in a society. Social problems are multidimensional problem which are created by various reasons. It may include security issues, transportation problem, accidental rate, acute disease, and other criteria, etc. The following **Table 4-49** showing the present social issues.

Table 4-49: Present Social Issues in the Study Area

SL#	Details		Frequency	Percent (%)
1	Security	High	98	49
		Moderate	70	35
		Low	16	8
		No Problem	16	8
Total			**200**	**100**
2	Transportation	High	150	75
		Moderate	30	15
		Low	20	10
		No Problem	0	0
Total			**200**	**100**
3	Accidental Rate	High	70	35
		Moderate	94	47
		Low	34	17
		No Problem	2	1
Total			**200**	**100**
4	Disease	High	120	60
		Moderate	52	26
		Low	22	11
		No Problem	6	3
Total			**200**	**100**

Source: EQMS Survey, October 2022

4.7.12 Environmental Issues

Environmental problems, that are perceived by the respondents in the study area, includes water pollution, air pollution, industrial pollution, noise pollution, deforestation, and drainage system etc. The following **Table 4-50** showing the present environmental issues.

Table 4-50: Present Status of Environmental Issues

SL#	Details		Frequency	Percent (%)
1	Water Problem	High	160	80
		Moderate	28	14
		Low	10	5
		No Problem	2	1

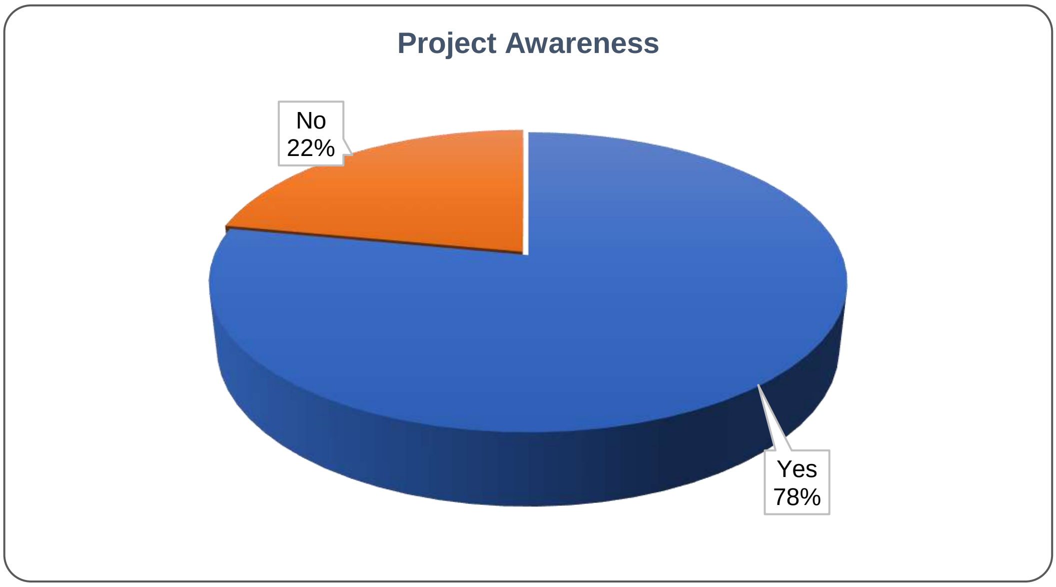
SL#	Details		Frequency	Percent (%)
Total			**200**	**100**
2	Noise Problem	High	40	20
		Moderate	62	31
		Low	46	23
		No Problem	52	26
Total			**200**	**100**
3	Air Problem	High	84	42
		Moderate	56	28
		Low	26	13
		No Problem	34	17
Total			**100**	**100**
4	Drainage Problem	High	110	55
		Moderate	68	34
		Low	18	9
		No Problem	4	2
Total			**100**	**100**
5	Industrial Problem	High	52	26
		Moderate	64	32
		Low	30	15
		No Problem	54	27
Total			**100**	**100**
6	Deforestation	High	42	21
		Moderate	82	41
		Low	26	13
		No Problem	50	25
Total			**100**	**100**
7	Population Problem	High	112	56
		Moderate	72	36
		Low	12	6
		No Problem	4	2
Total			**100**	**100**

The most pressing problem is water, noise and population in terms of the percentage of responses. The survey finds that, water pollution (80%) has been mentioned by respondent as environmental problem at present. The survey also reveals that 56% of the households mentioned population as highly problematic in the study area.

4.7.13 Project Awareness

Project awareness and perception may hinder or facilitate any project work's successful implementation. Moreover, community perception will lead to guide maintaining project activities in line of environmental & social standards. Survey result shows that 78% of total households are completely aware of this proposed project. Conversely, 22% of total households are found indifferent and know nothing regarding this project.

Figure 4-79: Awareness about the Project

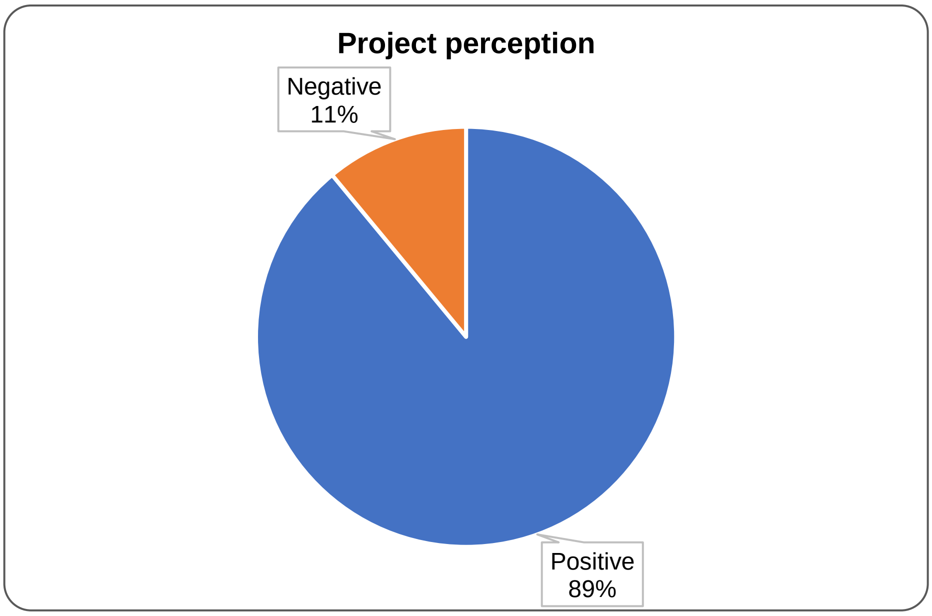


Source: EQMS Survey, October 2022

4.7.14 Perceived Impact

Among the surveyed population, about 89% believe that this project will bring positive impacts on the development of the local community and rest 11% do not believe so.

Figure 4-80: Perceived Perception of the Project



Source: EQMS Survey, October 2022

According to respondents, the project's implementation will result in a variety of benefits. According to the respondents, these benefits include increased employment opportunities, improved socioeconomic conditions, and overall development in the area. According to the respondents, some of the negative impacts include a loss of income source, land, agriculture, and land. About 93% of the respondents think that the HH members need training for new jobs or skill development. They also mentioned poultry farming, sewing, technical and mechanical etc. as the scope for training.

CHAPTER 6

Impact Assessment and Evaluation

5 ENVIRONMENTAL IMPACTS

This chapter presents the identification and appraisal of various impacts from the proposed power plant in the study area. Generally, the environmental impacts can be categorized as either primary or secondary. Primary impacts are those which are attributed directly to the project, and secondary impacts are those who are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the proposed action. The identified impacts significance has been evaluated based on nature, extent and location, duration, intensity/severity, irreplaceable loss, probability and magnitude. The detailed impact assessment methodology is given in Section 1.10 (Chapter-1) in this report. The impacts for pre-construction, construction and operation stages have been accessed in this section considering without mitigation measures.

Quantification of assessments in terms of measurable units would be the ideal method for impact assessment. Mathematical models are the best tools to quantitatively describe cause-effect relationships between sources of pollution and different components of the environment. Both quantitative and qualitative predictions have been made based on the model output, experience, and judgments.

The proposed project would create an impact on the environment in three distinct phases:

- During Pre-construction phase/land development phase may have some long term and short term impact;
- During the construction phase which may be regarded as temporary or short-term; and
- During the operation phase which would have long-term effects.

The pre-construction, construction and operational phase of the proposed project comprise various activities, each of which will have an impact on some or other environmental parameters. Various impacts during the pre-construction, construction and operation phase on the environmental parameters have been studied and elaborated in the subsequent sections.

5.1 Impact Identification

The potential impacts have been identified through a systematic process whereby the activities (both planned and unplanned) associated with the project have been considered with respect to their potential to interact with environmental and social resources or receptors.

The interaction matrix enables a methodical identification of the potential interactions each project activity may have on the range of resources/receptors within the area of influence i.e., the study area of the project. The interaction matrix for the project activities and likely impacted resources/receptors is presented in **Table 5-1**.

Table 5-1: Impact Identification Matrix for the Proposed Project

Project Activities	Potential Impacts																																	
	Physical Resources													Biological Resources				Socio-economic Resources										Community Health						
	Air Quality	Noise	Vibration	GHG emission	Surface water quantity	Surface water quality	Groundwater quantity	Groundwater quality	Soil Quality	Sediment quality	Land use	Drainage pattern	Aesthetics	Vegetation /Terrestrial Flora	Terrestrial fauna/wildlife	Aquatic fauna and fauna	Protected areas	Demographic (incl. Physical displacement)	Economy and livelihood	Social and cultural structure	Occupational health and safety	Employment	Economic displacement	Infrastructure and service	Cultural resources	Education and skills	Agriculture/cash crops	Public transportation	Communicable/non communicable disease	Social conflict	Vector borne disease	Sexually transmitted disease	Healthcare/recreational facilities	Vulnerable groups
Pre-Construction Phase																																		
Land Acquisition for power plant and coal conveyor belt																																		
Site Cleaning (Removal of vegetation/trees)																																		
Landfilling, levelling, excavation, and compaction																																		
Soil collection (dredging) and transportation to the project site																																		
Construction Phase																																		
Establishment and maintenance of Labor camp																																		
Generation of waste from labor camp and disposal																																		
Abstraction of water for construction activities and labor camp																																		
Construction of jetty (riverside)																																		

Project Activities	Potential Impacts																																	
	Physical Resources													Biological Resources				Socio-economic Resources										Community Health						
	Air Quality	Noise	Vibration	GHG emission	Surface water quantity	Surface water quality	Groundwater quantity	Groundwater quality	Soil Quality	Sediment quality	Land use	Drainage pattern	Aesthetics	Vegetation /Terrestrial Flora	Terrestrial fauna/wildlife	Aquatic fauna and fauna	Protected areas	Demographic (incl. Physical displacement)	Economy and livelihood	Social and cultural structure	Occupational health and safety	Employment	Economic displacement	Infrastructure and service	Cultural resources	Education and skills	Agriculture/cash crops	Public transportation	Communicable/non communicable disease	Social conflict	Vector borne disease	Sexually transmitted disease	Healthcare/recreational facilities	Vulnerable groups
Transportation and storage of construction materials																																		
Storage and handling of chemical																																		
Machineries and equipment's operation and maintenance in the construction site																																		
Civil construction of power plant and conveyor belt																																		
Mechanical and Electrical Erection Activities																																		
Influx of labor																																		
Removal of labor camp																																		
Operation Phase																																		
Coal transported from abroad																																		
Coal Unloading at jetty																																		
Coal transportation through conveyor belt																																		
Emission generated from stack																																		

Project Activities	Potential Impacts																																	
	Physical Resources													Biological Resources				Socio-economic Resources										Community Health						
	Air Quality	Noise	Vibration	GHG emission	Surface water quantity	Surface water quality	Groundwater quantity	Groundwater quality	Soil Quality	Sediment quality	Land use	Drainage pattern	Aesthetics	Vegetation /Terrestrial Flora	Terrestrial fauna/wildlife	Aquatic fauna and fauna	Protected areas	Demographic (incl. Physical displacement)	Economy and livelihood	Social and cultural structure	Occupational health and safety	Employment	Economic displacement	Infrastructure and service	Cultural resources	Education and skills	Agriculture/cash crops	Public transportation	Communicable/non communicable disease	Social conflict	Vector borne disease	Sexually transmitted disease	Healthcare/recreational facilities	Vulnerable groups
Fugitive emissions from handling and storage of coal in the stockyard, fly ash handling systems and transfer operations	■					■		■	■					■	■	■					■	■											■	
Generation of noise from power plant and vehicles movement		■														■					■												■	
Utilization of surface water from Kutubdia channel for the power plant operation					■											■																		
Hot water discharge to the river						■										■			■															
Generation, treatment, and disposal of effluent						■		■		■						■																		
Domestic and other non-hazardous wastes handling, storage, and disposal	■					■			■							■																	■	
Hazardous material and waste storage						■		■	■												■													
Maintenance and replacement of equipment						■		■	■												■	■												
Greenbelt development	■	■		■									■																				■	

5.2 Pre-Construction Stage

This includes the activities related to land acquisition, feasibility studies involving technical investigations, environmental assessment and preparatory works activities. The technical investigations included geotechnical investigations, topography, hydrological studies, erosion survey, soil testing, and engineering investigations. Pre-construction stage also includes site cleaning, Landfilling, levelling, excavation, and compaction. The probable impacts during pre-construction phase on various sectors of the environment (such as air, water, soil, biotic, socioeconomic environment etc.) have been identified.

5.2.1 Impact on Landform

A total of 1197.88 acres including the proposed project site land already acquired by the government and the land is owned by CPGCBL. OPDL-2 has taken 225 acres land as leased from CPGCBL to set up 635 MW coal based thermal power plant of which 204.64 acres for power plant, 18.63 acres for coal corridor and 1.3 acres for approach road construction. The proposed land is low lying which is being used for salt and shrimp cultivation. The average elevation of the site is +1.25 m which needs to be filled up at +10.0 meters elevation. The existing project site land will be developed through filling, levelling, and grading, prior to start the construction activities. There is no hilly area and designated wetland area inside of the project area. However, a canal is flowing through inside the project boundary at the eastern side and a creek at the western side. During the site preparation and land development, the existing canal and creek need to be filled up. An embankment is present at the western side of the project boundary which is also included within the project site. There is no permanent settlement within the project boundary. Only two squatters are living beside the embankment at the western side of the project boundary. Another two squatters fall under the coal corridor. No major tree species are present within the project boundary, only a few dispersed trees are present in the south-west corner of the project boundary. Land development activities will change the existing landform and land use of the project site but might not the surrounding area. The northern side of the proposed power plant area has already been acquired and there will be another power plant or other infrastructure in future. Also, Government of Bangladesh has taken "Moheshkhali-Matarbari Integrated Infrastructure Development Initiative (MIDI)" plan and accordingly several infrastructure developments will be executed in Matarbari region. Land use pattern of the project site will be changed from shrimp and salt cultivation land, embankment, canal, creek, shrubs and bushes to industrial category. The impacts on landform due to the site development activities are assessed to be **Medium-High**.

<table>
<tr><td>Impact</td><td colspan="9">Impacts on landform due to site development</td></tr>
<tr><td>Impact Nature</td><td colspan="2">Direct</td><td colspan="4">Indirect</td><td colspan="3">Induced</td></tr>
<tr><td>Impact Scale</td><td colspan="9">Inside of the project boundary</td></tr>
<tr><td>Frequency</td><td colspan="9">Limited to pre-construction stage</td></tr>
<tr><td>Extent and Location</td><td>Project Site</td><td colspan="2">Local</td><td colspan="2">Regional</td><td colspan="2">National</td><td colspan="2">Trans Boundary</td></tr>
<tr><td>Impact Duration</td><td>Short Term</td><td colspan="2">Medium Term</td><td colspan="2">Long-term</td><td colspan="2">Permanent-mitigated</td><td colspan="2">Permanent-no mitigation</td></tr>
<tr><td>Impact Intensity</td><td>Insignificant</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Very High</td></tr>
<tr><td>Potential for Irreplaceable Loss</td><td colspan="3">Low</td><td colspan="3">Medium</td><td colspan="3">High</td></tr>
<tr><td>Probability of Impact</td><td>Unlikely</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Definite</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Very Low</td><td>Low</td><td colspan="2">Medium-low</td><td colspan="2">Medium-high</td><td colspan="2">High</td><td>Very High</td></tr>
<tr><td colspan="9">Significance of impact consider Medium-high</td></tr>
</table>

5.2.2 Impact on the Sites from Where Material Would be Collected

During the pre-construction and development stage only site preparation and landfilling work will be done. The present average land elevation is + 1.25 meters which needs to be raised at +10.0 m to avoid flood and storm surge. Significant amount of landfilling material (dredge soil) will be required to develop the land. This landfilling material will be collected from the authorized vendor. The dredging site not yet confirmed because authorized vendor may take the required filling material from different part of the country. However, before starting dredging activity in the Bay of Bengal/River, the project proponent/vendors must be ensured the avoidance of Protected Area, Wildlife Sanctuary, Reserve Forest, Ecologically Critical Area, Marine Protected Area, Designated Fishing Ground, Hilsa breeding and migration route, Dolphins or others aquatic faunal migratory route and taken appropriate written approval from the concerned authority. The dredge material will be transported by vessels. Approximately 250 operator and labour will be required for dredge material transportation and land filling activities. Different equipment's including dredger(s), vessels, bulldozers, leveler, compactor, dump trucks and loaders will be required for land filling, leveling and compaction. The duration of the landfilling in the project site is expected to be limited during pre-construction phase. The dredge materials collection process in the sea/river will increase noise, turbidity and number of vessels movement, which may impact on aquatic ecosystem and disturbance the river traffic temporarily. Any accidental spillage of fuels and lubricants and improper management of the solid and liquid waste from the dredgers/vessels will impact on the aquatic ecosystem. Exhaust emission from the burning fossil fuel in the dredger/vessel will impact on ambient air quality. However, the impacts from the material collection activities in the sea/river is assessed to be **Medium-High**.

<table>
<tr><td>Impact</td><td colspan="9">Impacts due to material collection from the Sea/River</td></tr>
<tr><td>Impact Nature</td><td colspan="2">Direct</td><td colspan="4">Indirect</td><td colspan="3">Induced</td></tr>
<tr><td>Impact Scale</td><td colspan="9">Dredging site</td></tr>
<tr><td>Frequency</td><td colspan="9">Limited to pre-construction phase (Only dredging period)</td></tr>
<tr><td>Extent and Location</td><td>Project Site</td><td colspan="2">Local</td><td colspan="2">Regional</td><td colspan="2">National</td><td colspan="2">Trans Boundary</td></tr>
<tr><td>Impact Duration</td><td>Short Term</td><td colspan="2">Medium Term</td><td colspan="2">Long-term</td><td colspan="2">Permanent-mitigated</td><td colspan="2">Permanent-no mitigation</td></tr>
<tr><td>Impact Intensity</td><td>Insignificant</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Very High</td></tr>
<tr><td>Potential for Irreplaceable Loss</td><td colspan="3">Low</td><td colspan="3">Medium</td><td colspan="3">High</td></tr>
<tr><td>Probability of Impact</td><td>Unlikely</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Definite</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Very Low</td><td>Low</td><td colspan="2">Medium-low</td><td colspan="2">Medium-high</td><td colspan="2">High</td><td>Very High</td></tr>
<tr><td colspan="9">Significance of impact consider Medium-high</td></tr>
</table>

5.2.3 Drainage Pattern

The project site will be developed from +1.25 m to +10.0 m to avoid flood and storm surge. There is an embankment at the western side of the project site. The embankment is located all along the coast. There is a creek/canal at the western side of the project site which is flowing from north-south direction along the eastern side of the embankment. The creek was made by human to get water from Kutubdia channel for salt and shrimp cultivation. The creek/canal water is controlling by a regulator located on the embankment. There are some settlements and agricultural land at the southern side of the project site. Water availability and discharge of this region are controlling by the canal/creek. Due to land development the canals need to be filled up. As a result, water discharged will be hampered and may cause water logging. A natural canal is entered from northern boundary and flowing north-west-east direction in the project site and crossed the eastern boundary. The canal is originated from Kutubdia channel and falls in the Kuhelia river. The water of the canal is also controlled by a regulator for salt and shrimp cultivation. A total of 1197.88 acres including the proposed project site land already acquired by the government. The proposed project site land (204.65 acres) is located at the southern edge of the acquired land. Rest of the acquired land is located northern side of the proposed project land. All land will be developed and set up other power plants in future. The eastern side canal is inter-connected with other manmade creek hence, water discharge would not be a major problem until all acquired land development. Overall, natural or artificial drainage of the proposed project area and its surrounding area might be impacted due to landfilling activities and close the existing canal. Hence, the impact on drainage pattern has been accessed as **Medium High**.

Impact	*Drainage Pattern*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Change of drainage within the project site and surrounding					
Frequency	Land development phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Medium-high***					

5.2.4 Impact on Ambient Air

Particulate matter will be the predominant pollutant affecting the ambient air quality during the pre-construction and development phase of the proposed power plant project. Gaseous emission from the operation of machineries, equipment's, vessels and vehicles will impact on ambient air quality. During site cleaning, land filling, site establishment, earthwork and transportation activities in dry condition significant dust will be generated. The nearest settlement is located 420 m south to the project boundary. There are some settlements beside the access road. The particulate matter that would be released into the air could reduce visibility. During land development, settlement located near to the project site and access road will be impact due to dust generation.

Different equipment, vessel and vehicle will be used for land cleaning, dredge material transportation, filling, levelling, land development activities and transportation purpose. The equipment and vehicles will generate gaseous substances (NOx, SO_2) which will contribute to deteriorate the ambient air condition. These impacts are, however, reversible and of short duration, limited to the project boundary and dredging site and only during the pre-construction and development stage. The impacts on ambient air quality due to land filling material collection and land development activities is assessed to be **Medium-Low**.

Impact	*Air Quality Degradation*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Within the project location and surrounding					
Frequency	Limited to pre-construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
	Very Low	Low	Medium-low	Medium-high	High	Very High

Impact Significance	Significance of impact consider	***Medium-Low***

5.2.5 Impact on Ambient Noise

During pre-construction stage, major sources of noise generation are dredging activities, vessel movement, dredged material unloading pump operation, machine operation for site cleaning, filling, levelling, compaction and vehicle movement on the road and project site. Noise generation from the equipment in the project site will impact to the nearby resident. Settlement located beside the approach road from the Matarbari road to project site may experience noise due to vehicle movement. Noise generation from dredging will impact on aquatic ecosystem. It is expected that the impact will be minimum and short-term during the pre-construction stage. The impacts on ambient noise due to dredging and land development activity can be assessed to be **Medium-Low**.

Impact	*Noise Pollution*					
Impact Nature	Direct		Indirect		Induced	
Impact Scale	Dredging site, land filling and surrounding					
Frequency	Limited to pre-construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-Low***				

5.2.6 Impact on Waterbody

Dredging activities in the waterbodies will change the bottom topography and increase the turbidity. Solid waste, liquid waste and accidental spillage of oil and lubricant from the dredger will be significantly impact on the water resources as well as the aquatic life. Without secondary settling pond, runoff during dredged material dumping to the proposed site will increase the sediment content in the surrounding waterbody. Accidental spillage of fuels and lubricant from the vehicles in the land development site can be mixed with the rainfall-runoff and impact on aquatic environment. Windblown dust from the land-filling site can be dispersed and accumulated on the waterbody as a result TSS of the surface water might be increased. During the land development, the existing drainage pattern of the project site and surround will be changed (refer section 5.2.3). The impacts on waterbodies due to dredging and land development activities is assessed to be **Medium-Low**.

Impact	*Impacts on water bodies due to landfilling for site development*				
Impact Nature	Direct		Indirect		Induced
Impact Scale	Dredging river and project site surrounding water bodies				
Frequency	Limited to pre-construction Phase				
Extent and Location	Project Site	Local	Regional	National	Trans Boundary
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation
Impact Intensity	Insignificant	Low	Medium	High	Very High
Potential for Irreplaceable Loss	Low		Medium		High
Probability of Impact	Unlikely	Low	Medium	High	Definite

Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		***Medium-Low***			

5.2.7 Impact on Soil

Site cleaning and leveling, excavation and earth movement activities would result into permanent loss of fertile topsoil of the project site. Landfilling soil will be collected from the sea/river by dredging. The project area soil and surrounding land will be impacted if contaminated dredge soil is used for land development. Different machineries, equipment and vehicles will be used during land development. Accidental leakage during vehicle and equipment maintenance and operation may impact on soil quality. Soil will be compacted during the land development. Movement of heavy vehicles and construction machinery will also cause soil compaction. Soil compaction and possible damage to the soil structure due to heavy vehicular movement will only be limited to the vicinity of the project site. The land development period will be short and the impacts on soil quality due to land development activities is assessed to be **Low**.

Impact	*Impacts on Soil*					
Impact Nature	Direct		Indirect		Induced	
Impact Scale	Within the project location					
Frequency	Limited to pre-construction stage					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Low***				

5.2.8 Social Impact

5.2.8.1 Land Loss

The pre-construction phase of the project includes the acquisition of land, site clearance and land development activities. The project land used for shrimp cultivation and salt pan. Approximately an amount of 225 acres of land will be required for the proposed 635 MW coal fired power plant project at Matarbari Union, Maheshkhali Upazila under Cox's Bazar District. Among 225 acres land, total 204.64 acres land will be required for main power plant whereas 18.63 acres and 1.73 acres will be required for coal corridor and connecting road. Total 166.25 acres land is private land, and 58.75 acres land is government khas land. The proposed land has already been acquired by the government from the local community. Compensation was provided as per the guideline of Acquisition and Requisition of Immovable Property Ordinance (ARIPO-1982). The compensation for those who have had their land acquired has been paid through DC office. Now the land is owned by Coal Power Generation Company Bangladesh Limited (CPGCBL). A land lease agreement between CPGCBL and OPDL-2 has been signed to install the coal-based power plant on the land.

The landowner will lose their land permanently. As per consultation with local communities, all the landowners have received satisfactory compensation after acquiring their land. The impact is considered as ***Medium Low***.

Impact	*Loss of Land*		
Impact Nature	Direct	Indirect	Induced
Impact Scale	*Limited to the land in the project area and landowner*		

Extent	Project Site	Local	Regional	National	Trans boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity/ Severity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	*Medium-Low*				

5.2.8.2 Livelihood Loss

Total 204.64 acres of power plant land has been used as salt and shrimp cultivation. The predominant land use of the proposed project acquired land is salt pan during the dry season and shrimp culture during the monsoon and post-monsoon season. A significant number of land user such as worker working at the salt pan and shrimp cultivation will lose their livelihood due to the implementation of the project and associated facilities of the project. The source of impact in terms of loss of livelihood will be the following:

Salt Cultivation

In terms of salt cultivation, one worker is required for an acre of land. Approximately, 204 saltpan workers will lose their livelihood due to the intervention of proposed project. Usually, November to April is the time for salt cultivation. Moreover, some of the workers are engaged in salt cultivation for loading and unloading purpose for the entire year. Salt production per acre is estimated to be 20 tons for one season. Hence, total 4080 tons salt production will be lost.

As per the stakeholder consultation and socioeconomic baseline condition, it has been identified that the salt workers are unskilled labors and has no other employment option in case of economic displacement. A salt pan worker's income is 700 taka/ per day on average.

Shrimp Cultivation

In terms of shrimp cultivation, one worker is required for each 10 acres of land. Approximately, 20 shrimp cultivator will lose their livelihood due to the intervention of proposed project. Usually, May to October is the time for shrimp cultivation. A shrimp pan worker's income is 700 taka/ per day on average. Shrimp production per acre is estimated to be 600-800 kg for one season. So, it can be estimated the total shrimp production loss for 204.64 acres land as 122-163 tons/year.

As per the stakeholder consultation, it has been identified that the shrimp workers are mostly unskilled labors. During the dry season, some of the shrimp workers also engage in salt cultivation. Apart from salt and shrimp cultivation, these workers have no other employment option in case of economic displacement.

They are expected to be impacted by the change in livelihood because they have a direct reliance on this land for their livelihood. The duration of this impact has been assessed as Permanent with mitigation. The intensity of the impact has been assessed as Medium while the potential for irreplaceability/ vulnerability is High. Probability of the impact stands definite. As a result, the overall significance of the impact has been assessed as ***High***.

Impact	*Loss of livelihood associated with salt and shrimp cultivation*				
Impact Nature	Direct	Indirect		Induced	
Extent and Location	Project Site	Local	Regional	National	Trans boundary
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation

Impact Intensity	Insignificant	Low		Medium	High	Very High
Potential for Vulnerability	Low			Medium		High
Probability of Impact	Unlikely	Low		Medium	High	Definite
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		*High*			

5.2.8.3 Physical Displacement

The project site has already been acquired. However, the proposed power plant site is currently being used as salt pan and shrimp cultivation. The 4.9 km coal corridor area (20 m buffer) located on the western side of the embankment and all lands are government khas land. The project site and coal corridor have no legal housing structure. However, there are some squatters along the embankment in the project and within the coal corridor.

Plant Area: Approximately 204.64 Acres land will be required for the development of plant area. These lands have been acquired in 2016. However, nine (9) squatter households living in the project area adjacent to embankment. The squatters are living here for more than 20 years. The average family size of these household is 6. Approximately 54 people will be displaced considering the average household size. Most of these households are economically insolvent and living under poverty line. Their household type is mostly thatched. They are deprived of their basic needs including education, health and availability of drinking water. Some of these households are female headed which places themselves in the vulnerable category. Considering the local condition, an international NGO provided funds and built non-sanitary toilets for the households. The primary income source of these households is fishing during the monsoon period. Some of them have the alternative livelihood which is cattle rearing.

Coal corridor: Approximately 18.63 acres land is required for the development of coal corridor. There are twelve (12) households residing within 20 meters of the coal corridor. The households have different type of structure such as Semi-pucca, Katcha and thatched. The residents are living there illegally as the land has been acquired a long time ago. Hence, the development of coal corridor will have potential impact on the physical displacement of these households.

The duration of the impact is assessed to be long term, as the land is acquired permanently. The probability of impact is assessed as Definite, and the significance of impact is assessed as ***Medium-High***.

Impact	*Physical Displacement*					
Impact Nature	Direct		Indirect			Induced
Extent of Affected Stakeholders	Project Site	Local	Regional	National		Trans boundary
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated		Permanent-no mitigation
Impact Intensity	Insignificant	Low	Medium	High		Very High
Potential for Vulnerability	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High		Definite
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		*Medium-High*			

5.2.8.4 Employment Generation

The pre-construction phase activities will generate direct and indirect employment opportunities for the local community within the Maheshkhali Upazila and other areas in the country. The principal receptors are the local inhabitants and especially the economically active fisherman's, saltpan worker and farmers. The preconstruction and development phase activities of the power plant is envisaged to engage more than 300 workers in pre-construction works including operator and laborers. In addition, considerable indirect employment could be generated through contractors and other service providers and suppliers. Vendors would also emerge to provide food and catering services to the workers as well as trading in variety of items.

5.2.9 Impact on Ecosystem and Biodiversity

5.2.9.1 Impacts on Terrestrial Flora

The proposed project site is mainly used for salt and shrimp cultivation. Also, few dispersed trees are present in the south-west corner. Homestead plantation and agricultural lands were observed in the adjacent areas of the project site (eastern, south-eastern, and southern side). According to the baseline study, coastal plantation composed of *Casuarina equisetifolia*, *Acacia auriculiformis* and some common mangrove trees were established by the Forest Department on the right bank of Kutubdia Channel (Sagor para), eastern bank of Kohelia River, adjacent area of Rajghat Bridge and mouth of Matamuhuri River. Some *Casuarina equisetifolia (Jhau tree) and Bamboo trees* need to be cut down for land development of conveyer belt.

During pre-construction and development phase, activities that might impact on terrestrial flora include very small vegetation clearance. Dust will be generated during the land filling, levelling activities. Vehicle movement will also create dust. Dust will be dispersed by wind action. Excessive dust deposition on plants might reduce the photosynthetic process of floral species and hamper the plant growth which may result to causing diseases.

Considering the project activities and potential biological receptors within the project AOI, the impact on terrestrial flora during the pre-construction and development phase might be less significant and is assessed as ***Low***.

Impact	*Impact on Terrestrial Flora*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Project Site and adjacent area					
Frequency	Limited to Pre-Construction and site development Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Low***					

5.2.9.2 Impact on Terrestrial Fauna

The proposed project site is modified habitat which is mainly used for the salt and shrimp cultivation. A creek/canal was observed in west side of the site which is used by some migratory bird species viz. Common sandpiper, Wood sandpiper, Marsh Sandpiper etc. for their feeding and foraging purpose.

Impact on terrestrial fauna during the pre-construction and development phase may happen due to loss or degradation of habitats, excessive light from site development activities, dust, noise, and vibration from the operation of machineries, equipment, and vehicles for site development. During land development, birds shall move to other adjacent places for foraging activity.

Noise and vibration generated from operation of machineries used for site cleaning may affect the habitat and behavior of terrestrial fauna (migratory birds and shorebirds, herpetofauna, terrestrial mammals, and marine turtles) in the adjacent areas of the project sites. These activities will also lead to habitat destruction and/ or degradation of shorebirds and migratory birds. Transportation of materials and manpower in access roads might cause disturbance to movement of wildlife. Artificial lighting during pre-construction and development phase will hamper the movement of herpetofauna, and terrestrial mammals around the project site. Also, excessive light will negatively affect behavior, survivorship, and reproduction of migratory birds. Skyglow from excessive may change the migration pattern of the migratory shore birds.

Considering the project activities and potential biological receptors within the project AOI, the impact on terrestrial fauna during the pre-construction and development phase might be moderately significant. Therefore, it is assessed as ***Medium-low.***

Impact	*Impact on Terrestrial Fauna*					
Impact Nature	Direct	Indirect		Induced		
Impact Scale	Project Site and adjacent area					
Frequency	Limited to Pre-Construction					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-low***				

5.2.9.3 Impact on Aquatic Ecosystem

Impacts on the aquatic flora and fauna during pre-construction and development phase may happen due to dredging activity for land filling and navigation, transportation of machineries for site development, discharge of wastewater (domestic wastewater and water used to clean machineries and equipment).

Dredging activity for sourcing land filling material may lead to a loss of the aquatic invertebrate (benthic) community. Loss of benthic diversity may lead to the loss of a feeding ground for the fish species, which are directly dependent on benthic fauna.

The land filling activity at site development phase will generate sediment due to surface runoff during monsoon season leads to increase the suspended solids. Increase of suspended solid will increase the turbidity and lower dissolve oxygen level which affect the primary productivity of the impacted area. Accidental spillage and leakage of oil and lubricant used for site development machineries may get mixed up with surface run-off and thus will affect the primary productivity of sea and river adjacent to the project site.

Considering the project activities and potential biological receptors within the project AOI, the impact on aquatic fauna during the pre- construction and development phase might be moderately significant. Therefore, it is assessed as **Medium-Low**.

Impact	*Impact on Aquatic Ecosystem*		
Impact Nature	Direct	Indirect	Induced
Impact Scale	Dredging site and adjacent water bodies		

Frequency	Limited to Pre-Construction and site development Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		***Medium-low***			

5.2.10 Impact on Occupational health and safety

Site preparation involving cleaning and earthworks, operation of the machinery, movement of vehicles and machinery would generate dust, fumes and noise that could lead to possible respiratory problems, hearing loss and other health-related problems. Use of power tools and accessories, falling gadgets, cuts from sharp objects as well as the inhalation of exhaust fumes from vehicles and equipment could cause potential injuries and harm to health of workers and neighboring residence. Improper management of the labor camp will also impact on workers' health, sanitation, and safety. The impacts on workers' health, sanitation and safety are assessed to be **Medium-Low*.***

Impact	*Impact on Occupational health and safety*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Within the project boundary and labor camp					
Frequency	Limited to pre-construction phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity/ Severity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Medium-low***					

5.3 Construction Stage Impact

5.3.1 Impact on Land use

According to the OPDL-2, approximately 225 acres of land will be required for the establishment proposed power plant. Among 225 acres land, a total of 18.63 acres land will be required coal conveyer belt. The 4.7 km elevated coal conveyer belt will be installed from the Matarbari seaport following the western side of the embankment (along the seacoast). Primarily the existing proposed project area land is a salt pan area. A total of 204.64 acres land for main power plant will be developed through filling, levelling, and grading, prior to starting the construction activities. Land development activities will change the existing landform and land use of the project site. The land use pattern of the project site will be changed from fish farming, salt pan, natural and artificial water body to industrial category during pre-construction or land development stage.

Constructions activities including the establishment of main power block, coal conveyer belt, water intake and outfall structure, storage tanks, pump house, pipeline and construction of buildings and internal road network may change the visual landscape of the project site. The scenic beauty of Matabari sandy beach will be changed due to the elevated conveyor belt, water intake and outfall structure construction. Site clearance activities, gathering of equipment and construction materials, machinery and labor camp establishment on greenfield site may reduce the scenic beauty. According to the Moheshkhali-Matarbari Integrated Infrastructure Development Initiative (MIDI), there are several development plans including power plant, economic zone, deep seaport and other infrastructures. Hence, the current land use of Matarbari will be changed to an industrial area. Nevertheless, the impact is for a long duration and reversible as the project plan includes landscape planning, green belt development etc. The impact on land use due to the construction activities is assessed to be **Medium-High**.

<table>
<tr><td>Impact</td><td colspan="9">Impacts on land use</td></tr>
<tr><td>Impact Nature</td><td colspan="2">Direct</td><td colspan="4">Indirect</td><td colspan="3">Induced</td></tr>
<tr><td>Impact Scale</td><td colspan="9">Within project boundary</td></tr>
<tr><td>Frequency</td><td colspan="9">Throughout the project lifecycle</td></tr>
<tr><td>Extent and Location</td><td>Project Site</td><td colspan="2">Local</td><td colspan="2">Regional</td><td colspan="2">National</td><td colspan="2">Trans Boundary</td></tr>
<tr><td>Impact Duration</td><td>Short Term</td><td colspan="2">Medium Term</td><td colspan="2">Long-term</td><td colspan="2">Permanent-mitigated</td><td colspan="2">Permanent-no mitigation</td></tr>
<tr><td>Impact Intensity</td><td>Insignificant</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Very High</td></tr>
<tr><td>Potential for Irreplaceable Loss</td><td colspan="3">Low</td><td colspan="3">Medium</td><td colspan="3">High</td></tr>
<tr><td>Probability of Impact</td><td>Unlikely</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Definite</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Very Low</td><td>Low</td><td colspan="2">Medium-low</td><td colspan="2">Medium-high</td><td colspan="2">High</td><td>Very High</td></tr>
<tr><td colspan="9">Significance of impact consider Medium-high</td></tr>
</table>

5.3.2 Impact on Natural Resources

5.3.2.1 Impact on Agricultural Resources

The project site is in low lying area. The land is mainly used for shrimp cultivation during the wet season and salt cultivation in the dry season. There is no agricultural practice on the project site. There is even no agricultural practice adjacent to the project site which will be influenced by the project construction. Therefore, no major impacts are expected on agricultural resources including loss of crop production. The impacts on agricultural resources by the establishment of the power plant is assessed to be no impact.

5.3.2.2 Impact on Fisheries

A jetty will be constructed on the Kutubdia channel at the west side of the proposed power plant for construction material and plant's equipment unloading. A coal jetty will be constructed in the Matarbari port. During the construction phase of the proposed power plant, major construction materials for the plant will be transported by the waterway. As a result, number of vessels movement in the Kutubdia Channel will be increased during the construction phase. The movement of vessels in the river and accidental spillage of oil and lubricants, blast water, oil mixed water, solid waste from vessels and jetty construction activities will impact on the open water fisheries resources. During the piling of material unloading Jetty (west side of the project) in the Kutubdia channel, ambient noise level, vibration will be increased and increase the turbidity in the river. The fish and others aquatic animal will be disturbed by the noise and lighting from the vessels in the construction site. The fishing activity is limited to the jetty construction area. However, construction phase activities will restrict the fishermen to catch fish near the bank of the river and close to the project boundary. It will impact on fish production, income, and livelihoods of the fisherman's those who are engaged with the fishing activities near the project site. According to the fisherman, there is no fishing activities at western side of the project boundary, but fishing activities are carried out upstream and downstream of the project boundary in a limited scale.

Improper management of wastes and disposal from the construction workers camp, jetty construction area and vessel can pollute the surface water as well as the fish resources. The impact of fisheries during the construction phase of the power plant has been assessed to be **Medium-Low**.

Impact	*Impacts on Fisheries*					
Impact Nature	Direct	Indirect		Induced		
Impact Scale	Within the construction site, material transportation route and jetty site in the river					
Frequency	Limited to construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Medium-low***					

5.3.2.3 Impact on Forest

The project site does not have any forest land within the main power plant land. Even, no major tree species is present in the project boundary. A few Jhau trees planted by the forest department and bamboos on the coast need to be felt for coal conveyor belt construction. Some dispersed trees are present at the southwest side of the project site which will be cleared during the pre-construction and land development stage. So, impact can be assessed as **low**.

Impact	*Impact on forest trees*					
Impact Nature	Direct	Indirect		Induced		
Impact Scale	Planted trees by forest department					
Frequency	Limited to construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Low***					

5.3.2.4 Impact on Livestock

The project site is mainly used for fish and salt cultivation. The proposed coal-fired power plant project site doesn't encroach any grazing land. During the baseline data collection from the field, no grazing activities were observed inside of the project boundary. It is expected that livestock resources in the proposed project area will not be affected by the implementation of the proposed project.

5.3.3 Impact on Ambient Air Quality

The possible sources of dust generation activities and exhaust emission during the construction phase are as follows:

- Excavation of soil to construct building and equipment foundations;
- Pile driving for the equipment foundation;

- Movement of construction equipment by vehicle and barge;
- Loading and unloading of materials;
- Dust generated from stockpiles of materials, waste, loose earth, handling and moving excavated material and transporting wastes on vehicles.
- Concreting works, including the operation of the concrete batching plant;
- Exhaust emission from the movement of heavy equipment by barge, heavy loaders, trucks;
- Operation of diesel generators and other diesel based construction machinery;

Dust generated from many of these activities will increase the particulate matter levels in ambient air. Most of the construction activities mentioned above have the potential to generate dust. The extent of impacts from dust will depend on the exact location of these activities and on the weather conditions; stronger winds and dry conditions will enhance the transfer of dust, while damp or wet conditions will reduce this impact. Construction dust dispersion is expected to be localized due to the relatively high mass of the dust particles, which will tend to confine the most significant dust impacts to the area within 200 m of the source. The potential for dust emissions during the wet season will be small, due to the moistening of any dust by rainfall. As the dust is expected to settle within 200 m, the main receptors would be workers on site and neighbouring settlements.

Heavy equipment such as excavators, cranes, and compactors will be used onsite, and the vehicle will be used for carrying construction workers and officials. Emissions from these equipment, vehicles and diesel generator sets used to generate Power will cause impacts to ambient air quality. Construction material and labour carrying vehicles will also contribute to exhaust emissions. The principal pollutants would include sulfur dioxide (SO_2), nitrogen oxides (NO_X), particulate matter (PM) and carbon monoxide (CO). Impacts from vehicle emissions decrease rapidly with increasing distance from the source and are not likely to be significant at distances of more than 200 m from the source; they are usually minor at a distance of more than 50 m with limited no. of vehicles plying on the access road. Neighbouring settlements are located 420 m to the project boundary as well as a settlement are present along the approach road from the Matarbari road to the project site.

Moreover, the consequences will not be significant as the settlement is not located adjacent to the project boundary. However, the impacts on ambient air quality during construction phase is assessed to be ***Low***.

Impact	*Impact on Ambient Air*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Project surrounding and along approach road					
Frequency	Limited to construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity/ Severity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Low***					

5.3.4 Impact on Ambient Noise Level

The potential sources of noise during the construction phase of the Project include equipment, machinery and transportation used for the construction activities. The heavy equipment used for construction activities will be the major sources of noise. This will include piling and preparing concrete foundations for the plant, jetty, and buildings. The waterway and road traffic volume will be increased during the construction phase due to the transportation of equipment, construction materials and workers on the access road and river way which will be the source of noise to the closest receptor along the road.

The general noise levels during construction phase such as due to the working of heavy earth moving equipment and machinery installation may sometimes go up to 90 dB(A) at the work sites in the daytime. Different phases of construction activities at the project site are scheduled to take place for about 42 months. The workers, in general, are likely to be exposed to an equivalent noise level of 80-90 dB(A) in 8 hours shift.

Noise generation will be considered during such types of large-scale construction activities. Typical Noise sources during construction phases are mentioned in **Table 5-2**.

Table 5-2: Typical Noise Sources during Construction Phase

Description	Noise Level (dB(A))
Earth Movers	
Dozers	95-100
Front Loaders	72-84
Backhoes	72-93
Tractors	76-96
Tippers/Trucks	82-94
Material Handlers	
Concrete Mixers	75-83
Concrete Pumps	81 -83
Cranes (movable)	75-86
Vehicular Traffic (Construction material and plant machinery)	85-98
Stationary Equipment	
DG Sets	90-95
Pumps	69-71
Compressors	74-86
Impact Based Equipment	
Pneumatic Wrenches	83-88
Jackhammer and rock drills	81 -98
Pile drivers (peak)	95-105

The equipment and machinery will produce cumulative noise depending on source type and number, weather condition, distances and duration of the working period. If a single equipment will produce 90 dB (A) within 1m, it would be reduced gradually to its movement.

The produced noise will traverse to the adjacent communities from the sources. Local inhabitants may feel disturbed while receiving noise from line sources, point sources, nonpoint sources, and engineering sources individually or collectively.

Vibration also generates from the construction equipment, which may impact the local communities located near to the project site. Vibration may cause human health hazards such as tiredness, insomnia, mental disorder and working ability reduction. Regarding dwelling houses and other structures, with a vibration of minimum 5.0mm/s may cause harm to structures' lifespan.

Impact due to the construction work noise on the adjacent community would be minimum as the project site is located 420 m far from the nearby house. A significant source of noise during the construction phase is additional traffic to and from the project site as well as traffic on the site. The concrete batching plant will significantly reduce heavy traffic vehicle movement to and from the site. Construction traffic is expected to be generated throughout the entire construction period; however, the volume and type of traffic generated will depend on construction activities being conducted which will vary during the construction period. There is potential for disturbance to habitations in the proximity of construction site. Movement of traffic during night hours can also disturb the local community. The receptors are present more than 400 m to the project area, and along the approach road, therefore, peoples will feel discomfort due to the construction activities as well as the movement of vehicles on the access road. However, noises will be confined to the site (local) and of a temporary nature. The impacts on ambient noise due to power plant construction is assessed to be **Medium-Low**.

<table>
<tr><td>Impact</td><td colspan="6">Impact on Ambient Noise</td></tr>
<tr><td>Impact Nature</td><td colspan="2">Direct</td><td colspan="2">Indirect</td><td colspan="2">Induced</td></tr>
<tr><td>Impact Scale</td><td colspan="6">Project surrounding and along the approach road</td></tr>
<tr><td>Frequency</td><td colspan="6">Limited to construction Phase</td></tr>
<tr><td>Extent and Location</td><td>Project Site</td><td>Local</td><td>Regional</td><td>National</td><td colspan="2">Trans Boundary</td></tr>
<tr><td>Impact Duration</td><td>Short Term</td><td>Medium Term</td><td>Long-term</td><td>Permanent-mitigated</td><td colspan="2">Permanent-no mitigation</td></tr>
<tr><td>Impact Intensity</td><td>Insignificant</td><td>Low</td><td>Medium</td><td>High</td><td colspan="2">Very High</td></tr>
<tr><td>Potential for Irreplaceable Loss</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td></tr>
<tr><td>Probability of Impact</td><td>Unlikely</td><td>Low</td><td>Medium</td><td>High</td><td colspan="2">Definite</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Very Low</td><td>Low</td><td>Medium-low</td><td>Medium-high</td><td>High</td><td>Very High</td></tr>
<tr><td colspan="6">Significance of impact consider Medium-low</td></tr>
</table>

5.3.5 Impact on Water Bodies

The likely impacts on water quality during the construction phase may arise from inappropriate disposal of construction waste and wastewater generated from the power plant construction site, water intake and outfall structure construction. Wastewater generated from the site during the construction contains suspended materials, spillage and washings from the various areas. In addition to that, the presence of labours and another workforce in the construction site will generate wastewater during the construction phase of the project.

During the construction phase of the proposed power plant, water will be used for the construction of civil structures, dust suppression and drinking purpose. The water requirement is estimated to be about 40 m^3/hr and 100 m^3/hr during normal and peak construction. The potable water requirement will be range from 90 KLD – 180 KLD. The required water shall be met from the groundwater wells. Effluents from the construction area mainly contain suspended solids while the sanitary waste from the labour colonies contains suspended as well as organic matter. The loose construction material like sand, cement etc. and excavated earth/construction debris may get washed off during heavy precipitation and finally reach the nearby River. This may increase the suspended solids of the receiving water body.

For the sanitary sewage, it is anticipated that about 3000 workers will be on site during the peak period of construction. At an average water use by one person of 0.1 m^3/day, it is estimated that 300 m^3/day of sanitary wastewater will be generated. This is a significant amount of sanitary wastewater that without proper treatment and disposal methods could be discharged off-site with detrimental impacts on the environment.

Solid and liquid waste generated from barge and jetty construction area may impact on surface water. Oil spillage from the workshop and vessels, rainwater runoff may contaminate surface water near the construction site. Jetty, water intake and outfall construction in the Kutubdia Channel/sea will increase the turbidity. Dust from the construction site will be dispersed by the wind action and accumulate on the water bodies which will increase the TSS in the surface water. The impacts on the waterbodies during the construction phase of the proposed power plant project is assessed to be ***Medium-Low*.**

<table>
<tr><td>Impact</td><td colspan="8">Impact on water bodies</td></tr>
<tr><td>Impact Nature</td><td colspan="2">Direct</td><td colspan="3">Indirect</td><td colspan="3">Induced</td></tr>
<tr><td>Impact Scale</td><td colspan="8">Within the project boundary and adjacent area</td></tr>
<tr><td>Frequency</td><td colspan="8">Limited to construction Phase</td></tr>
<tr><td>Extent and Location</td><td>Project Site</td><td colspan="2">Local</td><td>Regional</td><td colspan="2">National</td><td colspan="2">Trans Boundary</td></tr>
<tr><td>Impact Duration</td><td>Short Term</td><td colspan="2">Medium Term</td><td>Long-term</td><td colspan="2">Permanent-mitigated</td><td colspan="2">Permanent-no mitigation</td></tr>
<tr><td>Impact Intensity</td><td>Insignificant</td><td colspan="2">Low</td><td>Medium</td><td colspan="2">High</td><td colspan="2">Very High</td></tr>
<tr><td>Potential for Irreplaceable Loss</td><td colspan="3">Low</td><td colspan="2">Medium</td><td colspan="3">High</td></tr>
<tr><td>Probability of Impact</td><td>Unlikely</td><td colspan="2">Low</td><td>Medium</td><td colspan="2">High</td><td colspan="2">Definite</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Very Low</td><td>Low</td><td colspan="2">Medium-low</td><td>Medium-high</td><td colspan="2">High</td><td>Very High</td></tr>
<tr><td colspan="8">Significance of impact consider Medium-low</td></tr>
</table>

5.3.6 Impact on Soil

During the land development phase, the project footprint area will be stripped of the topsoil and excavation done to receive reinforced concrete foundations for the power plant infrastructure. The present site elevation+1.25 m which will be raised to +10 m. Significant amount of sand material will be required for land filling. There is the potential for the loss of soil and other excavated material through erosion caused by runoff during rainy weather or from wind during the dry period in the construction phase of the proposed development.

Soil will be compacted during the establishment of laydown areas, internal roads and installation of equipment to ensure stability. Movement of heavy vehicles and construction machinery in project site and coal conveyer belt construction area will also cause soil compaction. Soil compaction and possible damage to the soil structure due to heavy vehicular movement will only not be limited to the vicinity of the power plant site but also the shore area/beach area during coal conveyer belt construction. Hence, there is a possibility of soil/sand compaction along the coal corridor/conveyer belt construction area.

Contamination of the soil may occur from improper handling of waste. The major sources are as follows:

- General construction waste will comprise of surplus or off-specification materials such as concrete, wooden pallets, steel cuttings/filings, packaging paper or plastic, wood, plastic pipes, metals etc.
- Domestic-type wastes consisting of food waste, plastic, glass, aluminium cans and waste paper will also be generated by the construction workforce.
- A small proportion of the waste generated during construction will be hazardous and may include:
  - Used paint, engine oils, hydraulic fluids and waste fuel;
  - Spent mineral oils and cleaning fluids from mechanical machinery; and
  - Spent solvents from equipment cleaning activities
  - Spent batteries or spent acid/alkali from the maintenance of machinery on site.

Soil contamination during the construction phase may result from leakage and spillage of oil, lubricants, fuel from heavy equipment or leakage from chemical/fuel storage. The majority of the generated wastes will be non-hazardous. If improperly managed, hazardous waste could create impacts not only to land but also to local air quality, water quality, and human health. Contamination from spillage and leakage can have a long-term impact on soil. Improper waste handling may cause direct, long-term negative impacts on soil quality. Hence, the impact on soil quality has been accessed as **Medium-High.**

<table>
<tr><td>Impact</td><td colspan="9">Impact on soil quality</td></tr>
<tr><td>Impact Nature</td><td colspan="2">Direct</td><td colspan="4">Indirect</td><td colspan="3">Induced</td></tr>
<tr><td>Impact Scale</td><td colspan="9">Within the project footprint area</td></tr>
<tr><td>Frequency</td><td colspan="9">Limited to construction Phase</td></tr>
<tr><td>Extent and Location</td><td>Project Site</td><td colspan="2">Local</td><td colspan="2">Regional</td><td colspan="2">National</td><td colspan="2">Trans Boundary</td></tr>
<tr><td>Impact Duration</td><td>Short Term</td><td colspan="2">Medium Term</td><td colspan="2">Long-term</td><td colspan="2">Permanent-mitigated</td><td colspan="2">Permanent-no mitigation</td></tr>
<tr><td>Impact Intensity/ Severity</td><td>Insignificant</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Very High</td></tr>
<tr><td>Potential for Irreplaceable Loss</td><td colspan="3">Low</td><td colspan="3">Medium</td><td colspan="3">High</td></tr>
<tr><td>Probability of Impact</td><td>Unlikely</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Definite</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Very Low</td><td>Low</td><td colspan="2">Medium-low</td><td colspan="2">Medium-high</td><td colspan="2">High</td><td>Very High</td></tr>
<tr><td colspan="3">Significance of impact consider</td><td colspan="6">Medium-high</td></tr>
</table>

5.3.7 Impact on Workers Health, Sanitation and Safety

The sources of impact to the workers' health, sanitation, and safety of the power plant project's construction workforce is listed below:

- Accidents and injuries associated with the operation of heavy machinery and other construction activities; and
- Health impacts associated with environmental conditions and changes in environmental quality, arising from emissions to air, water, land, and noise emissions from construction activities as well as from storage and handling of waste, particularly hazardous waste.

5.3.7.1 Accidents and Injuries from General Construction Activities

Over-exertion, ergonomic injuries, and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries on construction sites. Loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent causes of lost time accidents at construction sites. Falls from elevation associated with working with ladders, scaffolding, and partially built structures are also among the most common causes of fatal or permanent disabling injury at construction sites.

Construction activities may pose significant hazards related to the potential for dropping materials or tools, as well as ejection of solid particles from abrasive or other types of power tools, which can result in injury to the head, eyes, and extremities.

Vehicle traffic, use of lifting equipment and the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise. Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving. These risks could create long-term impacts to the health and safety of the construction workforce. The impact on workers' health safety due to accidents and injuries from general construction activities is assessed to be ***Medium-High***.

<table>
<tr><td>Impact</td><td colspan="7">Impact on workers' health, sanitation and safety due to Accident and Injuries</td></tr>
<tr><td>Impact Nature</td><td colspan="2">Direct</td><td colspan="3">Indirect</td><td colspan="2">Induced</td></tr>
<tr><td>Impact Scale</td><td colspan="7">Within the project boundary and construction camp</td></tr>
<tr><td>Frequency</td><td colspan="7">Limited to construction Phase</td></tr>
<tr><td>Extent and Location</td><td>Project Site</td><td colspan="2">Local</td><td>Regional</td><td colspan="2">National</td><td>Trans Boundary</td></tr>
</table>

Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-high***				

5.3.7.2 Health Impact associated with Environmental Conditions

Changes in the environmental quality of air, surface water, groundwater and soil quality may occur as a result of construction activities. High noise levels are also expected from the operation of heavy machinery. An increase in dust and noise during the construction period has the potential to lead to health impacts associated with eye irritation and general disturbance to daily activities.

Construction sites may pose a risk of exposure to dust, chemicals, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms. The impacts on workers' health and safety due to the changed environmental condition is assessed to be ***Low***.

Impact	*Impact due to associated environmental condition*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Within the project boundary and construction camp					
Frequency	Limited to construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Low***				

5.3.8 Impact on Key Point Installations and Others

The government has taken a master plan for development in Matarbari and Moheshkhali Islands through different implementing agencies, with finance from JICA under the project "Moheshkhali-Matarbari Integrated Infrastructure Development Initiative" (MIDI). According to the Moheshkhali-Matarbari Integrated Infrastructure Development Initiative" (MIDI), there will be road and rail network, power plant (Coal, LNG and solar), deep seaport, LNG terminal, 5 economic zones, SPM with double pipeline project in the Moheshkhali and Matarbari area. Among them, several development projects are under construction. The Matarbari 600X2 MW coal based thermal power plant is located 4.60 km south of the project site and BNS Sheikh Hasina Submarine base is located about 4.84 km north of the project site. These two are the existing key point installation near to the project site. During the proposed coal-based power plant, water way vehicle will be travel frequently that may impact on the navigation of the marine vehicle of Navy. Other than, no major impact is expected to the key point installation due to the proposed power plant construction since the KPI are located more than 4 km away from the project site. Hence, the impact can be assessed as Low.

Impact	*Impact on key point installation*		
Impact Nature	Direct	Indirect	Induced
Impact Scale	Within the project boundary and construction camp		
Frequency	Limited to construction Phase		

Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Low***					

5.3.9 Solid Waste Disposal

The proposed power plant project is expected to generate a variety of wastes during the construction phase of the project. Raw material from the construction of buildings and plant infrastructure may require offsite disposal. Some of the waste streams are likely to be generated during the excavations for building foundations and the construction of the building frame, internal fittings, electrical installation and external works and include the following waste streams:

- Hazardous wastes such as solvents, thinners, cleaners, cutting oils, paints, contaminated rags, packaging and containers, adhesives, light bulbs and batteries;
- Non- hazardous wastes such as food and canteen waste, scrap metal waste, concrete waste, waste paper, wood, cardboard packaging and
- Other wastes such as glass, uncontaminated soil and rubble, plastics and rubber

The improper management of the above wastes may have potential adverse impacts on air, water and soil in the absence of appropriate mitigation measures. The impacts on environment from solid waste disposal is assessed to be **Low**.

Impact	*Impact due to solid waste disposal*					
Impact Nature	Direct		Indirect		Induced	
Impact Scale	Within the project boundary and surrounding area					
Frequency	Limited to construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Low***					

5.3.10 Social Impact due to Industrial Set up

5.3.10.1 Impacts on Local Resources and Infrastructures

The proposed power plant project area is located inside of the rural area. There is no industry around the proposed project site. As a result, the existing infrastructures are not well developed in the project area. During the construction phase of the project, a good number of workers will be required on site and could lead to unwarranted pressure on key local resources and infrastructures such as water, healthcare, electricity, school, mosque and road etc. The construction activities usually attract a sizeable influx of population, which leads to construction of temporary hutments, having an effect on land-use pattern of the areas surrounding the project. The demand of local resources will be increased hence, the market price of the locally available products may be increased. Local people will get benefitted by selling the locally grown product. The impacts on local resources and infrastructures by the construction of power plant is assessed to be **Low**.

Impact	*Impacts on local resources and infrastructures*					
Impact Nature	Direct	Indirect		Induced		
Impact Scale	Project surrounding area					
Frequency	Limited to construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Low***				

5.3.10.2 Impact on Community Health and Safety

Possible sources of impacts on community health and safety during the construction phase are:

- Changes in environmental quality due to construction activities.
- Increased prevalence of disease arising from the influx of construction workers.
- Increase in traffic movement.

Changes in environmental quality: Health Impact associated with environmental conditions changes in the environmental quality of air, surface water, groundwater, and soil quality may occur as a result of construction activities. High noise levels are also expected from the operation of heavy machinery. An increase in dust and noise during the construction period has the potential to lead to health impacts associated with eye irritation and general disturbance to daily activities. Inhabitants residing close to project site and along the roads will be affected due to noise and dust generated from vehicular movement during the construction phase. The discharge of domestic waste effluent from sanitary facilities for construction workers may have the potential to cause contamination of surface water and groundwater in this area.

Transmission of infectious diseases: The influx of workers into the community may have an impact on public health, particularly an increase in disease prevalence. Inadequate sanitation facilities and waste disposal from the construction labor camp can result in vector-borne diseases and other infectious diseases. Food and water-borne diseases are the most common, owing to contamination by fecal elements, pests, and vectors, as well as a lack of sanitation facilities. Furthermore, the construction work will generate some debris. All such waste, if left on site, has the potential to breed vectors and pests, resulting in vector-borne diseases. As a result of the expected influx of workers, there is also the possibility of an increase in sexually transmitted diseases such as HIV/AIDS. If proper management is not implemented, the consequences will be severe.

Traffic movement on site approach road: Construction activities are expected to increase traffic load on the site approach road, potentially posing a public safety risk to nearby residents. Potential consequences include pedestrian safety concerns as well as slow-moving vehicle safety concerns. Additional construction vehicles for materials and equipment may cause traffic congestion on the existing road, which may be bothersome to the community, but it is likely to be irregular and insignificant, resulting in insignificant traffic impacts on the community.

The impact on community health and safety considering the associated impact in terms of changes in environmental quality, transmission of infectious diseases and traffic movement the impact nature assessed as direct, impact severity is high and overall significance of the impact is assessed as **Medium-low**.

Impact	*Community Health and Safety*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	*Inhabitant present close to the project site and along the access road*					
Frequency	*Limited to construction stage*					
Extent	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceability	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	*Medium-low*				

5.3.10.3 Impact on Demography

Over the construction period of about 45 months, the peak workforce is expected to be approximately 3,000 persons; 40% of these are expected to be foreigner while the other 60% are expected to be Bangladeshi.

A temporary construction camp will be constructed within the project site. The EPC contractor will design and build the accommodation, cooking and sanitary facilities for the construction workers, laydown areas and parking areas. The entire project site will be fenced off; the construction camp which will be located within the project site will be fenced off too, and access will be controlled and restricted to employees. The EPC contractor will develop and implement specific policies for the management of the camp and construction workforce.

The project is expected to impact the social fabric in the project area in the following ways:

- Conflict between workers and local people
- Rise in prevalence of sexually transmitted infections; and
- Increase in crime

The extent of the impacts to demographics will largely be contained within the project- affected communities and subsequently will be local in scale. The duration of impacts associated with the construction phase will largely be short-term, lasting about 42 months.

The communities living in the project area are culturally homogenous as the vast majority of people in and around the project site belong to the Muslim; subsequently any influx of "foreigners" or those from other parts of Bangladesh, will be keenly felt. Therefore, the demographic scenario including population, sex-ratio, literacy level etc. would undergo certain local changes within a limited peripheral zone. The overall impact over the study area would be marginal.

5.3.10.4 Impact on Gender

Based on consultations with stakeholders, it is visible that this project will not adversely impact women or any other. Because the labor camp will be located within the project site, the project intervention and relative influx of labor will have no impact on local women's movement and security. Hence, they will be impacted positively as employment and business opportunity will be enhanced during all phases of the project.

5.3.10.5 Employment Generation

The proposed project is envisioned to generate direct and indirect employment opportunities for both skilled and unskilled workers. Direct employment includes jobs at the power plant during the construction phase. Indirect employment will be realized through increased business opportunities and spurred economic growth both at the local and national levels.

Creation of employment opportunities was perceived to be the most important benefit of the project by the communities in Matarbari. This was mainly expected to benefit the unemployed people living within and around the proposed project site. The unemployment levels are generally high in the region and expectations on job opportunities are high among the people of the area.

During the construction phase, it is projected that the workforce will peak at approximately 3000 personnel with 60% of these being Bangladeshi workers and 40% foreign workers. These will mainly be semi-skilled and unskilled jobs. A large fraction of the construction-based jobs will be under civil works which will include but not limited to carpentry, steel-works, water-works, concrete-works and masonry. According to 98% of the stakeholders during survey, local people should be given preference in terms of employment prospects. Hence, employment generation will have a positive impact on the lives of the people.

Impact	*Impact on Employment Generation*					
Impact Nature	Direct		Indirect		Induced	
Impact Scale	*Local Community*					
Frequency	*Project construction stage*					
Extent	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceability	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		*Medium-low*			

5.3.10.6 Economic Growth

During the construction phase, different types of shops will be established near the project site, and local people will get the benefit. At least 3000 workers will be involved during the construction period. Many workers will stay in the Matarbari town as a result house rent will increase. Local vegetable and other goods consumption will increase therefore the local economy will positively be affected.

Besides, local community will be benefited by the different types of local business. The local enterprises, particularly involved in production and sale of construction materials are potential benefactors of the civil works involved in the project. Local market, businessman and shop owners will also be benefited from the construction activity as a considerable number of manpower will engage this project.

5.3.10.7 Capacity Building

OPDL-2 aims at building capacity of the local communities to enable them to benefit from the immediate project opportunities such as employment during the construction phase, as well as for sustainability throughout the project lifecycle. OPDL-2 envisions imparting practical skills to local youth with the aim of absorbing them into the project during the construction phase. These skills will be retained in the local community even after the decommissioning of the power plant and will increase the residents' employability as they secure jobs in other developments that may arise in the area. Additionally, OPDL-

2 will also increase the competency levels of its workers through continued capacity building and exposure.

The proposed 635-megawatt power plant will employ various international experts who will work with local employees. Through this, there will be a transfer of technology and skills to the local community, creating a pool of highly skilled professionals with specialized knowledge that will be utilized in the continued implementation of the power plant as well as in implementing future projects of a similar nature. OPDL-2 will institute deliberate structures to promote and enhance this knowledge transfer. Throughout the construction phase of the project, OPDL-2 and its contractors will maintain a workforce composition of at least 50% Bangladeshi personnel to work and learn alongside foreign expatriates.

5.3.11 Impacts due to Wastewater Generation and Disposal

Construction work and activities will consume considerable amounts of water and generate significant amounts of wastewater. The principal activities consuming water include concrete and construction works, ground watering and domestic applications. During the construction period of the proposed project, water will be collected from underground. For the concreting work, more water will be required, and it is expected that its amount will be approximately 40 m^3/hour to 100 m^3/hour during normal and peak demand during construction and domestic purposes approximately 90 KLD – 180 KLD will be required. Wastewater resulting from construction works and ground watering would be insignificant, if well managed and monitored. However, domestic sewage would be a key source of wastewater generation in the construction site. Similarly, considering the scale of development and related operational requirements, the human activities would be significant as it is estimated that approximately three thousand people would be involved in the peak time of the constructional phase.

Consequently, the domestic sewage could be very significant if not well managed and controlled and could possibly pollute the receiving water bodies. The principal receptor would be nearby surface water body (Kutubdia Channel and Matamuhuri-Kuhelia River), the sea (Bay of Bengal) and likely, the groundwater as the sewage may be drained into these water bodies. Due to the improper management and disposal of wastewater into the open environment will impact on soil quality, sediment quality, surface water quality, groundwater quality and aquatic environment. The impacts of wastewater generation and disposal is assessed to be ***Medium-High*****.**

<table>
<tr><td>Impact</td><td colspan="9">Impact due to Wastewater disposal</td></tr>
<tr><td>Impact Nature</td><td colspan="2">Direct</td><td colspan="4">Indirect</td><td colspan="3">Induced</td></tr>
<tr><td>Impact Scale</td><td colspan="9">Project surrounding environment</td></tr>
<tr><td>Frequency</td><td colspan="9">Limited to construction Phase</td></tr>
<tr><td>Extent and Location</td><td>Project Site</td><td colspan="2">Local</td><td colspan="2">Regional</td><td colspan="2">National</td><td colspan="2">Trans Boundary</td></tr>
<tr><td>Impact Duration</td><td>Short Term</td><td colspan="2">Medium Term</td><td colspan="2">Long-term</td><td colspan="2">Permanent-mitigated</td><td colspan="2">Permanent-no mitigation</td></tr>
<tr><td>Impact Intensity</td><td>Insignificant</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Very High</td></tr>
<tr><td>Potential for Irreplaceable Loss</td><td colspan="3">Low</td><td colspan="3">Medium</td><td colspan="3">High</td></tr>
<tr><td>Probability of Impact</td><td>Unlikely</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Definite</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Very Low</td><td>Low</td><td colspan="2">Medium-low</td><td colspan="2">Medium-high</td><td colspan="2">High</td><td>Very High</td></tr>
<tr><td colspan="9">Significance of impact consider Medium-high</td></tr>
</table>

5.3.12 Impact due to Transportation of Raw Materials

During construction phase of the proposed project, most of the major construction materials and heavy equipment's shall be transported through the waterway (Kutubdia channel and Bay of Bengal). Heavy equipment of 635 MW coal-fired power generation unit mainly including boiler structural girders, STG stators and rotors, main transformer etc. will be imported principally from abroad and transported to the affiliated material offloading facility. The units would then be transferred to flat transporters at the project site and transported to the erection site. During the traffic survey it was found that a total of 74 river vehicles were running in the river. It was noticed that a major contributor (around 31%) of the vehicular traffic was Burge followed by Motorized Fishing Boat (25.68%). It can be assumed that the river traffic movement is not significant. There is a naval base at 4.84 km south side of the project location. During the construction phase, traffic load on the waterway may be increased and accidents might be increased. The main receptor could be the vessels movement in the Kutubdia channel, ships/sub marine/vessel of navy, fisherman's and fishing site near the project site river and particularly river users. At the jetty site, the Kutubdia channel width is 3.9 km and the current river vehicle is not significant, the impact due to the traffic movement during construction phase is expected to be **Medium Low**.

Heavy-duty vehicles and trucks carrying construction and building materials, personnel and equipment's to and from the project site during construction may affect traffic flow and could even cause accidents on existing access roads. Existing project site access road is used by the small types of vehicles like CNG, Easy bike, motorcycle, private car, Van, Pickup and Power Tiller. According to the traffic survey during the baseline data collection, total 3720 no of vehicles were plying in 24 hours on Uttar Nalbila to Matarbari road. It was noticed that a major contributor (around 80%) of the vehicular traffic was CNG Motor/ Easy Bike followed by Motorcycles (12.50%). During construction phase, most of the construction material will come through water way. Mostly workers and other staff will use the road. The traffic movement on the access road will create dust pollution and exhaust emission from the fuel combustion. From the traffic movement, noise level will be increased, terrestrial fauna will be disturbed, and community health and safety will be impacted. During the construction phase, vehicle can be used two access road from Uttar Nalbila to project site. Hence, the traffic load will be less on the road. The impacts on traffic during the construction phase due to transportation of raw materials is assessed to be **Medium- Low**.

Impact	*Impacts due to transportation of raw materials*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Project Site and surrounding area					
Frequency	Limited to construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Medium-low***					

5.3.13 Impact on Ecology

5.3.13.1 Impact on Terrestrial Flora

During the construction phase, activities that might impact on terrestrial flora include construction of plant, movement of construction vehicles, construction of jetty in Kutubdia Channel, construction labor camps, influx of labor force, construction of elevated coal conveyor for coal transportation in the coal yard of the project site.

Dust generated from these activities will lead to dust deposition on plant leaves, twigs, and stems which may hamper photosynthesis, respiration, and other physiological processes. As a result, it will affect plant growth and cause diseases. In construction period there will be an influx of labor force from outside of the project area. The construction workers will be primarily residing in the nearby habitation or in the construction camp. There is a likelihood of impact the construction camps on nearby vegetation due to the requirement of fuel and timber from the vegetation. The construction of elevated coal conveyor may require clearance of small patches of Casuarina plantation in the western side of project site which can change the land use patterns. However, the baseline study represents to have no threatened terrestrial plant species within the project AOI.

Considering the project activities and potential biological receptors within the project AOI, the impact on terrestrial flora during the construction phase might be less significant and is assessed as **Low**.

Impact	*Impact on Terrestrial Flora*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Project Site and adjacent Area					
Frequency	Limited to Construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Low***				

5.3.13.2 Impact on Terrestrial Fauna

Impact on terrestrial fauna during construction phase may happen due to excessive light, dust, noise, and vibration from the construction activities.

According to the field study, there is no significant faunal habitat in the proposed project site. However, twenty migratory shorebirds found in the AOI (approximately 3km north, 2km north-west, 9.5 km south and southwest from the project site). Among them, Eurasian Curlew (Numenius arquata) and Black-headed Ibis (Threskiornis melanocephalus) is classified as a Near Threatened and Vulnerable, respectively (IUCN Red List of Bangladesh, 2015). Eurasian Curlew (Numenius arquata) and Black-headed Ibis (Threskiornis melanocephalus) is classified as a Near Threatened in Global IUCN Red List (Version 2022-2). Herpetofaunal species listed in the AOI are 'Least Concern (LC)' according to the IUCN Red List of Bangladesh, 2015 except Bengal Monitor Lizard (Varanus bengalensis) which is listed as Near Threatened (NT).

Noise and vibration generated from operation of machineries used for site construction, construction of 4.7 km elevated coal corridor (Coal conveyer system) from Matarbari deep Seaport to project site (above the shoreline of Matarbari sandy beach) may affect the habitat and behavior of terrestrial fauna residing in the adjacent areas of the project sites such as herpetofauna, terrestrial mammals, and Shore bird species. These activities will also lead to habitat destruction and/ or degradation of shorebirds and migratory birds residing shoreline area. Transportation of materials and manpower in access roads might cause disturbance to movement of wildlife.

Artificial lighting, noise and vibration during construction phase will hamper the movement of herpetofaunal species around the project area. Also, excessive light will negatively affect behavior, survivorship, and reproduction of migratory and shore birds. Skyglow may change the migration pattern of the migratory shore birds.

Considering the project activities and potential biological receptors within the project AOI, the impact on terrestrial fauna during the construction phase might be moderately significant. Therefore, it is assessed as **Medium-low**.

Impact	*Impact on Terrestrial Fauna*

Impact Nature	Direct	Indirect	Induced			
Impact Scale	Project Site and adjacent Area					
Frequency	Limited to Construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Medium-low***					

5.3.13.3 Impact on Aquatic Flora and Fauna

Impact on Aquatic Flora and fauna during construction phase may happen due to construction of elevated coal conveyer, accidental disposal of domestic sewage waste, transportation of machinery and construction material to the site, piling work of jetty area, construction of water intake and outfall structure.

Transportation of machinery and construction materials to the site will be undertaken through the Kutubdia Channel. A jetty will be used for offloading the material at the site. There is a likelihood of accidental spillage of oil and other chemicals during unloading activities and from storage area. This may reach the Kutubdia Channel directly or by runoff and impact the aquatic flora and fauna. Based on the baseline study, fifty-nine (59) species of fish and Fifteen (15) species of crustaceans were recorded.

Construction of elevated coal corridor (coal conveyor system) will generate noise and vibration in land and underwater though the major part will be constructed through the shoreline area of Matarbari Island and some part will be on water. Noise and Vibration negatively affects the movements of aquatic associated fauna (fish, crustacean species like shrimps and crabs, marine turtle, etc.).

Construction of jetty, and construction of water intake and outfall channel would require dredging and pilling work. The sediments in the dredged part of the river channel would be subject to redistribution and strong tidal flow. Piling activity (water part) for coal conveyer negatively affect bottom dwelling benthic organisms. This may result in benthos mortality and impact the benthic habitat during the construction of riverfront facilities. However, only a small area of habitat will be affected and only for a limited time period of few months, such that there is no loss of viability or function of the habitat. High sediment content may increase the turbidity of the surface water that may disturb fish breathing even may lead some species to death.

According to the baseline, Dhalghata sea beach and Hacher Char is the potential nesting habitat of marine turtles especially Olive Ridley Turtle (*Lepidochelys olivacea*) which is listed as Vulnerable in IUCN Red List of Threatened species of Bangladesh (2015), and Global IUCN Red List (Version 2022-2). Dhalghata sea beach and Hacher Char are far from the project site. According to local people, Olive Ridley Turtle rarely come to the Matarbai sea beach during winter season. Construction of coal conveyer belt may interrupt turtle coming to the beach.

Approximately 3000 workers during the peak construction period will be engaged. Accidental discharge of untreated sewage from the facility will increase the BOD load in the receiving surface waterbodies; this will ultimately affect the primary productivity of the adjacent discharged area. In addition, improper management of wastes and disposal from the construction workers camp or facilities can pollute the surface water as well as the fish resources. Wastewater from the project site and water transportation may temporarily effect on aquatic species and their habitat.

Considering the project activities, the impact on aquatic ecosystems during construction phase might be moderately significant. Therefore, it is assessed as **Medium-High**.

Impact	*Impact on Aquatic Ecosystem*					
Impact Nature	Direct	Indirect		Induced		
Impact Scale	Kutubdia Channel					
Frequency	Limited to Construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-high***				

5.3.14 Impact on Groundwater

5.3.14.1 Ground Water Quality

Potential impact on ground water could arise from:

- The spillage and seepage of chemical, oil and lubricants from storage area, waste handling area and generation of domestic waste/wastewater from construction labour camp area may adversely affect ground water quality in the area.
- Liquid effluents will be generated from washing of construction equipment and vehicles

The existing groundwater quality analysis around project does not reveal any existing contamination or pollution. Groundwater contamination during the construction phase may occur from unplanned events such as leaks and spills of oil, lubricants, fuel from heavy equipment, improper handling of sewage or chemical/fuel storage. Improper handling of chemicals, waste and liquid effluents, the impact to groundwater from spills and leaks is assessed to be **Medium-low**.

Impact	*Ground water Quality*					
Impact Nature	Direct	Indirect		Induced		
Impact Scale	Ground water resources of the area					
Frequency	Construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-low***				

5.3.14.2 Groundwater Availability

Groundwater table fluctuations indicate the recharge and discharge to the groundwater reservoir. The highest groundwater table occurs in the study area during the month of August-September when the aquifer recharges fully and the lowest is during February-March due to natural discharge and groundwater use for domestic and irrigation purposes.

The water demand for the construction works will be about 40 m^3/hour to 100 m^3/hour during normal and peak demand respectively and will be sourced from underground. The potable water requirement will be range from 90 KLD – 180 KLD and will also be sourced from the underground. The required will be sourced from deep tube well (approximately >500 ft). There are no household adjacent to the power plant boundary. The households are located only south side within 300 meters of the plant boundary. The main source of drinking water of the villages is shallow tube well (within 100-200 ft). Since the project will withdraw the required water from deep tube well whereas the villagers use the shallow tube well. Also, there is no dense household near to the project site. Hence, the impact due to the withdrawal of groundwater has been assessed as **Medium-Low**.

Impact	*Groundwater Availability*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Surrounding the project site					
Frequency	Limited to construction Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-low***				

5.4 Operation Stage Impact

5.4.1 Impact on Natural Resources

5.4.1.1 Impact on Agricultural Resources

Deposition of fly ash to be emitted from the stack on agricultural land may not have any negative impact on crops. Rather it may increase crop production. Application of fly ash in agricultural land increases crop production. The operation of the coal-based power plant will lead to industrial development in the surrounding area that ultimately increases the stress on the surrounding agricultural land. Therefore, agricultural land of the surrounding area will be converted to the industrial and commercial.

5.4.1.2 Impact on Livestock

The project site is non-agricultural land. Only salt and shrimp are being cultivated. The Matarbari area is dominated by salt and shrimp/white fish cultivation. There is limited agricultural land in Matarbari area. The agricultural field is present around 10 km of the power plant site, and people can use this area as grazing ground. Since the project site has no contribution to livestock, the impact on livelihood can be accessed as insignificant.

5.4.2 Impact due to Collection of Resources from Local Resources within the Country

The main fuel to be used for generating electricity in the proposed project will be the imported coal. Based on the estimations of the Feasibility report, the daily coal requirement for generation of 635 MW power by operating 1 x 635 MW power plant shall be 4042 tons per day and 1.47 million tons per annum.

Besides, 500 KL/annum HFO and LDO will be required for the plant. All the required coal will be imported from Australia and Indonesia. Liquid fuel will also be imported from abroad. No major resource will be collected from locally. So, no impact has been predicted locally for collection of resources.

5.4.3 Impact on Air Quality

The operation phase of the proposed plant will involve air emissions from fuel combustion and fugitive dust emissions from coal handling, storage and transportation and coal preparation activities. The proposed project operation will also lead to greenhouse gas emissions. The impacts on air quality anticipated due to project activities have been discussed below:

5.4.3.1 Coal Handling, Transportation and Storage

The coal transportation system for the proposed project will comprise ship unloaders and a conveyor system. The coal from the ship will be unloaded on to the coal collection point at the site using cranes, from where it will be conveyed to the coal yard using a belt conveyor system. The rated capacity of the belt conveyor will be about 2400 tons/hour and will have a speed of 2.8 m/s.

The conveyor belt will be covered. However, the unloading of coal, its conveyance and its storage will involve fugitive dust emissions. The fugitive emissions will depend on several factors such as coal properties including moisture content, particle shape and particle size distribution. Other influencing factors will include meteorological conditions such as wind speed and direction, solar radiation and rainfall and stockpile design and layout.

The dust emissions are considered severe if the moisture content of coal is in the range of 1-4 %, mild for 4-5% and low if it is greater than 8%. The moisture content of the coal to be transported is expected to be near the design coal range of 15%. The emission factor for particulate matter was estimated for coal handling using US EPA AP42 13.2.4-3*.* The equation and calculation for the emission factor have been presented in **Box 5-1***.* Considering that about 4042 MT of coal will be handled per day, the total fugitive emission from coal handling has been estimated as 1.25 kg/day. The coal unloading crane area will be provided with a wet dust suppression system which will significantly control the fugitive dust.

Box 5-1: Emission factors for Coal Handling

Drop Equation for Coal Handling, $E = k \times (0.0032) \times \dfrac{(U/5)^{1.3}}{(M/2)^{1.4}}$	
k, Particle Size multiplier for PM	0.74
k, Particle size multiplier for PM_{10}	0.35
k, Particle size multiplier for $PM_{2.5}$	0.053
U - mean wind speed, m/s	4.10
U - mean wind speed, mile/hr.	9.17
M, Moisture Content (%)	15 (Design Range)
PM Emission factor, uncontrolled, kg/ton	0.00031
PM_{10} Emission factor, uncontrolled, kg/ton	0.000147
$PM_{2.5}$ Emission factor, uncontrolled, kg/ton	2.22E-05

5.4.3.2 Coal Preparation

Once the coal is received in the coal yard, it will be pulverised and homogenised to meet the coal design specifications. The coal may also contain some impurities such as shale and sandstone. Occasionally, it may also contain some metal pieces such as broken shovel teeth, brake shoe and wires and will have to be removed before the coal is fed to the boilers. The coal preparation will involve screening, crushing of coal and magnetic separation.

The coal preparation activities will involve emissions of fugitive dust during the coal screening, crushing and conveyance for magnetic separation. The impact of these emissions will depend on the quantity and drift potential of the dust particles injected into the atmosphere. In addition to large dust particles that settle out near the source (often creating a local nuisance), considerable amounts of fine particles will also be emitted from the coal preparation activities that will get dispersed over much greater distances from the source.

The potential drift distance of particles is governed by the initial injection height of the particle, the terminal settling velocity of the particle, and the degree of atmospheric turbulence. As per US EPA AP-42 estimates, for a typical mean wind speed of 16 km/hr., particles larger than about 100 µm are likely to settle out within 6 to 9 meters (20-30 feet) from the point of emission. Particles that are 30 to 100 µm in diameter are likely to undergo impeded settling. These particles, depending upon the extent of atmospheric turbulence, are likely to settle within a few hundred feet from the point of emission. Smaller particles, particularly PM-10 have much slower gravitational settling velocities and are much more likely to have their settling rate retarded by atmospheric turbulence.

The design of transfer tower for equipment are all including dust suppression system or control of dust emissions from dust generation points such as transfer points, feeders, crushers etc. Dust control is achieved by dust suppression and extraction system. The accumulated dust on the floors of the buildings (structures), such as coal conveying trestle, transfer tower, crusher room, and belt conveyor layer of coal bunker bay of boiler, take-up device room will be cleaned hydraulically.

The indoor flushing water of the coal handling system will be drained to floor drains or open trenches and then is drained into the dispersed water collection pit. The water drainage trench and collection pit will be designed to locate at the bottom floor of the coal handling system building. With the installation of this dust suppression system, it is expected that almost 100 % dust control will be obtained and thereby the impact on the surrounding community is expected to be negligible.

5.4.3.3 Fuel Combustion in 635 MW Power Project

a. Source of Impact

The proposed project will use of the following fuels:

- Coal as the main fuel
- Light Diesel Oil (LDO) for unit warm-up and start-up
- Heavy Fuel Oil (HFO) for unit start-up and flame stabilization
- Light Diesel Oil for Emergency Diesel Generators and Auxiliary boiler

The impact assessment has been considered only for coal since it will be the main fuel and LDO and HFO will only be used for startup and emergency operations. The major pollutants of concern from coal combustion are particulate matter (PM), sulfur di-oxides (SO_2), and nitrogen oxides (NOx). Some unburned combustibles, including carbon monoxide (CO) and numerous organic compounds, are also generally emitted even under proper boiler operating conditions.

Particulate Matter (PM_{10} and $PM_{2.5}$) - Uncontrolled PM emissions from coal-fired boilers include the ash from the combustion of the fuel as well as unburned carbon resulting from incomplete combustion. In pulverized coal systems, combustion is almost complete; thus, the emitted PM is primarily composed of inorganic ash residues. Soot blowing is also a source of intermittent PM emissions in coal-fired boilers. Steam soot and air soot blowing are periodically used to dislodge ash from heat transfer surfaces in the furnace, convective section, economizer, and air preheater.

Sulfur di-oxides (SO_2) - Gaseous SO_2 from coal combustion are primarily sulfur dioxide (SO_2), with a much lower quantity of sulfur trioxide (SO_3) and gaseous sulphates. These compounds form as the organic and pyritic sulfur in the coal are oxidized during the combustion process.

Nitrogen Oxides (NOx) - NOx emissions from coal combustion are primarily nitric oxide (NO), with only a few volume percents as nitrogen dioxide (NO_2). Nitrous oxide (N_2O) is also emitted at a few parts per million. NOx formation results from the thermal fixation of atmospheric nitrogen in the combustion flame and from the oxidation of nitrogen bound in the coal.

Carbon Monoxide (CO) - The rate of CO emissions from combustion sources depends on the fuel oxidation efficiency of the source.

Air dispersion model has been performed considering the plant running on coal as part of the impact assessment. The air quality impacts of the proposed power plant have been assessed using baseline information gathered through field studies, analysis of the information provided by the proponent and advanced air modelling using preliminary design, technical information, fuel rate and operating data. The stack heights have been determined as 220 m.

Emission Inventory

The proposed project is a 1x635MW sub-bituminous coal based thermal power Plant. The plant will consist of one ultra-supercritical pulverized coal fired boiler with built in dry low NOx burners suitable for outdoor installation with a stack of 220-meter high and a tandem-compound, multi cylinder design condensing type steam turbine. The plant will have Electrostatic Precipitator (ESP) to arrest dust and Flue Gas Desulfurization (FGD) system for reduction sulfur di-oxide. The proposed plant will comprise of an opposed wall fired Benson once through two pass radiant- type super critical boiler with a super heater steam system and a single reheat steam system and will be able to operate in sliding pressure mode. The proposed coal-based power plant will consume 4042.31 MT/day coal to generate 635 MW (net) electricity.

Pollutants of concern released the power stations are Particulate Matter (PM), Oxides of Nitrogen (NOx), Sulfur di-oxide (SO_2) and Carbon Monoxide (CO). The resulting ground level concentration (GLC) from air quality modelling will be referred to the applicable limits of ambient air quality from schedule 1 of Bangladesh air pollution control rules 2022.

The emission inventory has been presented based on the guaranteed emission concentration from equipment. The emission inventory of the power plant is presented in **Table 5-3**.

Table 5-3: Emission Inventory of Waste to Energy Power Plant

Pollutant	Unit	Emission Concentration
Particulate Matter (PM)	mg/Nm^3	40
Oxides of Nitrogen (NOx)	mg/Nm^3	350
Sulfur Dioxide (SO_2)	mg/Nm^3	200
Carbon Monoxide (CO)	mg/Nm^3	200

Source: OPDL-2

Emission Source

The proposed power plant can be considered located in a rural area. There is no major industry around the project site. The Matarbari coal fired power plant and other projects are under construction. Generally, air pollution within the same airshed (20kmX20km study area) are from road dust, black smoke from diesel engines, construction dust, river transport, windblown dust from agricultural lands, domestic heating and cooking and brick kilns.

The project adopts the form of single-tube chimney. The chimney/stack height is 220 m above finished ground level. Finished ground base elevation for stack has been considered as 10 meters. The location of the stacks is presented in **Table 5-4**.

Table 5-4: Stack Location of Proposed Power Plant

Power Plant	Stack/Chimney	X coordinate (meter)	Y coordinate (meter)	Base Elevation
635 MW coal based thermal power plant at Matarbari[27]	Stack 1	385647.81	2405220.16	10.0

The air quality modelling assessment was based on maximum plant load factor. This involves both electricity generation and equipment at maximum rates. The maximum concentrations modelled are based on the plant operating 24 hours per day, seven days per week. Point source input parameter and emission rate are presented in **Table 5-5**.

Table 5-5: Source Input Parameter and Emission Rate of the Plant

Parameter	Unit	Value[27]
Stack Height	m	220
Stack Internal Diameter	m	7.0
Stack Exit Temperature	k	398
Gas Exit Velocity	m/s	20.5
Gas exit flow rate	m^3/s	788.3
Emission Rate		
NO_2	g/s	189.4
SO_2	g/s	108.2
PM_{10}	g/s	21.6
CO	g/s	108.2

b. Prediction of Impact

The air dispersion modelling input data consisted of meteorological data, detailed information on the physical environment (including building dimensions and terrain features) and design details for all emission points on-site. Using this input data, the model predicts ambient ground level concentrations beyond the site boundary for each hour of the modelled meteorological years. The model post-processes the data to identify the location and concentration of the worst-case ground level concentrations.

Emissions from the site have been modelled using the AERMOD dispersion model (Version 11.2.0) which has been developed by the United States Environmental Protection Agency (USEPA). The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources. The model has been designated the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and complex terrain. Resulting GLCs were determined specifically for NO_2 -24hr and Annual average, CO-1hr and 8 hr, SO_2, PM_{10} and $PM_{2.5}$ -24 hr and Annual average.

The resultant NO_2 concentrations are largely driven by the ambient chemical environment (i.e., the reaction of NO with ambient ozone to form NO_2) and the initial NO_2/NO_x ratio of the emissions. The model has been run for NO_2 considering Tier 1 (NO_2/NOx ratio 1:1) to determine the worst condition.

[27] Orion Power Unit-2 Dhaka Limited

Background Concentration

Baseline concentration of the criteria pollutants is accounted for different duration. Primary ambient air quality samples were taken from five locations both wet and dry seasons. According to the baseline air quality monitoring, the current air quality of the Matarbari and its surrounding are good. There is no major air pollution source in the 10 km study area. The Matarbari 1200 MW coal based thermal power plant is under construction which will be commissioned in 2024. Other industries will be established in the Maheshkhali area as per the plan in later stage. Long term air quality data is required to determine the airshed whether it is degraded or non-degraded. There is no continuous air quality monitoring station in Matarbari area. Hence, the background concentration from primary air quality monitoring was converted into various averaging period for compliance monitoring. The concentration of criteria pollutants has been converted to different averaging periods using the following USEPA recommended conversion factors. Maximum value has been taken among five primary air quality monitoring locations to determine the worst-case scenario. **Table 5-7** shows the maximum background concentration.

Table 5-6: Averaging Time Conversion Factors[28]

Convert to / Convert from	1 hour	8 hours	24 hours	Annual
1 hour	1	0.7	0.4	0.08
8 hours	1.67	1	-	-
24 hours	2.5	-	1	0.2
Annual	12.5	-	5	1

Table 5-7: Maximum Background Concentration of Criteria Pollutants

Criteria Pollutants	Standard Concentration (APCR, 2022)		Concentration
	Averaging time	µg/m³	µg/m³
Carbon Monoxide (CO)	8-hr	5000	380
	1-hr	20000	635
Nitrogen Dioxide (NO_2)	Annual	40	3.74
	24-hr	80	18.7
Particulate Matter (PM_{10})	Annual	50	8.9
	24-hr	150	44.5
Particulate Matter ($PM_{2.5}$)	Annual	35	6.6
	24-hr	65	32.8
Sulfur Dioxide (SO_2)	24-hr	80	13.5
	1-hr	250	33.7

Meteorology

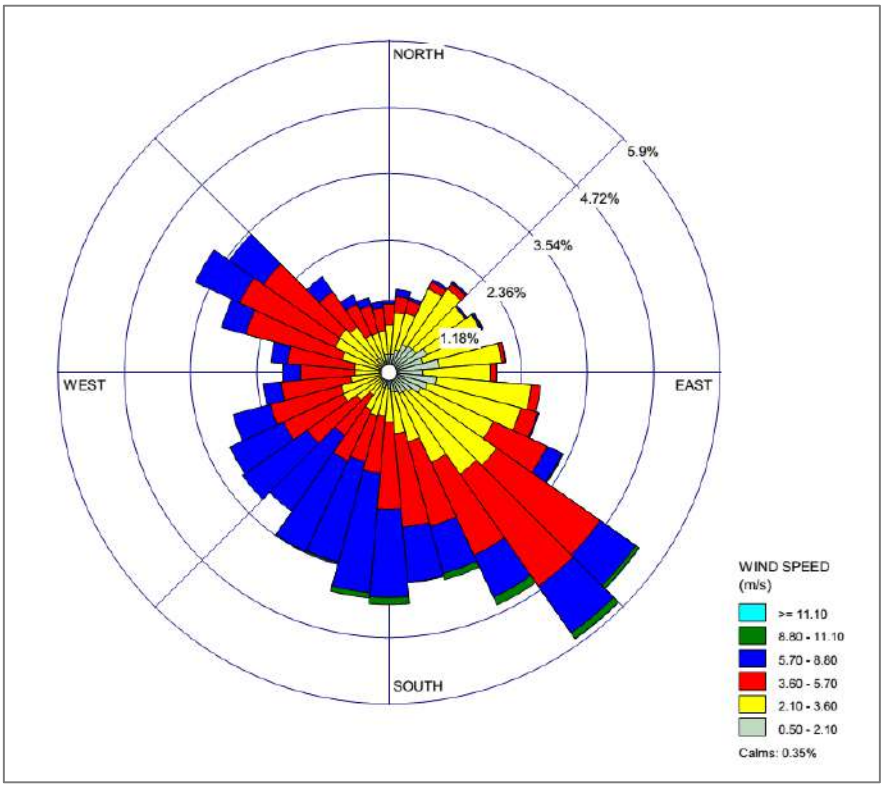
Air quality is dependent on the rate of pollutant emissions into the atmosphere and the ability of the atmosphere to disperse the pollutant emissions. The dispersion of air pollutants is affected by local meteorological patterns. The wind direction controls the path that air pollutants follow from the point of emission to the receptors. In addition, wind speeds affect the time taken for pollutants to travel from source to receptor and the distance over which air pollutants travel. As a result, wind speeds also impact

[28] U.S. EPA document Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised, EPA-454/R-92-019

the dispersion of air pollutants. Therefore, it is important to assess local meteorological patterns to assess potential air quality effects.

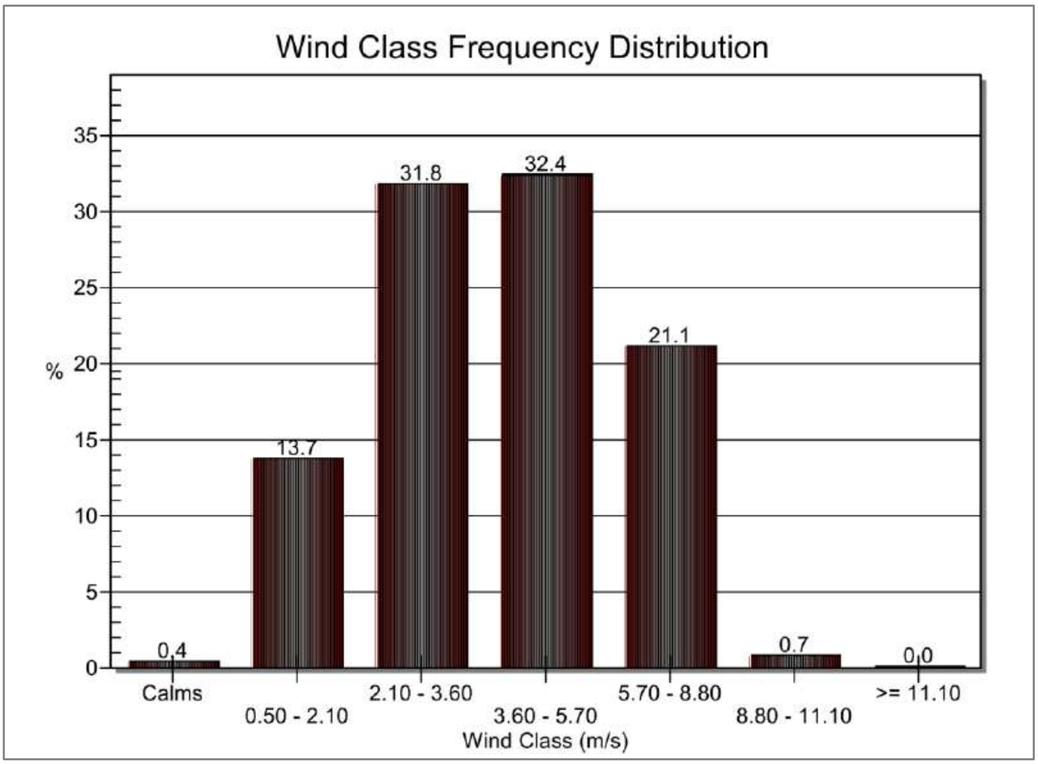
AERMET (Version #11.2.0), AERMOD's meteorological pre-processor requires hourly surface observations along with concurrent twice-daily upper air observations. As such, the dispersion modelling used three years (2020-2022) of meteorological data from lakes environment WRF data. **Figure 5-1** shows a 3-year (2020-2022) wind rose for meteorological data over the study area. The prevailing wind direction throughout the year from South-east to North-east. **Figure 5-2** shows a frequency distribution of the wind over 6 wind speed class ranges. The highest wind speed varies between 3.60-5.70 m/s at 32.2% followed by 2.10-3.60 m/s (31.8%), 0.50-2.10 m/s (13.7%) and 8.80-11.1 m/s (0.7%) whereas 0.35% calm wind. Average wind speed over the study area is 4.1 m/s. It has been concluded that the receptors present at the North-west direction are more susceptible to pollution generated from plant.

Figure 5-1: Annual Wind Rose of the Study Area



Source: Data acquired from Lakes Environmental

Figure 5-2: Wind Class Frequency Distribution of Meteorological Data (Jan. 1, 2020 – Dec. 31, 2022)



Source: Data acquired from Lakes Environmental

Study Area

An area, 20 km x 20 km centering the proposed coal-based power plant has been selected for the air quality analysis. The plant boundary and air quality-modeling domain are presented in **Table 5-8**.

Table 5-8: Project Site Coordinates

Domain	Easting (m)	Northing (m)
Project Boundary		
Project Center	385397.91	2405278.14
Northeast Corner	386324.90	2405461.65
Northwest Corner	384541.25	2405624.39
Southeast Corner	386260.30	2405014.56
Southwest Corner	384476.84	2405179.32
Model Domain		
Northeast Corner	405648.62	2425216.08
Northwest Corner	365646.97	2425206.32
Southeast Corner	405648.91	2385210.87
Southwest Corner	365649.55	2385209.26

UTM Zone: N 46

The model was set up to examine the impact of emissions on the area surrounding the site using a series of receptors. A receptor is a location at which the model will calculate maximum process contributions (PCs) / GLCs. A multi-tier grid receptor system was established with the site at power plant stack location. A multi-tier grid with 3 receptor grids of varying resolution was established.

A 5km x 5km grid with receptors at 50m spacings was created with the development site at its center. Around this, a coarser 10km x 10km grid with 200m receptor spacings was created from centre. A third

20km x 20km grid with 500m receptor spacings was created around this. Grid network is presented in **Table 5-9**.

This network used Cartesian (X, Y) receptors with UTM coordinates. Base elevation of all the receptors were found using terrain elevations interpolated from SRTM (~30 m) Digital Elevation Model (DEM) data. In addition, 19 discrete cartesian receptors also taken into consideration, where the sensitive receptors are located (**Table 5-10**).

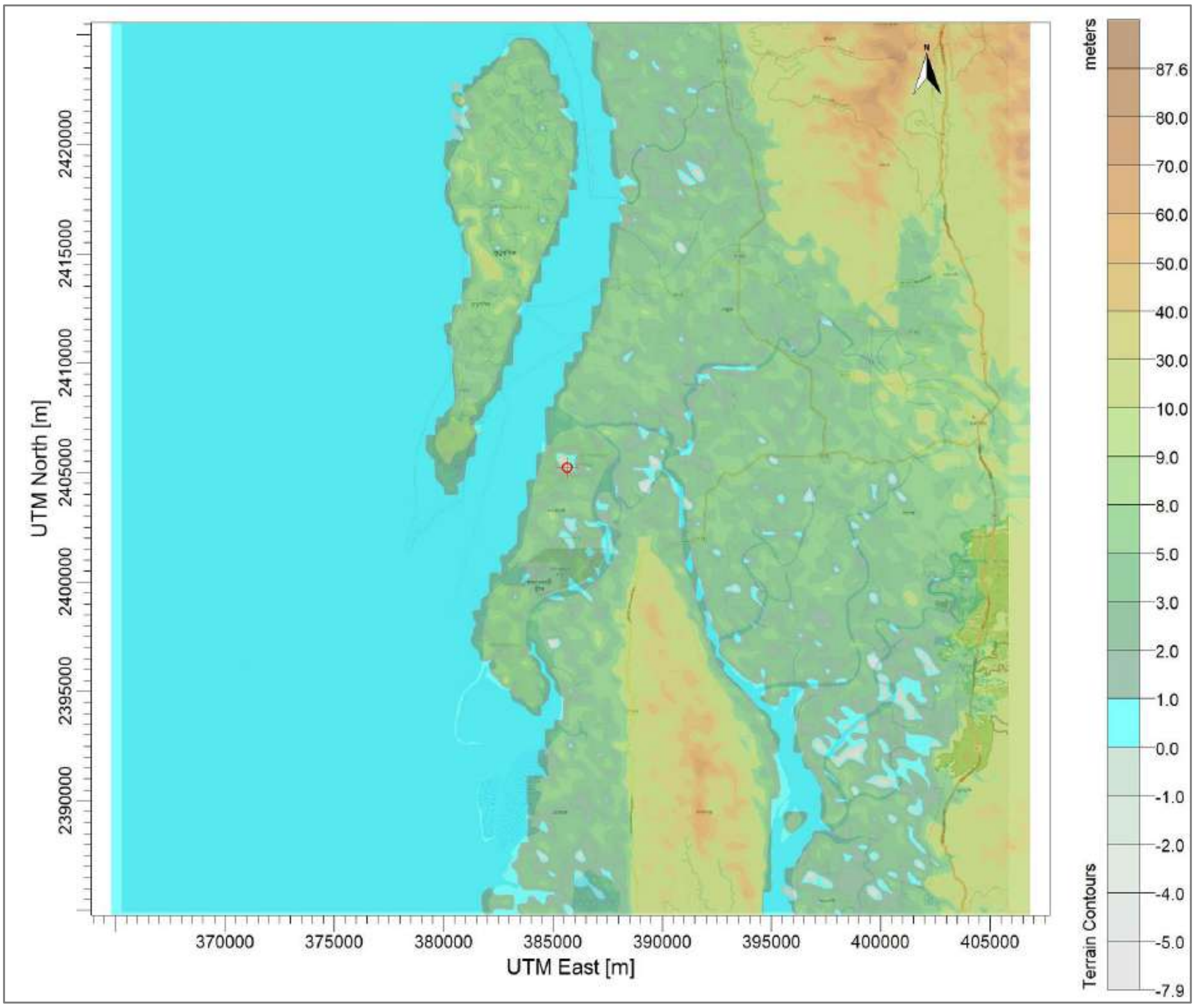
Table 5-9: Multi-Tier Grid Receptors

Tier	Distance from Center (m)	Tier Spacing (m)
1	5000	50
2	10000	200
3	20000	500

Terrain

A terrain height for each of the receptors on the grid was input to the model in order to accurately represent the changing elevations of the surrounding landscape. Terrain data for the AERMAP model were taken from the 30 m SRTM database. The elevation of the 20 km area varies between -7.9 to 87.6 m. There are some hilly areas within 20 km model domain at the south-west and north-east from the project site. Highest elevation of the study is found as 27.65 meters. The land elevation of the study area is presented in **Figure 5-3**.

Figure 5-3: Land Elevation of the Study Area



Source: Shuttle Radar Topography Mission (SRTM)

Sensitive Receptors

It is important to identify the sensitive receptors in and around the project surroundings for the air quality impact assessment. Total five air quality samples were collected from different sensitive receptors. Besides total 338 discrete sensitive receptors have been identified based on the field visit and google imagery analysis. Air Quality monitoring location is presented in **Table 5-10** and other sensitive locations is shown in **Appendix H-1**. **Figure 5-4** shows the sensitive receptor locations within the model domain.

Table 5-10: Air Quality Monitoring Location

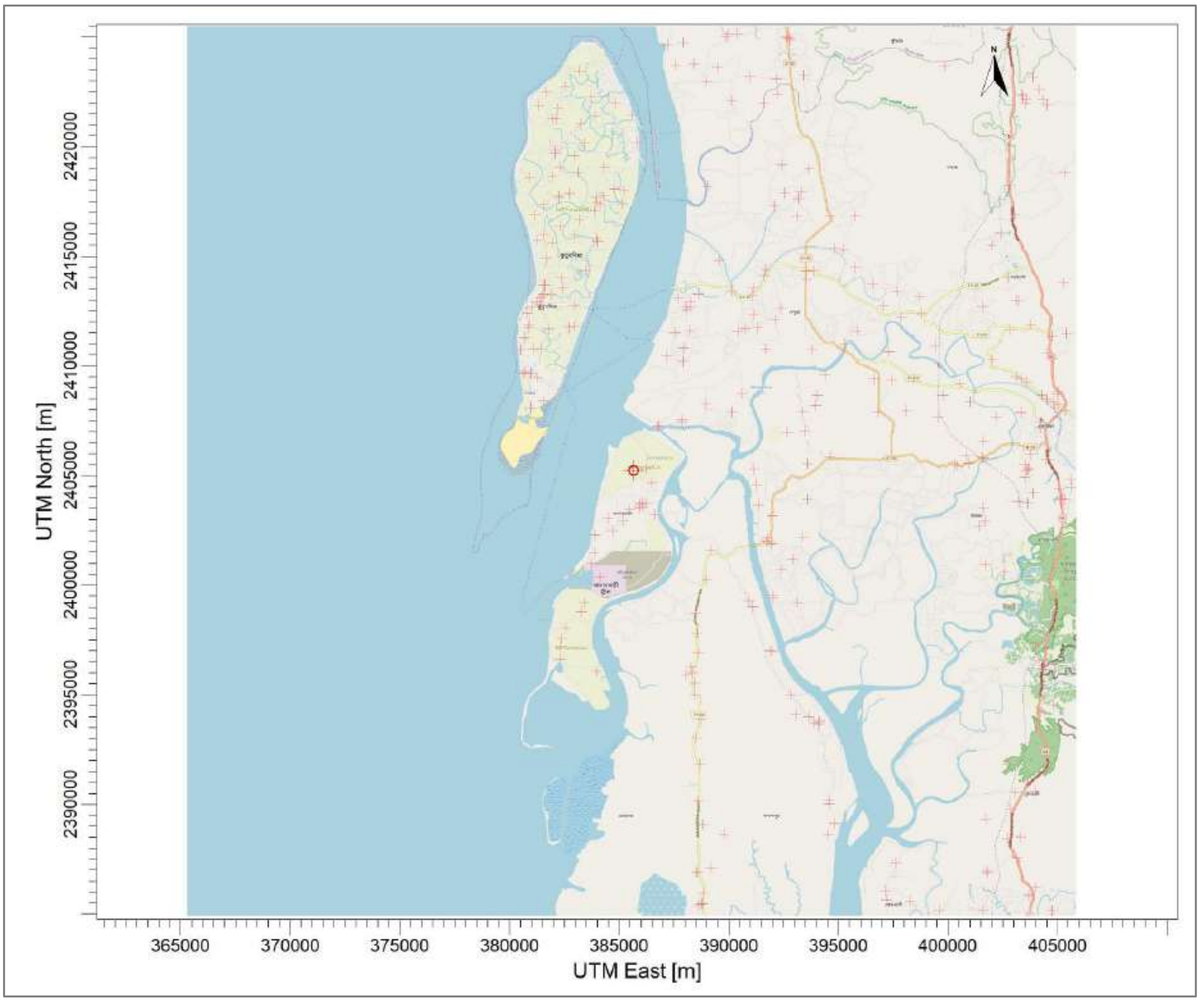
ID	Receptor's Location Name	Coordinate*		Distance and direction from the plant boundary
		X	Y	
AAQ-1	Project Site	386229.00	2405305.00	Within the project boundary
AAQ-2	Near West Ujantia Govt: Primary School, Ujantia	386782.00	2407232.00	1.8 km north from project boundary
AAQ-3	Behind Hasem House, Bedarbill Para, New Market, Mognama	387939.00	2410813.00	5.6 km north from project boundary

ID	Receptor's Location Name	Coordinate*		Distance and direction from the plant boundary
		X	Y	
AAQ-4	Near Anamul Haque House, South Sikdarpara, 2 No: Ward, Matarbari	386483.00	2404664.00	355 m south from project boundary
AAQ-5	Joynal Abedin House, Notun Ghuna Para, 1 No: Ward, Badarkhali	391135.00	2405295.00	4.5 km east from project boundary

*UTM-46

Source: Field Visit

Figure 5-4: Location of Sensitive Receptors



*UTM-46

Source: Field Visit and Google Earth Imagery

Building Structure

Air streams blowing across buildings can become disrupted, with turbulent eddies occurring downwind in the building wake. If an emission point is sufficiently close to a building, then the plume may become entrained in the turbulent eddies of the building wake.

This entrainment can cause plume downwash resulting in elevated emission concentrations close to the emission point. The stacks modelled are subject to downwash and, as a result, direction specific building dimensions were calculated.

The AERMOD model interprets the influence zone of each building for a given wind direction using the Building Profile Input Program (BPIP). All of the main buildings on the site were included in the modelling analysis. Building details of the power plant is presented in **Table 5-11**. Power plant 3D view is presented in **Figure 5-5**.

Table 5-11: Detail of Power Plant Building

Description	Base Elevation [m]	Height [m]
Turbine Building	10.0	14.0
Boiler House	10.0	87.6
Central Control Building & Air Compressor House	10.0	28.3
Forced Draft Fan	10.0	29.0
ESP	10.0	30.0
Induced Draft Fan	10.0	29.6
Coal Storage Yard-1	10.0	50.0
Coal Storage Yard-2	10.0	50.0
Fuel Oil Tnak	10.0	7.5
Fuel Oil Tank 2	10.0	7.5
Emergency Oil Pit for Turbine	10.0	5.0
Lubricating Oil Storage Tank	10.0	5.0

Source: OPDL-2

Figure 5-5: 3D Model of Major Project Components

Model Input Data

The input parameters considered for the air dispersion modelling have been summarized in **Table 5-12**.

Table 5-12: Input Data Considered for Air Dispersion Modeling Exercise

No.	Scenario	Value
1	**Control Pathway**	

No.	Scenario		Value
	Dispersion option		Default Option with stack-tip downwash, elevated terrain effect, use of calms processing routine, use of missing data processing routine and no exponential decay
2	**Meteorological Input**		
	Met Input Data		Meteorological data from 1 January 2020 to 31 December 2022 (Pre-processed Meteorological Data)
	Wind Speed Categories		Default
	Latitude		21°44'48.79"N
	Longitude		91°53'38.98"E
	Anemometer Height		14 m since the wind data were supplied as WRF data (Lakes Environmental)
	Base Elevation		2.06 m
3	**Receptor Pathway**		
	Flagpole Receptor Height		1.5 m
	Tier	Distance (m)	Spacing (m)
	1	5000	50
	2	10000	200
	3	20000	500
	Sensitive Receptor		343
4	**Source Pathway**		Point Source
5	**Output Pathway**		Pollutants Ground Level Concentration
	PM_{10}		1 Hourly, 24 Hourly and Annual
	$PM_{2.5}$		1 Hourly, 24 Hourly and Annual
	SO_2		1 Hourly, 24 Hourly and Annual
	NO_2		1 Hourly, 24 Hourly and Annual
	CO		1 Hourly, 8 Hourly and Annual

Modelling Result and Discussion

The following assumptions were used for the air quality modeling:

Background level concentration: Primary air quality data for both dry and wet seasons were collected from the study area. Since, there is no continuous air quality monitoring station, primary baseline monitoring data has been used for background concentration. Highest concentration data were used for NO_2, SO_2, CO and PM_{10} to analyse the worst-case scenario. Different scenarios have been considered for the air dispersion modelling as follows–

A. **Only Project Contribution (Project only)** – Primary air quality monitoring data shows that the airshed is non-degraded in terms of NO_2, SO_2, CO and PM_{10}. Air dispersion modelling was done considering the model input data, stack details, gas exit temperature, velocity and emission rate presented in **Table 5-12** and **Table 5-5**. The PM emission from Table 6(B) of the IFC-WB EHS Guidelines for Thermal Power Plant 2008 does not give the breakdown of PM_{10} or $PM_{2.5}$. Therefore, it has been assumed that $PM=PM_{10}=PM_{2.5}$, the proposed power plant will have the same contribution of PM_{10} and $PM_{2.5}$ as PM.

B. Project Operation Period (Project Contribution + background concentration) – this includes project contribution, background concentration from primary air quality monitoring. Highest background concentration has been taken for analyzing worst case scenario.

Major source of pollution from the plant will be NO_2, SO_2, CO and Particulate Matter. The proposed power plant has different provision for air pollution abatement measures therefore, the model has been carried out considering mitigation measures. ESP will be installed to reduce particulate matter whereas FGD and Low NOx burner will be adopted for SO_2 and NOx reduction. Based on the emission rates, operating data, meteorological data as well as the assumption given above, following section presents the results of air quality modelling.

5.4.3.3.1 Nitrogen Dioxide (NO_2)

Project Contribution (Project Only) run on Coal

The air quality assessment is made in relation to ensuring compliance with the national standards. Due to the proposed plant operation, the 24-hourly predicted maximum NO_2 concentration found as 7.98 µg/m^3 (385647.81 m E 2405270.25 m N) at 51.2 meters to the north direction of the stack location which is within power plant boundary. The proposed plant will contribute maximum Ground Level Concentration (GLC) of 1.34 µg/m^3 (annual averaging time) of NO_2 to the airshed based on an emission concentration of 350 mg/Nm^3 with Tier 1 (NO_2/NOx = 1). The annual predicted maximum NO_2 concentration was found as 1.3 µg /m^3 (386497.81m E 2406670.25m N) at 1670 meters to the north-east direction of the power plant. The results of ambient air quality modeling for NO_2 are presented in **Table 5-13**. In terms of impact on health, the maximum 24 hourly NO_2 contribution to GLC with a 350 mg/Nm^3 emission concentration and 220 m stack height is about 10.0% of the 24-hourly national standard (Schedule-1 of Air Pollution Control Rules 2022). The plant will contribute about 3.4% of the annual national standard. NO_2 Isopleths of 24-hourly and annual due to 635 MW coal based power plant operation are shown in **Figure 5-6** and **Figure 5-7**.

Project Contribution + Background Concentration

During the scenario-2 analysis, highest background concentration has been taken from primary air quality monitoring for worst case analysis. Short term 24-hourly baseline concentration was found 18.7 µg/m^3 (23.4% of national standard-APCR) and annual maximum baseline concentration estimated as 3.74 µg/m^3 which is 9.4% of national standard (**Table 5-13**). Hence, the background maximum NO_2 concentration is within the standard. The project contribution including baseline concentration shows that the 24 hours and annual maximum concentration are 26.7 µg/m^3 (33.4% of national standard-APCR) and 5.1 µg/m^3 (12.7% of national standard). It can be concluded that only project will contribute less NO_2 on the airshed.

Table 5-13: Results of Air Quality Modeling for NO_2 due to Proposed Power Plant Operation

Scenario	Max. Concentration (µg/m^3)		Max. Concentration Location	APCR, 2022[a] (µg/m^3)	% of APCR 2022 standard
	Avg. Time	Max. Value			
Only Project run on coal	24-hr.	7.98	385647.81 2405270.25	80	10.0
	Annual	1.34	386497.81 2406670.25	40	3.4
Baseline Concentration (µg/m^3)- Worst Scenario	24-hr.	18.7	387939.00 2410813.00	80	23.4
	Annual	3.74	387939.00 2410813.00	40	9.4
Project run on coal + Actual background concentration in worst case	24-hr.	26.7	-	80	33.4
	Annual	5.1	-	40	12.7

[a] Schedule-1 (Ambient Air Quality Standards), Air Pollution Control Rules 2022

Figure 5-6: NO_2 Isopleths- 24 Hourly Average Maximum GLC with Coal as Fuel for Proposed Power Plant

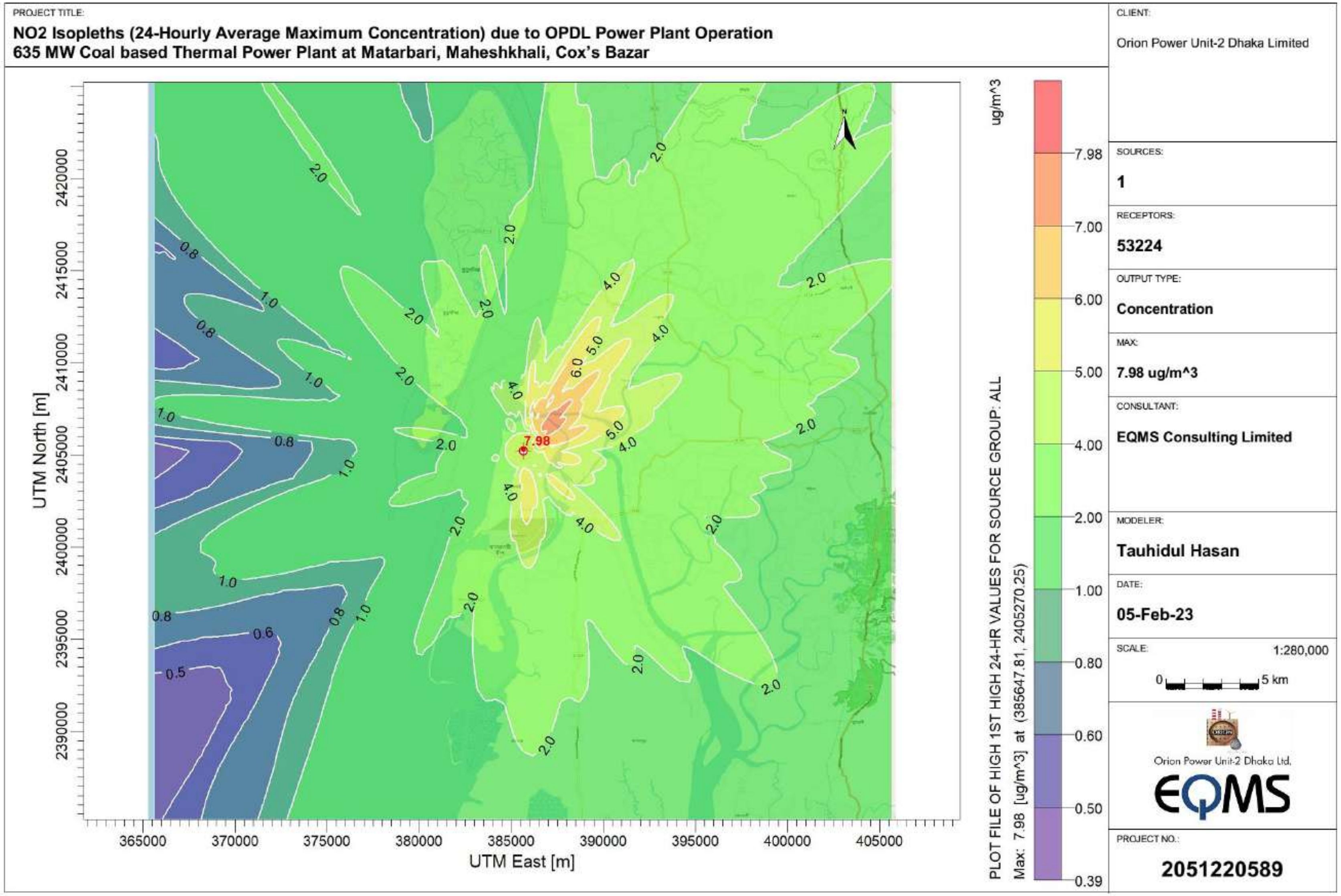
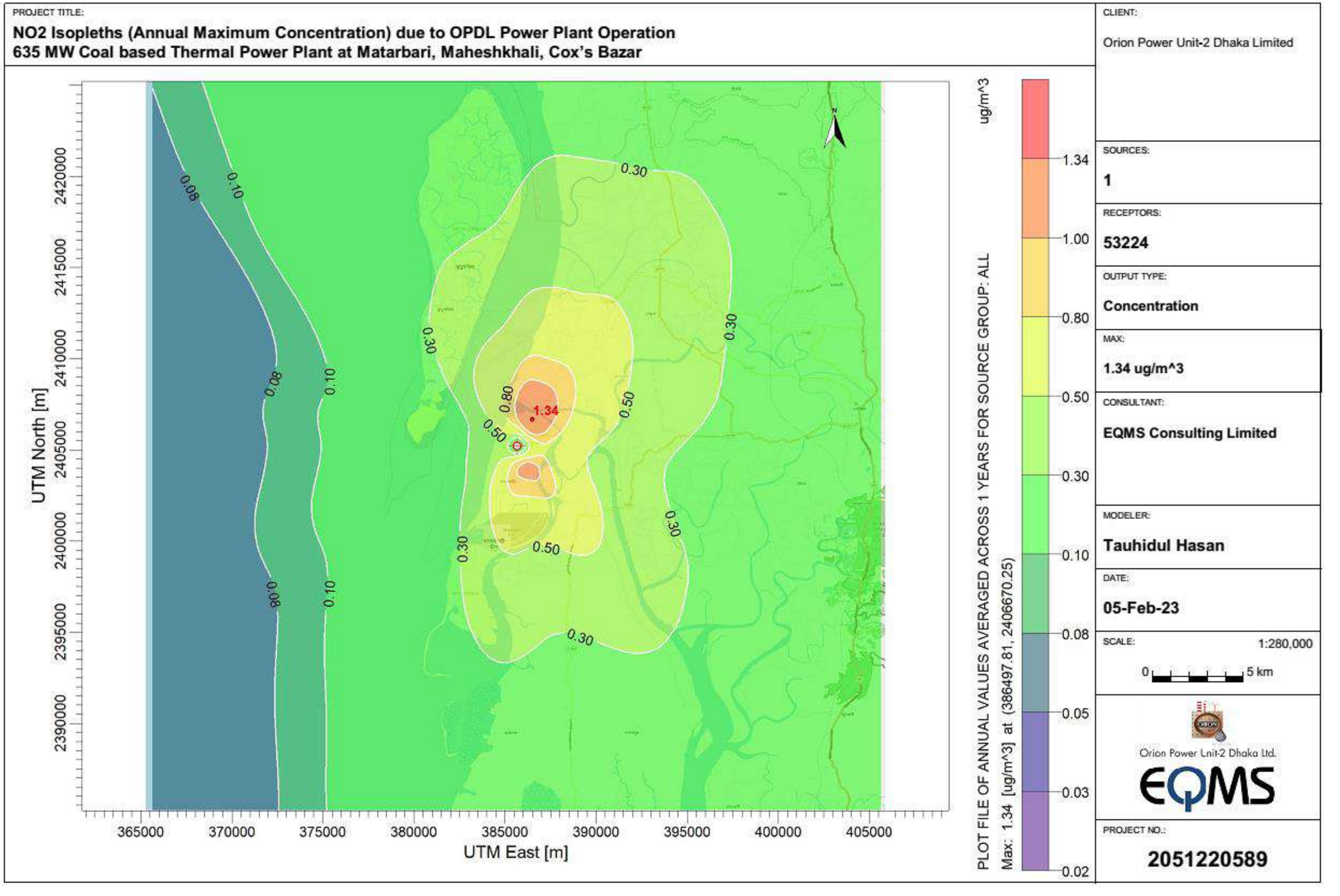


Figure 5-7: NO_2 Isopleths- Annual Maximum GLC with Coal as Fuel for Proposed Power Plant



Project Contribution on Sensitive Receptors

Total five air quality monitoring were conducted at the sensitive location during the baseline monitoring period. The nearest settlement is located 420 m south to the project boundary. **Table 5-14** presents that the maximum 24 NO_2 was found 14.5 µg/m^3 (18.1% of APCR) at AAQ1 to 18.7 µg/m^3 (23.4% of APCR) at AAQ5 whereas annual NO_2 concentration estimated as 2.9 µg/m^3 (7.3% of APCR) at AAQ1 to 3.7 µg/m^3 (9.4% of APCR) at AAQ5. **Table 5-14** presents that the predicted 24-hourly and annual NO_2 concentration due to only 635 MW coal-based power plant operation varies between 3.5 µg/m^3 (AAQ5) - 6.8 µg/m^3 (AAQ2) and 0.4 µg/m^3 (AAQ5) -1.3 µg/m^3 (AAQ2) at 5 air quality monitoring locations. It reveals that predicted NO_2 concentrations on sensitive receptors are well within the national standard.

Table 5-14 shows that total 24-hourly NO_2 concentration (maximum baseline concentration + proposed 635 MW power plant operation) varies in between 19.4 µg/m^3 (AAQ1) – 24.4 µg/m^3 (AAQ2). Annual NO_2 concentration found in the range of 3.3 µg/m^3 (AAQ1) – 4.8 µg/m^3 (AAQ2). Among the 5 receptors, the maximum annual GLC of 4.8 ug/m^3 (12.0 % of APCR) found at AAQ2 (west Ujantia Govt. primary school) and maximum 24-hr GLC of 24.4 ug/m^3 (30.5% of APCR) was found at AAQ2.

Besides the 5 receptors, another 338 receptors present within 20 km domain have been modelled. The 24-hourly NO_2 concentration was found in the range of 1.15 µg/m^3 - 7.35 µg/m^3 due to the only proposed 635 MW coal based thermal power plant operation. The highest NO_2 concentration 7.35 µg/m^3 was found at SR 182 (Maddhyam Ujantia Veluarpara Government Primary School) with 3.8 km north-east direction from project boundary. The annual NO_2 concentration was found in between 0.14 µg/m^3 – 1.28 µg/m^3 among the sensitive receptors. The highest annual concentration 1.28 µg/m^3 was found at SR185 (Khan Bahadur Ebtedaye Madrasa) having 2.8 km north-east direction from the project boundary. NO_2 concentration on sensitive receptors due to the operation of proposed power plant is presented in **Appendix H-1.**

The project itself does not result in any exceedance of the guidelines. Short term impacts on health tend to be less severe than long term impacts (e.g. eye irritation versus increased mortality) and the maximum short-term concentration from the project whilst significant is unlikely.

Table 5-14: Predicted Concentration of NO_2 at Air Quality Monitoring Locations due to Plant Operation

Scenario	Avg. Time	Concentration (µg/m^3)					APCR, 2022[a] (µg/m^3)
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	
Baseline Air Quality (Maximum)	24-hr.	14.5	17.6	18.7	16.7	18.7	80
	Annual	2.9	3.5	3.7	3.3	3.7	40
Only Project run on coal	24-hr.	4.9	6.8	4.2	4.2	3.5	80
	Annual	0.4	1.3	0.7	0.8	0.4	40
Only project + maximum baseline concentration	24-hr.	19.4	24.4	22.9	20.9	22.2	80
	Annual	3.3	4.8	4.4	4.1	4.2	40

5.4.3.3.2 Sulfur Dioxide (SO_2)

Project Contribution (Project Only) run on Coal

The air quality assessment is made in relation to ensuring compliance with the national standards. Due to the proposed power plant operation, 1- hourly maximum SO_2 concentration was found 114 µg/m^3 (45.6% of national standard) at 51.2 m (385647.81 m E 2405270.25 m N) north direction from the stack location which is within the project boundary whereas 24- hourly SO_2 concentration was found 4.75 µg/m^3 (5.9% of national standard) at 51.2 meters (385647.81 m E 2405270.25 m N) to the north direction from the stack location. The results of ambient air quality modeling for SO_2 are presented in **Table 5-15.** The project alone SO_2 contribution to the airshed is within the standard. SO_2 Isopleths of 1 hourly and 24-hourly due to the 635 MW coal-based power plant operation are shown in **Figure 5-8** and **Figure 5-9**.

Table 5-15: Results of Air Quality Modeling for SO_2 due to Proposed Power Plant Operation

Scenario	Max. Concentration (µg/m³)		Max. Concentration Location	APCR, 2022[a] (µg/m³)	% of APCR 2022 standard
	Avg. Time	Max. Value			
Only Project run on coal	1-hr.	114	385647.81 2405270.25	250	45.6
	24-hr.	4.75	385647.81 2405270.25	80	5.9
Baseline Concentration (µg/m³)-Worst Scenario	1-hr.	33.7	386782.00 2407232.00	250	13.5
	24-hr.	13.5	386782.00 2407232.00	80	16.9
Project run on coal + Actual background concentration in worst case	1-hr.	147.7	-	250	59.1
	24-hr.	18.3	-	80	22.8

[a] Schedule-1 (Ambient Air Quality Standards), Air Pollution Control Rules 2022

Project Contribution + Background Concentration

The 24-hourly maximum background concentration of SO_2 found as 13.5 µg/m³ and 1-hourly SO_2 estimated as 33.7 µg/m³ which are well within the national ambient air quality standard. Only 635 MW coal-based power plant operation will contribute 1-hourly 114 µg/m³ (45.6% of national standard) and 24-hourly 4.75 µg/m³ (5.9% of national standard). **Table 5-15** shows that the project contribution including baseline concentration for 1-hourly and 24-hourly maximum concentration stands 147.7 µg/m³ (59.1% of national standard-APCR) and 18.3 µg/m³ (22.8% of national standard-APCR). It can be stated that project will contribute 1- hourly SO_2 significantly.

Figure 5-8: SO_2 Isopleths- 1 Hourly Average Maximum GLC with Coal as Fuel for Proposed Power Plant

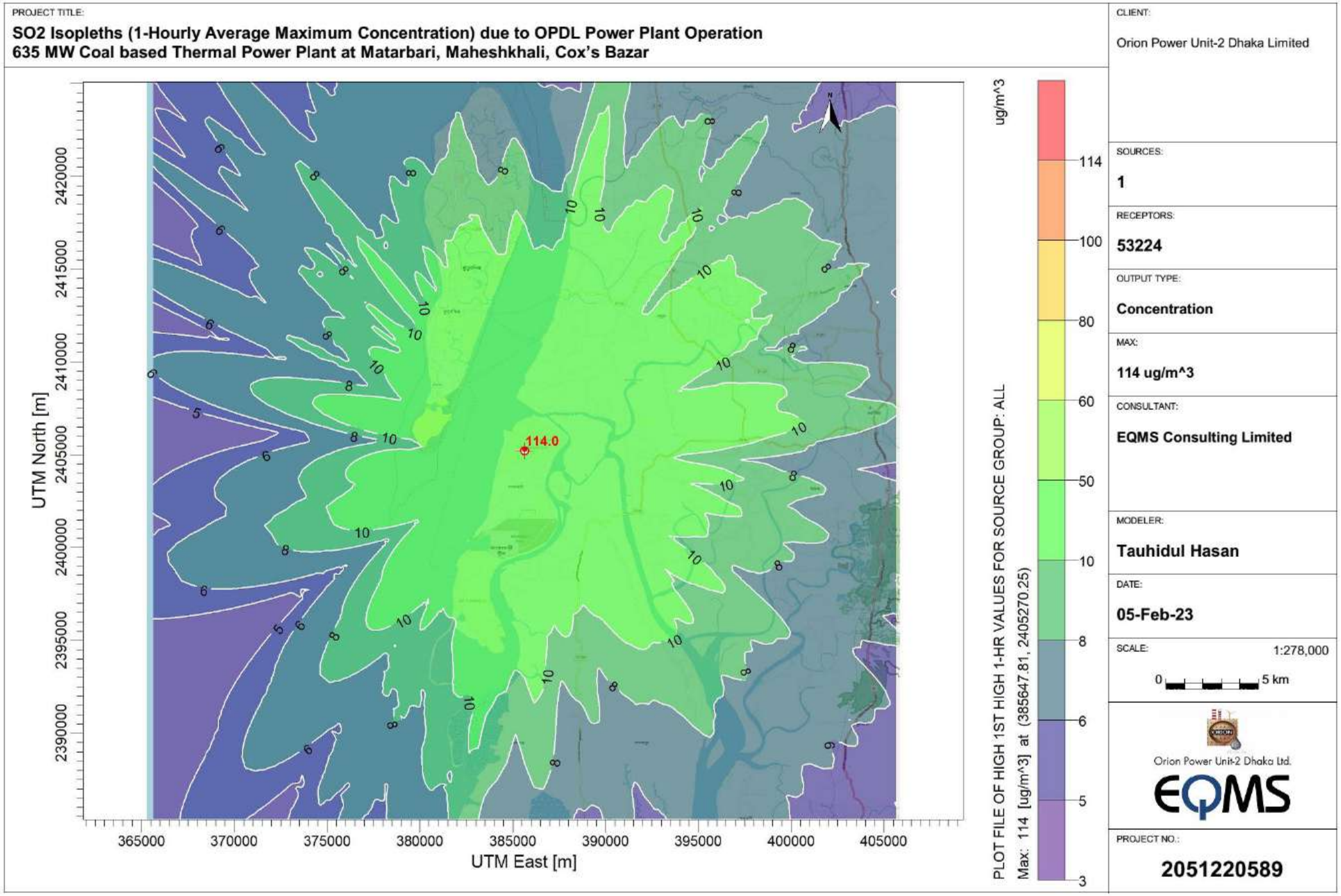
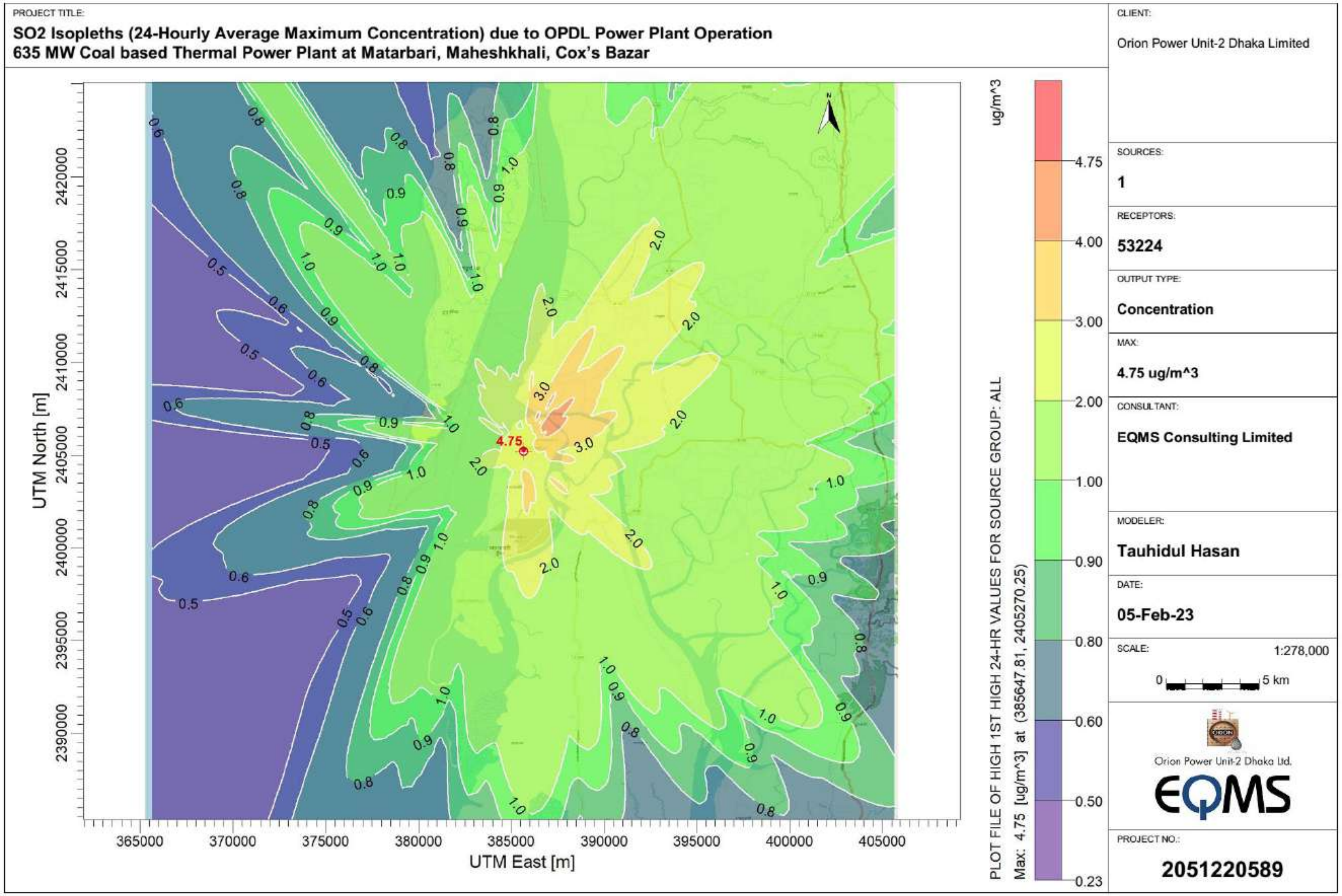


Figure 5-9: SO_2 Isopleths- 24 Hourly Average Maximum GLC with Coal as Fuel for Proposed Power Plant



Project Contribution on Sensitive Receptors

Total five air quality monitoring were conducted at the five sensitive location during the baseline monitoring period. **Table 5-16** presents that the maximum 24-hour SO_2 was found 9.8 µg/m^3 (AAQ4)- 13.5 µg/m^3 (AAQ2) whereas 1-hourly SO_2 concentration estimated as 24.5 µg/m^3 (AAQ4)- 33.8 µg/m^3 (AAQ2). The model shows 1-hourly and 24-hourly SO_2 concentration due to the proposed 635 MW coal-based power plant operation will contribute to the range of 13.8 µg/m^3 (AAQ5) – 27.8 µg/m^3 (AAQ1) and 2.0 µg/m^3 (AAQ5) -3.9 µg/m^3 (AAQ2) at 5 air quality monitoring locations.

Table 5-16 shows that total 1-hourly SO_2 concentration (maximum baseline concentration + proposed 635 MW power plant operation) varies in between 44.8 µg/m^3 (AAQ5) – 55.8 µg/m^3 (AAQ1). Whereas 24-hourly SO_2 concentration found in the range of 14.1 µg/m^3 (AAQ1) – 17.4 µg/m^3 (AAQ2). Among the 5 receptors, the maximum 1-hourly GLC of 55.8 ug/m^3 (22.3 % of APCR) found at AQ1 (project site) and maximum 24-hr GLC of 17.4 ug/m^3 (21.8% of APCR) was found at AQ2 (Near West Ujantia Govt. Primary School, Ujantia).

The 1-hourly SO_2 concentration was found in the range of 5.21 µg/m^3 – 20.5 µg/m^3 at 338 sensitive receptors within 20 km modelled domain due to the only proposed 635 MW coal based thermal power plant operation. The highest 1- hourly SO_2 concentration 20.5 µg/m^3 was found at SR 223 (Adarsha Public High School, Matarbari) with 2.15 km south direction from project boundary. The 24-hourly SO_2 concentration was found in between 0.66 µg/m^3 – 4.23 µg/m^3 among the sensitive receptors. The highest 24-hourly SO_2 concentration 4.23 µg/m^3 was found at SR182 (Khan Bahadur Para Govt Primary School) having 2.6 km north-east direction from the project boundary. It shows that SO_2 contribution due to the only project operation on the receptors is negligible. SO_2 concentration on sensitive receptors due to the operation of proposed power plant is presented in **Appendix H-2**.

Table 5-16: Predicted Concentration of SO_2 at Air Quality Monitoring Locations due to Proposed Power Plant Operation

Scenario	Avg. Time	Concentration (µg/m^3)					APCR, 2022[a] (µg/m^3)
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	
Baseline Air Quality (Maximum)	24-hr.	28.0	33.8	32.0	24.5	31.0	250
	Annual	11.2	13.5	12.8	9.8	12.4	80
Only Project run on coal	24-hr.	27.8	19.0	14.8	23.6	13.8	250
	Annual	2.9	3.9	2.4	2.4	2.0	80
Project run on coal + maximum baseline concentration	24-hr.	55.8	52.7	46.8	48.1	44.8	250
	Annual	14.1	17.4	15.2	12.2	14.4	80

5.4.3.3.3 Carbon Monoxide (CO)

Project Contribution (Project Only) run on Coal

Due to the proposed power plant operation, 1- hourly maximum CO concentration was found 109 µg/m^3 (2.2% of national standard) at 51.2 m (385647.81 m E 2405270.25 m N) north direction from the stack location which falls within the project boundary whereas 8- hourly CO concentration was found 13.7 µg/m^3 (0.1% of national standard) at 48.6 meters (386497.81 m E 2406670.25 m N) to the north direction from the stack location. The results of ambient air quality modeling for CO are presented in **Table 5-17.** The project alone CO contribution to the airshed is within the standard and found to be negligible. CO Isopleths of 1 hourly and 8-hourly due to the 635 MW coal-based power plant operation are shown in **Figure 5-10** and **Figure 5-11**.

Table 5-17: Results of Air Quality Modeling for CO due to Proposed Power Plant Operation

Scenario	Max. Concentration ($\mu g/m^3$)		Max. Concentration Location	APCR, 2022[a] ($\mu g/m^3$)	% of APCR 2022 standard
	Avg. Time	Max. Value			
Only Project run on coal	1-hr.	109	385647.81 2405270.25	5000	2.2
	8-hr.	13.7	386497.81 2406670.25	20000	0.1
Baseline Concentration ($\mu g/m^3$)-Worst Scenario	1-hr.	635	386782.00 2407232.00	5000	12.7
	8-hr.	380	386782.00 2407232.00	20000	1.9
Project run on coal + Actual background concentration in worst case	1-hr.	744.0	-	5000	14.9
	24-hr.	393.7	-	20000	2.0

[a] Schedule-1 (Ambient Air Quality Standards), Air Pollution Control Rules 2022

Project Contribution + Background Concentration

The 1-hourly maximum background concentration (baseline concentration) of CO was found as 635 $\mu g/m^3$ and 8-hourly CO was found as 380 $\mu g/m^3$ which are well within the national ambient air quality standard. Only 635 MW coal-based power plant operation will contribute 1-hourly 109 $\mu g/m^3$ (2.2% of national standard) and 8-hourly 13.7 $\mu g/m^3$ (0.1% of national standard). **Table 5-17** shows that the total CO concentration including project contribution and baseline concentration for 1-hourly and 8-hourly are 744 $\mu g/m^3$ (14.9% of national standard-APCR) and 393.7 $\mu g/m^3$ (2.0% of national standard-APCR). It shows that the total CO concentration (project contribution + maximum baseline concentration) is well within the standard.

Figure 5-10: CO Isopleths- 1 Hourly Average Maximum GLC with Coal as Fuel for the Proposed Power Plant

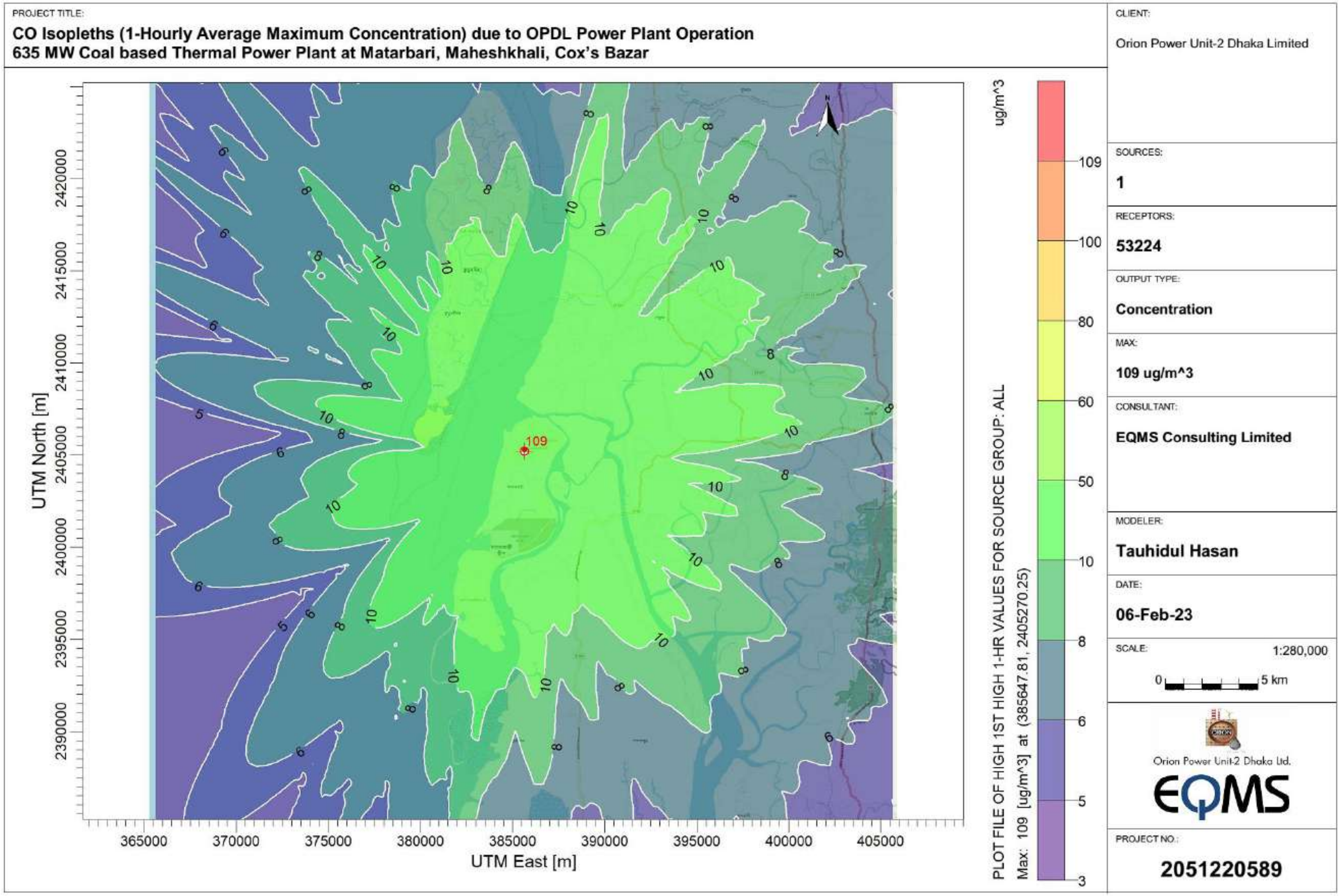
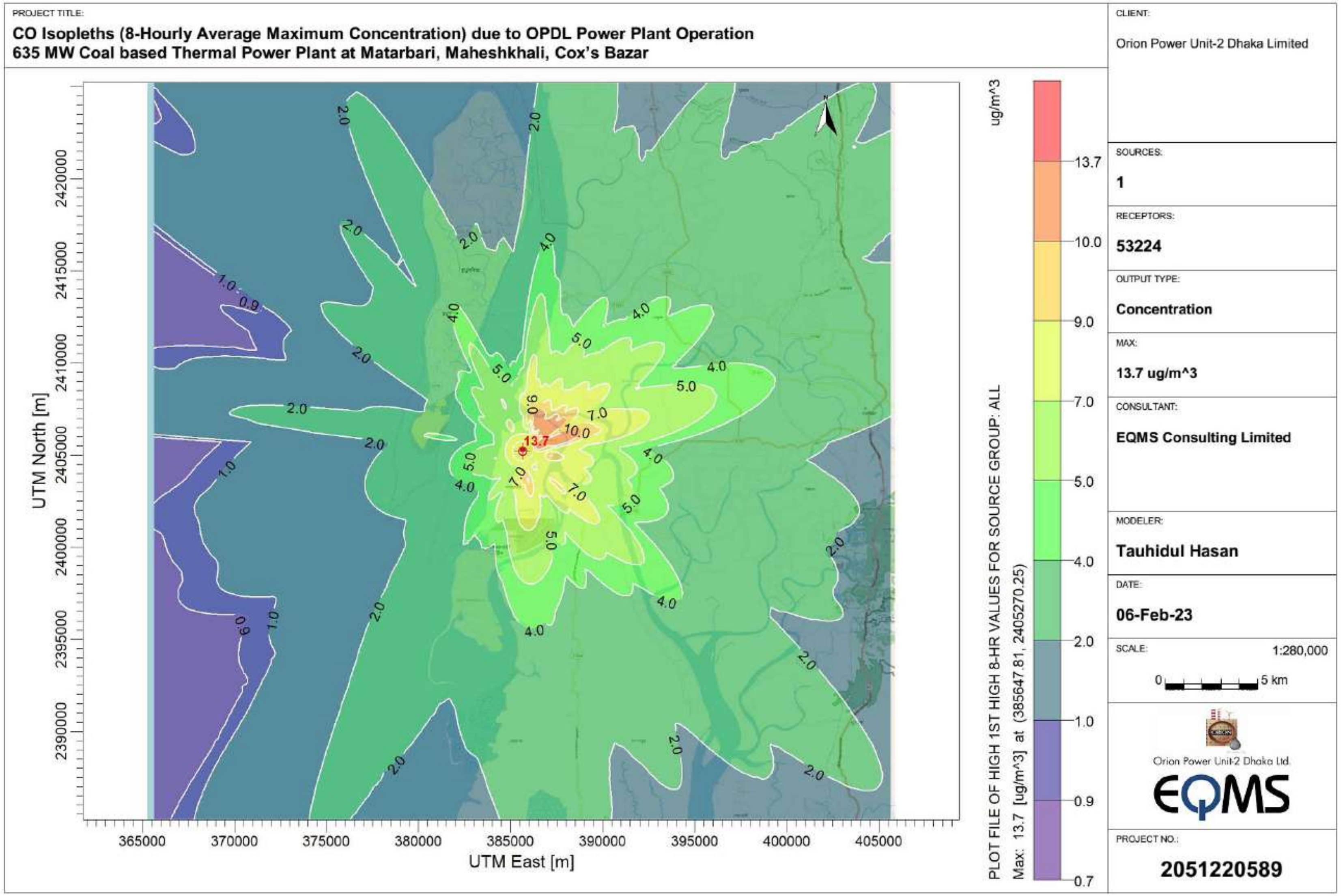


Figure 5-11: CO Isopleths- 8 Hourly Average Maximum GLC with Coal as Fuel for the Proposed Power Plant



Project Contribution on Sensitive Receptors

Total five air quality monitoring were conducted at the five sensitive location during the baseline monitoring period. **Table 5-18** presents that the maximum 1-hourly CO was found 183.7 µg/m^3 (AAQ3 & AAQ4) – 634.6 µg/m^3 (AAQ2) whereas 8-hourly CO concentration found 110 µg/m^3 (AAQ3 & AAQ4)-380 µg/m^3 (AAQ2). The model shows 1-hourly and 8-hourly CO concentration due to the proposed 635 MW coal-based power plant operation will contribute to the range of 13.7 µg/m^3 (AAQ5) – 27.6 µg/m^3 (AAQ1) and 4.6 µg/m^3 (AAQ3) -10.3 µg/m^3 (AAQ2) on 5 air quality monitoring locations.

Table 5-16 shows that total (maximum baseline concentration + proposed 635 MW power plant operation)1-hourly CO concentration varied in between 198.5 µg/m^3 (AAQ3) – 653.4 µg/m^3 (AAQ2). Whereas 8-hourly CO concentration found in the range of 114.6 µg/m^3 (AAQ3) – 390.3 µg/m^3 (AAQ2). Among the 5 receptors, the maximum 1-hourly GLC of 653.4 ug/m^3 (3.3 % of APCR) found at AAQ2 (Near West Ujantia Govt. Primary School, Ujantia) and maximum 8-hr GLC of 390.3 ug/m^3 (7.8% of APCR) was found also at AAQ2.

Besides 5 ambient air quality monitoring locations, total 338 sensitive receptors within 20 km area were modelled. The 1-hourly CO concentration was found in the range of 5.2 µg/m^3 – 20.3 µg/m^3 at 338 sensitive receptors within 20 km modelled domain due to the only proposed 635 MW coal based thermal power plant operation. The highest 1- hourly CO concentration 20.3 µg/m^3 was found at SR 223 (Adarsha Public High School, Matarbari) with 2.15 km south direction from project boundary. The 8-hourly CO concentration was found in between 1.4 µg/m^3 – 10.3 µg/m^3 among the sensitive receptors. The highest 8-hourly CO concentration 10.3 µg/m^3 was found at SR184 (West Ujantia Govt. Primary School, Ujantia) having 1.8 km north direction from the project boundary. It shows that CO contribution due to the only project operation on the receptors is negligible. CO concentration on sensitive receptors due to the operation of proposed power plant is presented in **Appendix H-3**.

Table 5-18: Predicted Concentration of CO at Air Quality Monitoring Locations

Scenario	Avg. Time	Concentration (µg/m^3)					APCR, 2022[a] (µg/m^3)
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	
Baseline Air Quality (Maximum)	1-hr.	197.1	634.6	183.7	183.7	255.5	20000
	8-hr.	118.0	380.0	110.0	110.0	153.0	5000
Only Project run on coal	1-hr.	27.6	18.8	14.8	23.5	13.7	20000
	8-hr.	8.5	10.3	4.6	7.2	4.8	5000
Project run on coal + maximum baseline concentration	1-hr.	224.7	653.4	198.5	207.2	269.2	20000
	8-hr.	126.5	390.3	114.6	117.2	157.8	5000

5.4.3.3.4 Particulate Matter (PM_{10})

Project Contribution (Project Only) run on Coal

The particulate matter emission concentration considered as 40 mg/Nm^3. Since there is no fraction of particulate matter as PM_{10} and $PM_{2.5}$ in national standard and WHO guidelines hence, it has been assumed that $PM=PM_{10}=PM_{2.5}$, the proposed power plant will have the same contribution of PM_{10} as PM which is considered worst case scenario. The proposed plant will contribute maximum Ground Level Concentration (GLC) of 0.91 µg/m^3 (24-hourly averaging time) of PM_{10} to the airshed based on an emission concentration of 40 mg/Nm^3. The 24-hourly predicted maximum PM_{10} concentration was found as 0.91 µg /m^3 (385647.81 m E 2405270.25 m N) at 51.2 meters to the north direction of the stack location which is within power plant boundary. The annual predicted maximum PM_{10} concentration was found as 0.15 µg /m^3 (386497.81m E 2406670.25m N) at 1670 meters to the north-east direction of the power plant boundary. The results of ambient air quality modeling for PM_{10} are presented in **Table 5-19**. In terms of impact on health, the maximum project contribution to GLC with a 40 mg/Nm^3 emission concentration and 220 m stack height is about 0.6% and 2.0% of the short term 24-hourly national standard (Schedule-1 of Air Pollution Control Rules 2022) for PM_{10}. The plant will contribute about 0.3% of the annual national standard. It shows that PM_{10} contribution to the airshed due to the proposed coal-based power plant operation is negligible. PM_{10} Isopleths of 24-hourly and annual due to 635 MW coal-based power plant operation are shown in **Figure 5-12** and **Figure 5-13**.

Table 5-19: Results of Air Quality Modeling for PM_{10}

Scenario	Max. Concentration (µg/m^3)		Max. Concentration Location	APCR, 2022[a] (µg/m^3)	% of APCR 2022 standard
	Avg. Time	Max. Value			
Only Project run on coal	24-hr.	0.91	385647.81 2405270.25	150	0.6
	Annual	0.153	386497.81 2406670.25	50	0.3
Baseline Concentration (µg/m^3)-Worst Scenario	24-hr.	44.5	391135.00 2405295.00	150	29.7
	Annual	8.9	391135.00 2405295.00	50	17.8
Project run on coal + Actual background concentration in worst case	24-hr.	45.4	-	150	30.3
	Annual	9.1	-	50	18.1

[a] Schedule-1 (Ambient Air Quality Standards), Air Pollution Control Rules 2022

Project Contribution + Background Concentration

During the scenario-2 analysis, highest background concentration has been taken from primary air quality monitoring for worst case analysis. 24-hourly maximum baseline concentration was found as 44.5 µg/m^3 which is 29.7 % of national standard value whereas annual concentration estimated as 8.9 µg/m^3 (17.8% of national standard-APCR) (**Table 5-19**). Hence, the background maximum PM_{10} concentration is within the standard. The project contribution including baseline concentration shows that the 24 hours and annual maximum concentration are 45.4 µg/m^3 (30.3% of national standard) and 9.1 µg/m^3 (18.1% of national standard-APCR). It can be concluded that only project will contribute insignificant PM_{10} on the airshed.

Figure 5-12: PM_{10} Isopleths- 24 Hourly Maximum GLC with Coal as Fuel for the Proposed Power Plant

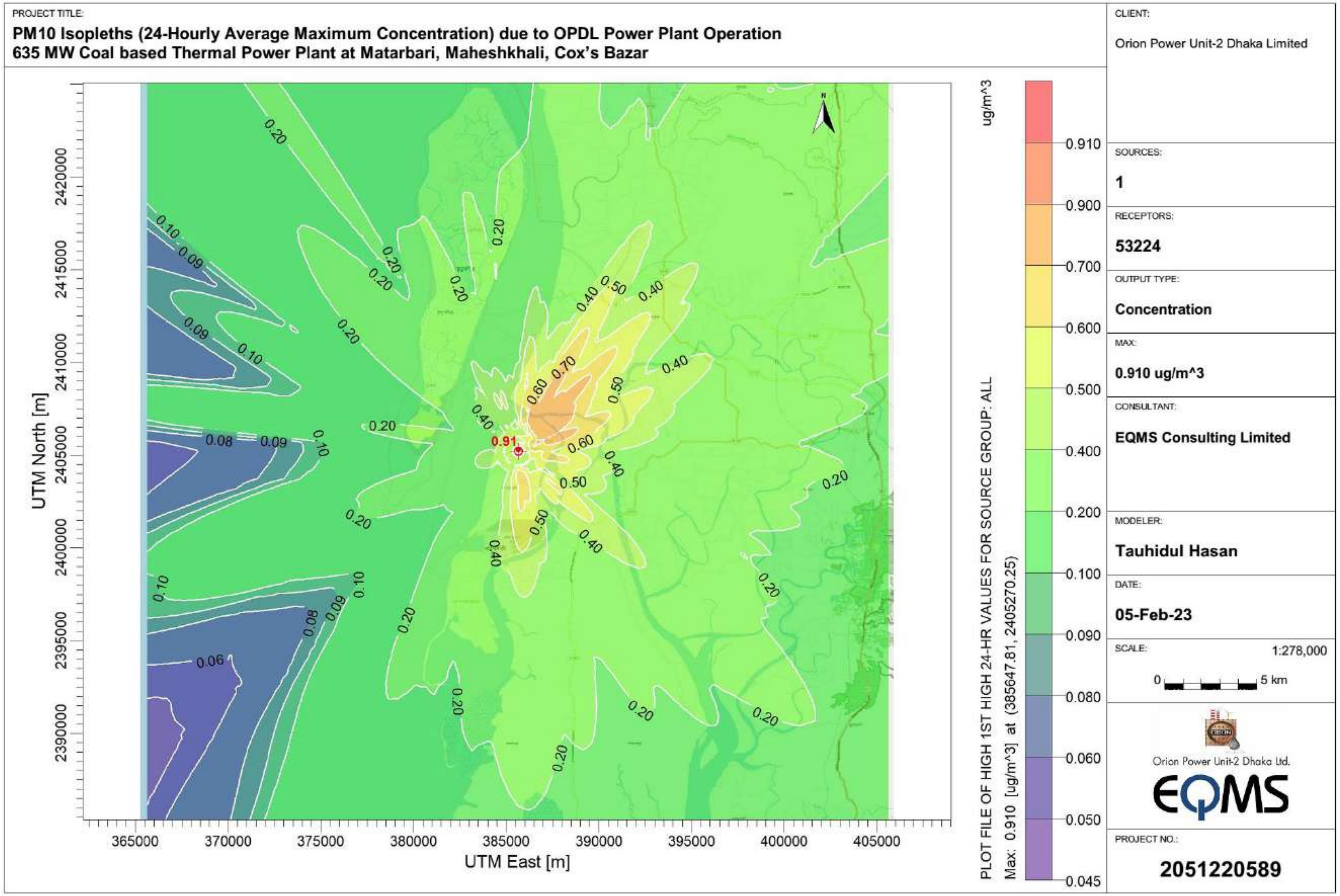
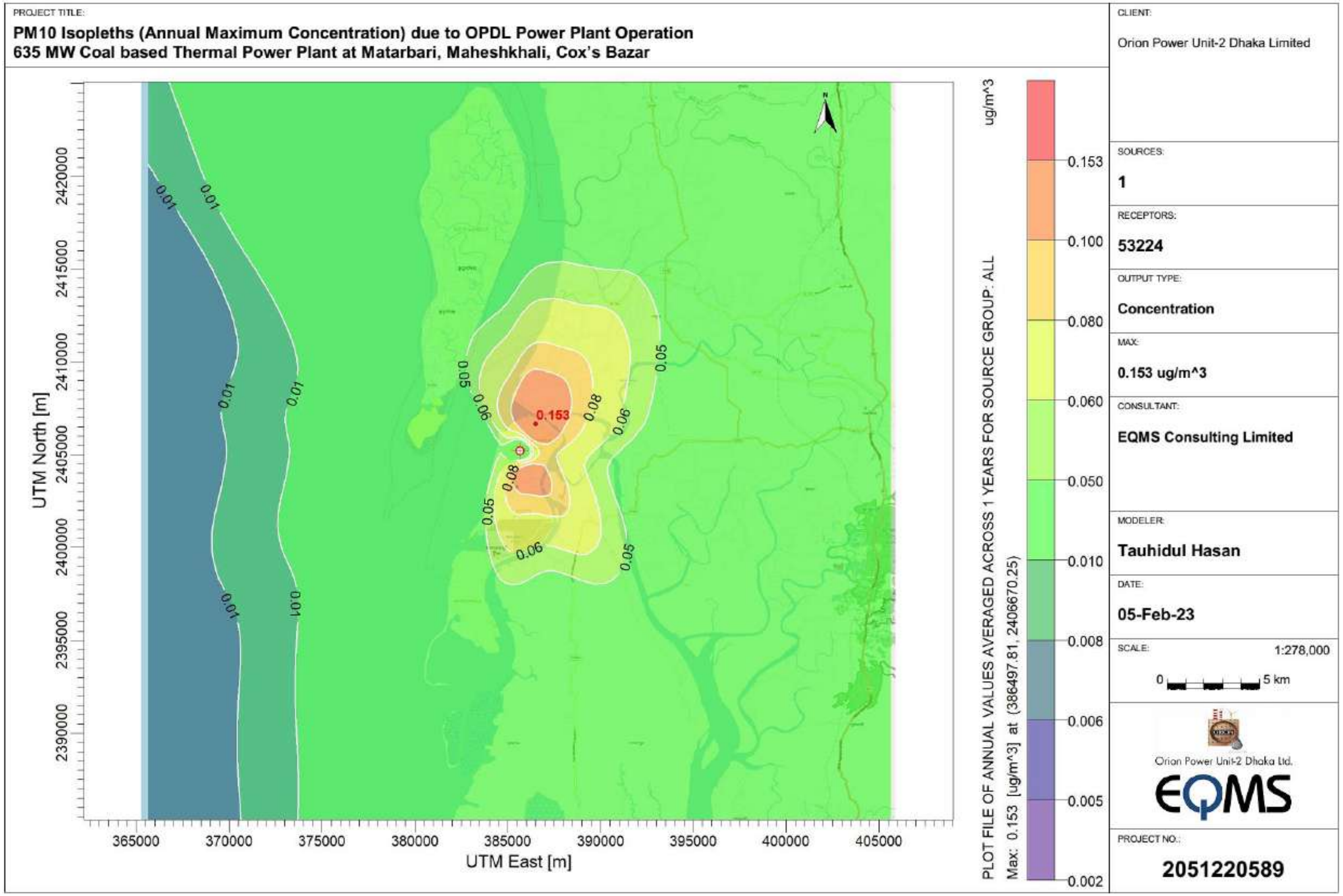


Figure 5-13: PM_{10} Isopleths- Annual Maximum GLC with Coal as Fuel for the Proposed Power Plant



Project Contribution on Sensitive Receptors

Total five air quality monitoring were conducted at the sensitive location during the baseline monitoring period. **Table 5-20** presents that the maximum 24-hour PM_{10} was found 34.7 µg/m³ (23.1% of APCR) at AAQ1 to 44.5 µg/m³ (29.7% of APCR) at AAQ5 whereas annual PM_{10} concentration estimated as 6.9 µg/m³ (13.9% of APCR) at AAQ1 to 8.9 µg/m³ (17.8% of APCR) at AAQ5. **Table 5-20** shows that the predicted 24-hourly and annual PM_{10} concentration due to only 635 MW coal-based power plant operation will vary 0.4 µg/m³ (AAQ5) – 0.8 µg/m³ (AAQ2) and 0.05 µg/m³ (AAQ1 & AAQ5) – 0.15 µg/m³ (AAQ2) at 5 air quality monitoring locations. It reveals that predicted PM_{10} concentrations on sensitive receptors are well within both national and WHO guidelines value.

Table 5-20 shows that total 24-hourly PM_{10} concentration (maximum baseline concentration + proposed 635 MW power plant operation) varies in between 35.3 µg/m³ (AAQ1) – 44.9 µg/m³ (AAQ5). Annual PM_{10} concentration found in the range of 7.0 µg/m³ (AAQ1) – 9.0 µg/m³ (AAQ5). Among the 5 receptors, maximum 24-hr GLC of 44.9 ug/m³ (29.9% of APCR) was found at AAQ5 (Joynal Abedin House, Notun Ghuna Para, Badarkhali) and the maximum annual GLC of 9.0 ug/m³ (17.9 % of APCR) also found at AAQ5.

Besides the 5 receptors, another 338 receptors present within 20 km model domain have been modelled. The 24-hourly PM_{10} concentration was found in the range of 0.13 µg/m³ – 0.84 µg/m³ due to the only proposed 635 MW coal based thermal power plant operation on the 338 sensitive receptors. Among the sensitive receptors, the highest PM_{10} concentration 0.84 µg/m³ was found at SR 182 (Maddhyam Ujantia Veluarpara Government Primary School) with 3.8 km north-east direction from project boundary. The annual PM_{10} concentration was found in between 0.02 µg/m³ – 0.15 µg/m³ among the sensitive receptors. The highest annual concentration 0.15 µg/m³ was found at SR185 (Khan Bahadur Ebtedaye Madrasa) with 2.8 km north-east direction from the project boundary. It shows that PM_{10} contribution due to the only project operation on the receptors is insignificant. PM_{10} concentration on sensitive receptors due to the operation of proposed power plant is presented in **Appendix H-4**.

Table 5-20: Predicted Concentration of PM_{10} at Air Quality Monitoring Locations

Scenario	Avg. Time	Concentration (µg/m³)					APCR, 2022[a] (µg/m³)
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	
Baseline Air Quality (Maximum)	24-hr.	34.7	42.3	39.7	40.5	44.5	150
	Annual	6.9	8.5	7.9	8.1	8.9	50
Only Project run on coal	24-hr.	0.6	0.8	0.5	0.5	0.4	150
	Annual	0.05	0.15	0.08	0.09	0.05	50
Only project + maximum baseline concentration	24-hr.	35.3	43.1	40.2	41.0	44.9	150
	Annual	7.0	8.6	8.0	8.2	9.0	50

5.4.3.3.5 Particulate Matter ($PM_{2.5}$)

Project Contribution (Project Only)

Since there is no fraction of particulate matter as PM_{10} and $PM_{2.5}$ in national standard and WHO guidelines. Therefore, it has been assumed that $PM=PM_{10}=PM_{2.5}$, the proposed power plant will have the same contribution of $PM_{2.5}$ as PM_{10} which is considered as worst-case scenario. The proposed plant will contribute maximum 24 hourly and annual Ground Level Concentration (GLC) of $PM_{2.5}$ like the PM_{10}. The proposed plant will contribute maximum Ground Level Concentration (GLC) of 0.91 µg/m³ (24-hourly averaging time) of $PM_{2.5}$ to the airshed based on an emission concentration of 40 mg/Nm³. The 24-hourly predicted maximum $PM_{2.5}$ concentration was found as 0.91 µg /m³ (385647.81 m E 2405270.25 m N) at 51.2 meters to the north direction of the stack location which is within power plant boundary. The annual predicted maximum PM_{10} concentration was found as 0.15 µg /m³ (386497.81m

E 2406670.25m N) at 1670 meters to the north-east direction of the power plant boundary. The results of ambient air quality modeling for $PM_{2.5}$ are presented in **Table 5-21**. In terms of impact on health, the maximum project contribution of $PM_{2.5}$ to GLC with a 40 mg/Nm^3 emission concentration and 220 m stack height is about 1.4% and 6.1% of the short term 24-hourly national standard (Schedule-1 of Air Pollution Control Rules 2022) for $PM_{2.5}$. The plant will contribute about 0.4% of the annual national standard. It shows that $PM_{2.5}$ contribution to the airshed due to the proposed coal-based power plant operation is negligible. $PM_{2.5}$ Isopleths of 24-hourly and annual due to 635 MW coal-based power plant operation are shown in **Figure 5-14** and **Figure 5-15**.

Table 5-21: Results of Air Quality Modeling for $PM_{2.5}$

Scenario	Max. Concentration (µg/m^3)		Max. Concentration Location	APCR, 2022[a] (µg/m^3)	% of APCR 2022 standard
	Avg. Time	Max. Value			
Only Project run on coal	24-hr.	0.91	385647.81 2405270.25	65	1.4
	Annual	0.153	386497.81 2406670.25	35	0.4
Baseline Concentration (µg/m^3)-Worst Scenario	24-hr.	32.8	391135.00 2405295.00	65	50.5
	Annual	6.6	391135.00 2405295.00	35	18.9
Project run on coal + Actual background concentration in worst case	24-hr.	33.7		65	51.9
	Annual	6.8		35	19.3

[a] Schedule-1 (Ambient Air Quality Standards), Air Pollution Control Rules 2022

Project Contribution + Background Concentration

During the scenario-2 analysis (project contribution + background concentration), highest background concentration has been taken from primary air quality monitoring for worst case analysis. 24-hourly maximum baseline $PM_{2.5}$ concentration was found as 32.8 µg/m^3 which is 50.5 % of national standard and 218.7% of WHO guideline value whereas annual concentration estimated as 6.6 µg/m^3 (18.9% of national standard-APCR and 132.0% of WHO guideline value) (**Table 5-21**). Hence, the background maximum $PM_{2.5}$ concentration is within the national standard. The project contribution including baseline concentration shows that the 24 hours and annual maximum $PM_{2.5}$ concentration are 33.7 µg/m^3 (351.9% of national standard) and 6.8 µg/m^3 (19.3% of national standard-APCR). The only project contribution is less compared to the baseline concentration. It can be concluded that the $PM_{2.5}$ contribution due to the only project operation will be insignificant.

Figure 5-14: $PM_{2.5}$ Isopleths- 24 Hourly Average Maximum GLC with Coal as Fuel for the Proposed Power Plant

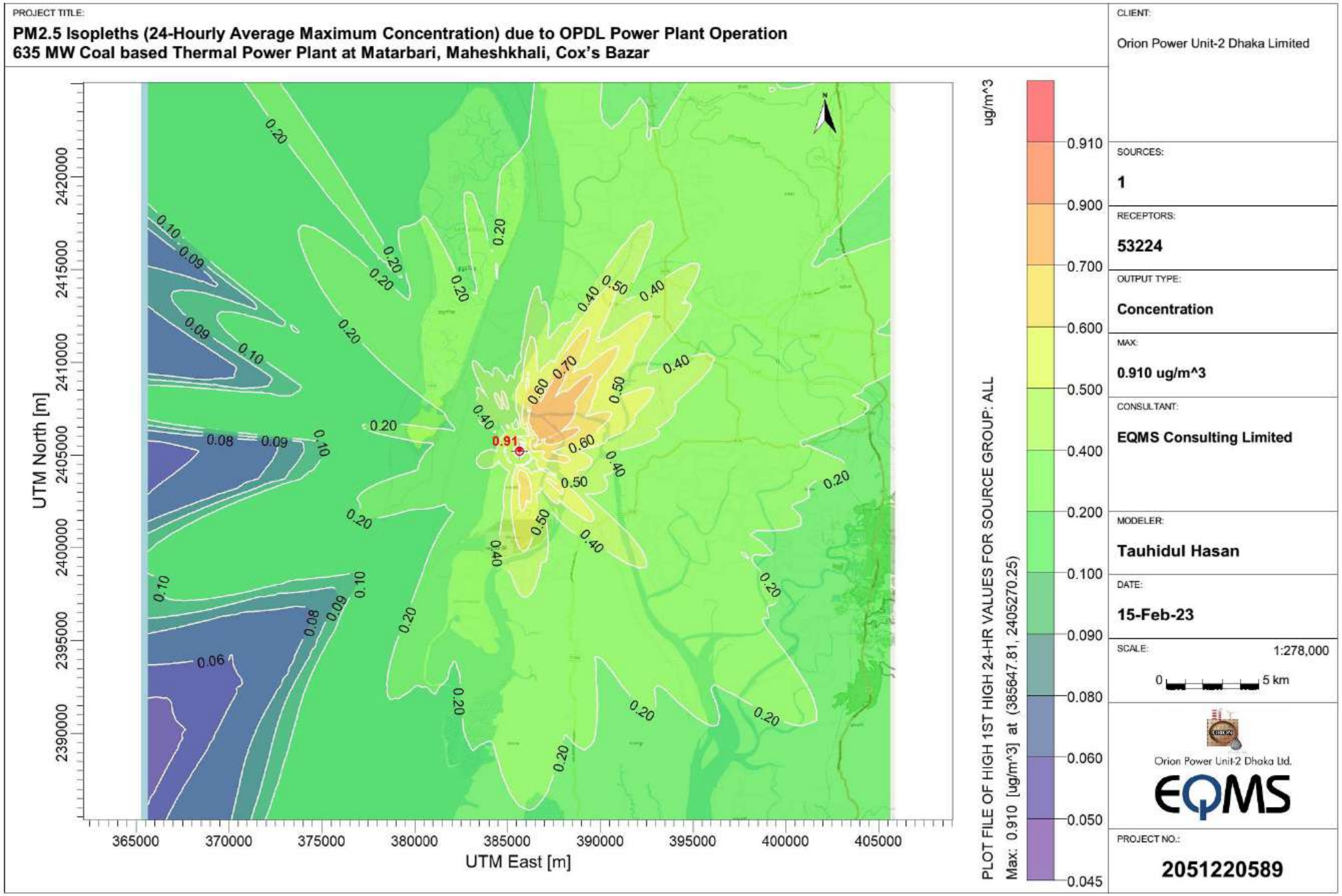
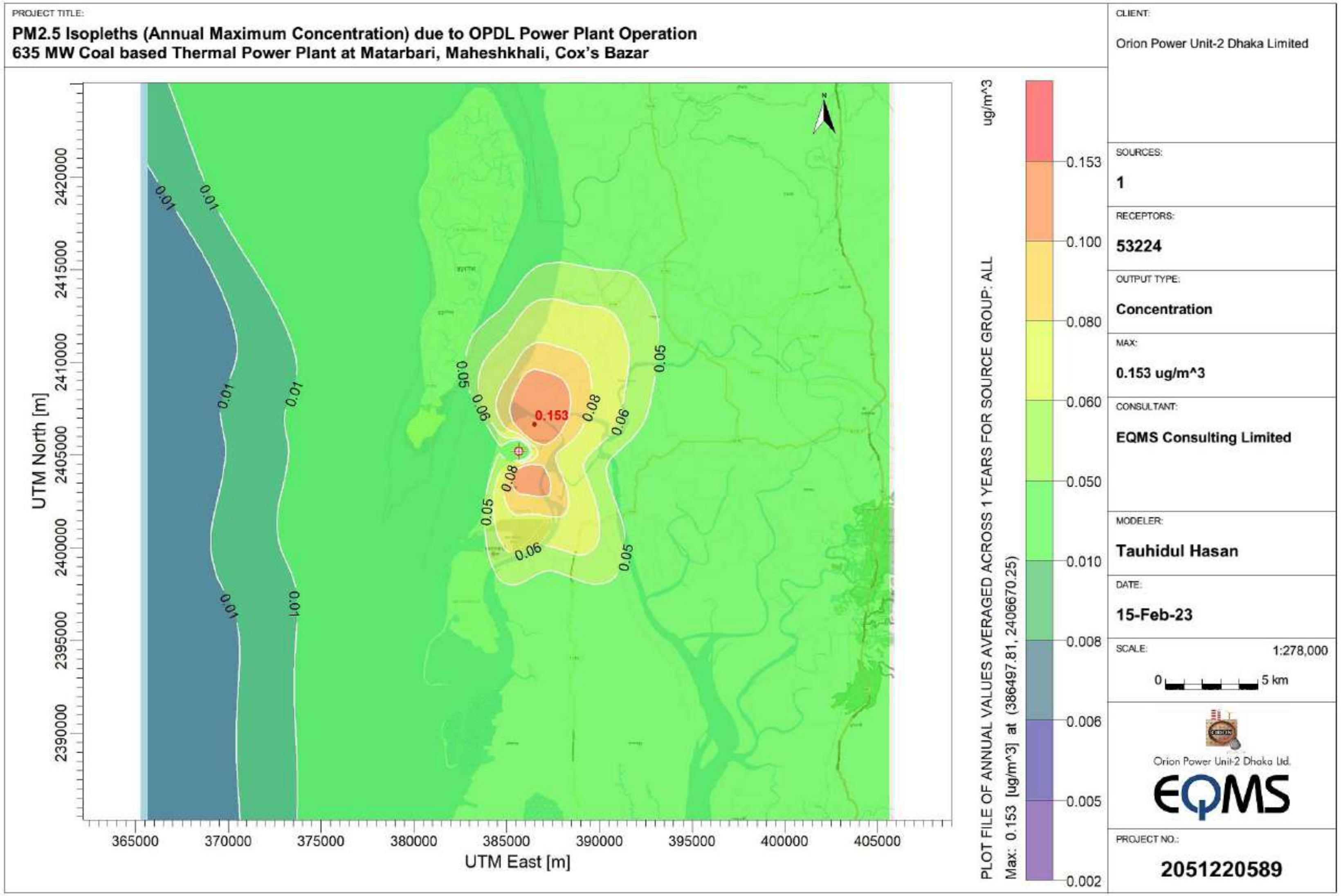


Figure 5-15: $PM_{2.5}$ Isopleths- Annual Maximum GLC with Coal as Fuel for the Proposed Power Plant



Project Contribution on Sensitive Receptors

Total five air quality monitoring were conducted at the sensitive location during the baseline monitoring period. **Table 5-22** presents that the maximum 24-hour $PM_{2.5}$ was found 25.6 µg/m^3 (39.4% of APCR) at AAQ1 to 32.8 µg/m^3 (50.5% of APCR) at AAQ5 whereas annual $PM_{2.5}$ concentration estimated as 5.1 µg/m^3 (14.6% of APCR) at AAQ1 to 6.6 µg/m^3 (18.7% of APCR) at AAQ5. **Table 5-22** shows that the predicted 24-hourly and annual $PM_{2.5}$ concentration due to only 635 MW coal-based power plant operation will vary 0.4 µg/m^3 (AAQ5) – 0.8 µg/m^3 (AAQ2) and 0.05 µg/m^3 (AAQ1 & AAQ5) – 0.15 µg/m^3 (AAQ2) at 5 air quality monitoring locations. It reveals that predicted $PM_{2.5}$ concentrations on sensitive receptors due to the only proposed plant operation are well within the national standard.

Table 5-22 shows that total 24-hourly $PM_{2.5}$ concentration (maximum baseline concentration + proposed 635 MW power plant operation) varies in between 26.2 µg/m^3 (AAQ1) – 33.2 µg/m^3 (AAQ5). Annual $PM_{2.5}$ concentration found in the range of 5.2 µg/m^3 (AAQ1) – 6.6 µg/m^3 (AAQ5). Among the 5 receptors, maximum 24-hr GLC of 33.2 ug/m^3 (51.1% of APCR) was found at AAQ5 (Joynal Abedin House, Notun Ghuna Para, Badarkhali) and the maximum annual GLC of 6.6 ug/m^3 (18.9 % of APCR) also found at AAQ5.

Besides the 5 receptors, another 338 receptors present within 20 km model domain have been modelled. The 24-hourly $PM_{2.5}$ concentration was found in the range of 0.13 µg/m^3 – 0.84 µg/m^3 due to the only proposed 635 MW coal based thermal power plant operation on the 338 sensitive receptors. Among the sensitive receptors, the highest $PM_{2.5}$ concentration 0.84 µg/m^3 was found at SR 182 (Maddhyam Ujantia Veluarpara Government Primary School) with 3.8 km north-east direction from project boundary. The annual $PM_{2.5}$ concentration was found in between 0.02 µg/m^3 – 0.15 µg/m^3 among the sensitive receptors. The highest annual concentration 0.15 µg/m^3 was found at SR185 (Khan Bahadur Ebtedaye Madrasa) with 2.8 km north-east direction from the project boundary. It shows that $PM_{2.5}$ contribution due to the only project operation on the receptors is insignificant. PM_{10} and $PM_{2.5}$ concentration on sensitive receptors due to the operation of proposed power plant and other power plants are considered same (**Appendix H-4**).

Table 5-22: Predicted Concentration of PM_{10} at Air Quality Monitoring Locations

Scenario	Avg. Time	Concentration (µg/m^3)					APCR, 2022[a] (µg/m^3)	WHO, 2021[b] (µg/m^3)
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5		
Baseline Air Quality (Maximum)	24-hr.	25.6	31.5	29.3	29.8	32.8	65	15
	Annual	5.1	6.3	5.9	6.0	6.6	35	5
Only Project run on coal	24-hr.	0.6	0.8	0.5	0.5	0.4	65	15
	Annual	0.1	0.1	0.1	0.1	0.1	35	5
Only project + maximum baseline concentration	24-hr.	26.2	32.3	29.8	30.3	33.2	65	15
	Annual	5.2	6.4	5.9	6.0	6.6	35	5

It is evident that the maximum ground level concentration due to the plant operation with coal as fuel will be well within the applicable air quality standard. Furthermore, Project contribution for all of the pollutants considered in the study are < 25% of the applicable air quality standard except 1-hourly SO_2 concentration which is 45.6% of national standard and therefore, impact magnitude due to operation of 635 MW coal based thermal power plant project with natural gas as fuel is assessed to be **Medium-Low**.

Impact	*Air Quality Degradation due to power plant operation*		
Impact Nature	Direct	Indirect	Induced
Impact Scale	Power plant and surrounding area		
Frequency	Operation Phase		

<table>
<tr><td>Extent and Location</td><td>Project Site</td><td colspan="2">Local</td><td colspan="2">Regional</td><td colspan="2">National</td><td colspan="2">Trans Boundary</td></tr>
<tr><td>Impact Duration</td><td>Short Term</td><td colspan="2">Medium Term</td><td colspan="2">Long-term</td><td colspan="2">Permanent-mitigated</td><td colspan="2">Permanent-no mitigation</td></tr>
<tr><td>Impact Intensity</td><td>Insignificant</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Very High</td></tr>
<tr><td>Potential for Irreplaceable</td><td colspan="3">Low</td><td colspan="3">Medium</td><td colspan="3">High</td></tr>
<tr><td>Probability of Impact</td><td>Unlikely</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Definite</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Very Low</td><td>Low</td><td colspan="2">Medium-low</td><td colspan="2">Medium-high</td><td colspan="2">High</td><td>Very High</td></tr>
<tr><td colspan="3">Significance of impact consider</td><td colspan="6">Medium-low</td></tr>
</table>

5.4.3.4 Cumulative Impact on Air Quality

a. Source of Impact

Besides the proposed 635 MW coal based power plant, there are Matarbari 2X600 MW coal-based power plant which will come in operation in January 2024 (expected) and proposed 591.1 MW LNG based gas fired combined cycle power plant near (1 km north) to the proposed 635 MW coal-based power plant. Matarbari 600X2 MW power plant has double-tube chimney whereas LNG based power plant will have single tube chimney. The location of the stacks is presented in **Table 5-23**.

Table 5-23: Stack Locations of other Power Plants

Power Plant	Stack/Chimney	X coordinate (meter)	Y coordinate (meter)	Base Elevation
Matarbari 600X2 MW Coal fired power plant[29]	Stack 2	384630.00	2400114.00	10.0
	Stack 3	384638.00	2400114.00	10.0
LND based Gas fired Combined Cycle Power Plant	Stack 4	385171.79	2406690.81	10.0

Point source input parameter and emission rate of other power plants are presented in **Table 5-5**.

Table 5-24: Source Input Parameter and Emission Rate of Other Power Plants

Parameter	Unit	Stack 2[30]	Stack 3	Stack 4[31]
Stack Height	m	275	275	80
Stack Internal Diameter	m	7.2	7.2	5.0
Stack Exit Temperature	k	348	348	373
Gas Exit Velocity	m/s	22.0	22.0	20.0
Gas exit flow rate	m^3/s	895.7	895.7	392.7
Emission Rate				
NO_2	g/s	242.2	242.2	16.0
SO_2	g/s	431.7	431.7	-
PM_{10}	g/s	26.4	26.4	3.14
CO	g/s	-	-	-

[30] EIA of Matarbari 600*2 MW Coal Fired Power Plant and Associated Facilities

[31] ESIA report for LNG based Gas Fired Combined Cycle Power Plant at Matarbari, Maheshkhali

Modelling Result and Discussion for Cumulative Case

The following assumptions were used for the cumulative air quality modeling:

Background level concentration: Primary air quality data for both dry and wet seasons were collected from the study area. Since, there is no continuous air quality monitoring station, primary baseline monitoring data has been used for background concentration. Highest concentration data were used for NO_2, SO_2, CO and PM_{10} to analyse the worst-case scenario. Different scenarios have been considered for the air dispersion modelling as follows–

I. **Cumulative case (Project Contribution + Background Concentration + Other Power Plant Operation)**- this considered maximum background (baseline) data of primary monitoring, Project emission and other upcoming power plant (Matarbari 600X2 MW coal-based power plant and proposed 591.1 MW LNG based gas fired combined cycle power plant).

5.4.3.4.1 Nitrogen Dioxide (NO_2)

Cumulative Case (Project Contribution + Background Concentration + Other Power Plant)

During the cumulative scenario analysis, highest background concentration, proposed 635 MW coal-based power plant, one LNG based power plant and under construction Matarbari 600X2 MW coal-based power plant have been taken consideration. The proposed LNG based power plant will contribute less NO_2 on the airshed since it will run on natural gas. Three power plants operation will contribute 24-hr maximum NO_2 GLC as 20.2 µg/m³ (25.3% of national standard) to the airshed (386247.81 m E 2401820.25 m N) at 3.4 km south-east direction from the proposed 635 MW coal-based power plant stack location and 2.3 km north-east direction from Matarbari coal-based power plant stack location (**Table 5-25**). Whereas annually NO_2 maximum GLC of 4.0 µg/m³ (10% of national standard) to the airshed (385697.81 m E 2402170.25 m N) at 3.5 km south direction from the proposed 635 MW coal-based power plant stack location and 2.3 km north-east direction from Matarbari coal-based power plant stack location. There is no human settlement at maximum ground level concentration location, and it is found to be salt pan area. Cumulative scenario (baseline and three power plant operations) shows that it will contribute 24-hourly NO_2 maximum GLC of 38.9 µg/m³ (48.6% of national standard). On the other hand, annual maximum GLC of 7.7 µg/m³ (19.4% of national standard) of NO_2 to the airshed (**Table 5-25**). NO_2 Isopleths of 24-hourly and annual during cumulative scenario (three power plants operation) are shown in **Figure 5-16** and **Figure 5-17**. It is found that the cumulative impact due to the three power plants operation will meet the national ambient air quality standard of NO_2.

Table 5-25: Results of Air Quality Modeling for NO_2 due to 3 Power Plants Operation

Scenario	Max. Concentration (µg/m³)		Max. Concentration Location	APCR, 2022[a] (µg/m³)	% of APCR 2022 standard
	Avg. Time	Max. Value			
Project run on coal + LNG based power plant run on NG + Matarbari power plant run on coal	24-hr.	20.2	386247.81 2401820.25	80	25.3
	Annual	4.0	385697.81 2402170.25	40	10.0
Baseline Concentration (µg/m³)-Worst Scenario	24-hr.	18.7	387939.00 2410813.00	80	23.4
	Annual	3.74	387939.00 2410813.00	40	9.4
Cumulative (Project run on coal + LNG based power plant run on NG + Matarbari power plant run on coal+ Background Concentration)	24-hr.	38.9	-	80	48.6
	Annual	7.7	-	40	19.4

[a] Schedule-1 (Ambient Air Quality Standards), Air Pollution Control Rules 2022

Figure 5-16: NO_2 Isopleths- 24 Hourly Average Maximum GLC considering 3 Power Plants in Matarbari

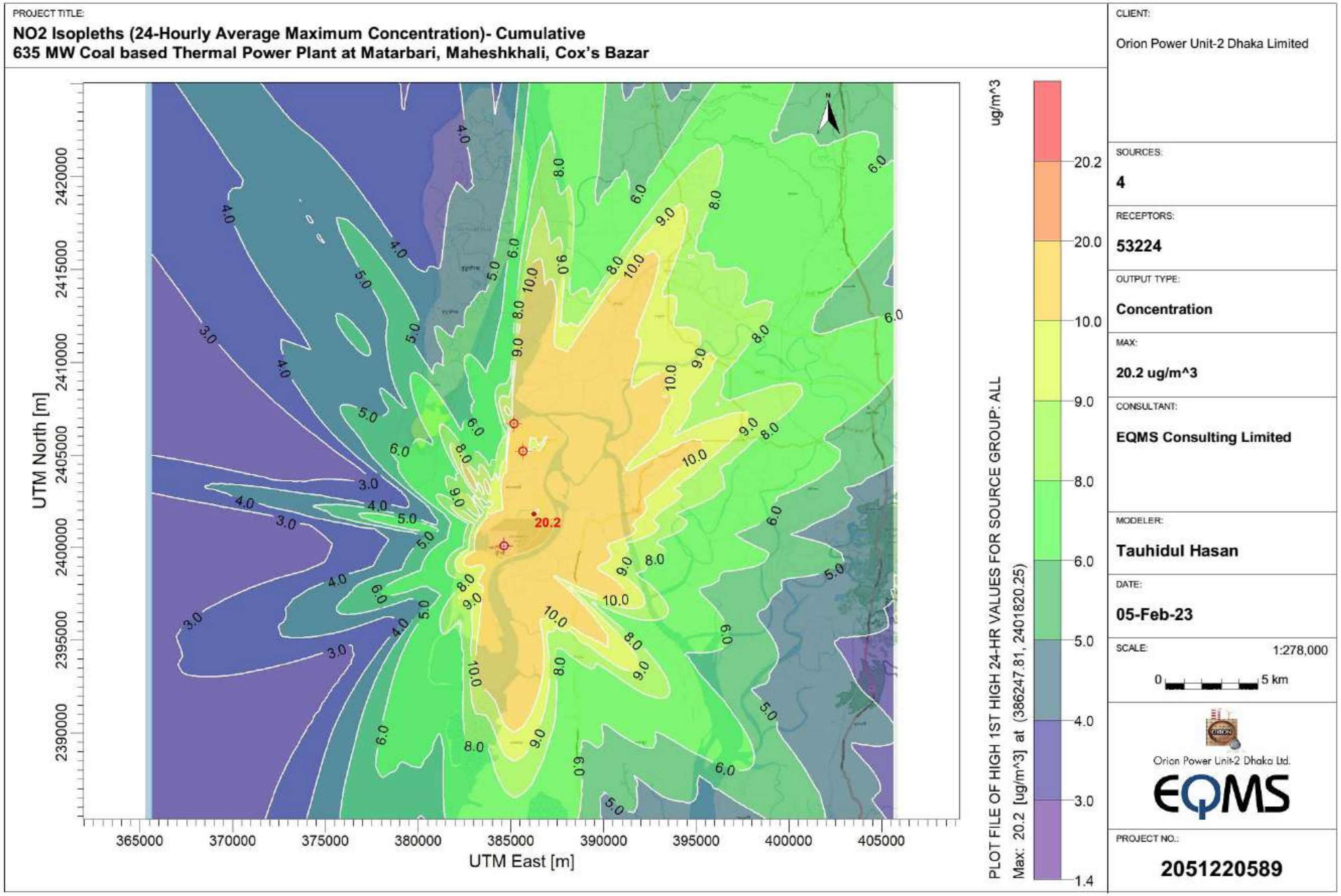
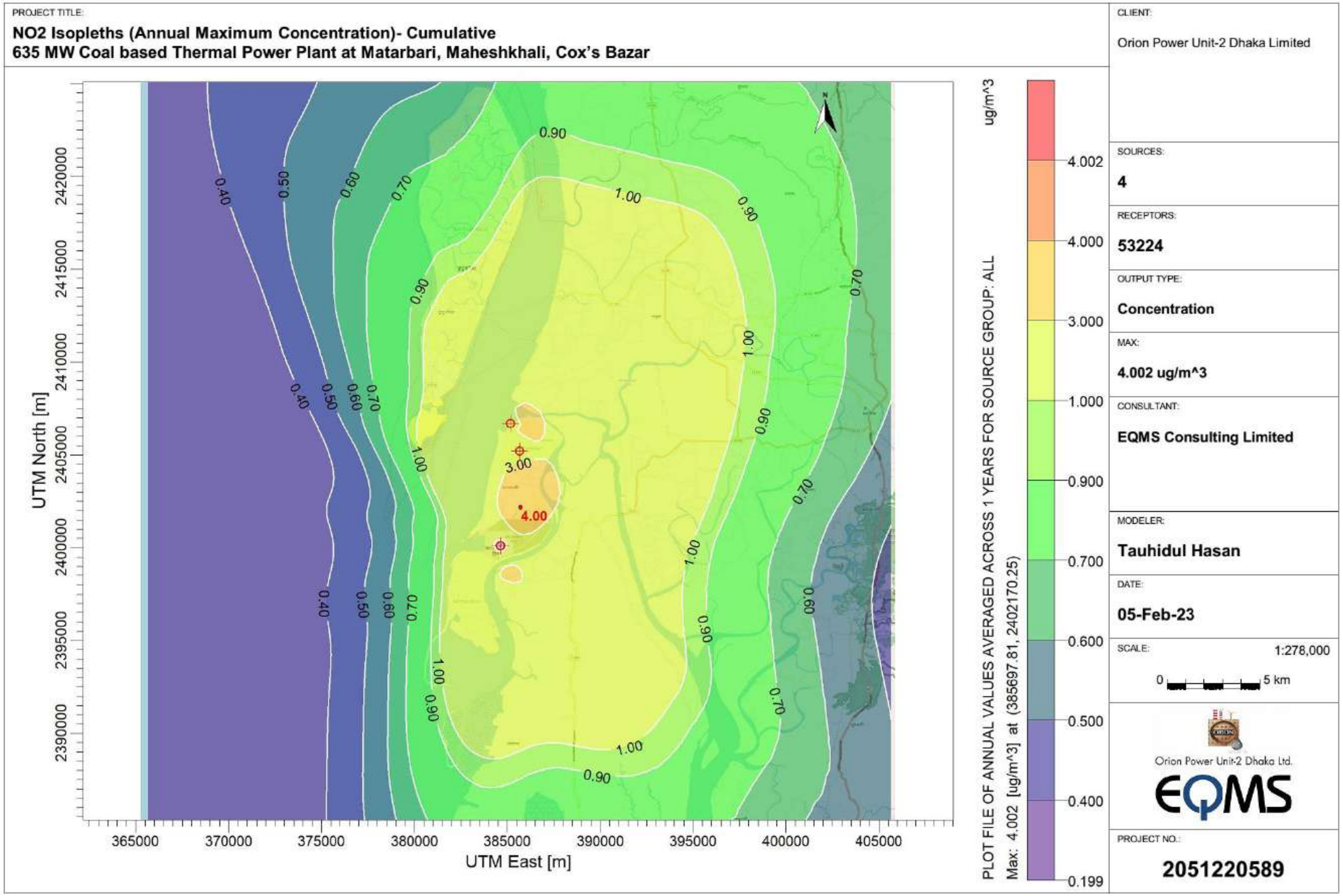


Figure 5-17: NO_2 Isopleths- Annual Maximum GLC considering 3 Power Plants Operation in Matarbari



Cumulative Contribution on Sensitive Receptors

Three power plant operation will contribute 24-hourly maximum NO_2 concentration on ambient air monitoring locations in between 9.9 µg/m^3 (12.4% of APCR) -12.6 µg/m^3 (15.7% of APCR). Annual maximum NO_2 concentration varies 1.9 µg/m^3 (4.4% of APCR) -3.0 µg/m^3 (7.7% of APCR). In cumulative case (maximum baseline concentration+ 3 power plants operation) it has been found that 24-hourly NO_2 concentration on the receptors varied in between 24.7 µg/m^3 (AAQ1) – 30.2 µg/m^3 (AAQ2) whereas annually it varies 5.5 µg/m^3 (AAQ1 & AAQ5) – 6.5 µg/m^3 (AAQ2). Among the 5 receptors, the maximum annual GLC of 6.4 ug/m^3 (16.3 % of APCR) found at AAQ2 (west Ujantia Govt. primary school) and maximum 24-hr GLC of 30.2 ug/m^3 (37.7% of APCR) was found at AAQ2 (**Table 5-26**).

On the other hand, 24-hourly and annual cumulative (3 power plants operation) NO_2 concentration varied 3.59 µg/m^3 -15.80 µg/m^3 and 0.49 µg/m^3 -3.73 µg/m^3 on the 338 sensitive receptors within the 20 km modelled area. The highest 24-hourly NO_2 concentration (15.80 µg/m^3) was found on SR224 (Srijoni Kindergarten and Junior High School, Matarbari) at 2.68 km south direction from project boundary whereas annual highest concentration was found on SR219 (Matarbari Health & Welfare Centre) at 1.3 km south direction from the project boundary. NO_2 concentration on sensitive receptors due to the operation of proposed power plant and other power plants is presented in **Appendix H-1**.

Table 5-26: Cumulative Concentration of NO_2 at Air Quality Monitoring Locations

Scenario	Avg. Time	Concentration (µg/m^3)					APCR, 2022[a] (µg/m^3)
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	
Baseline Air Quality (Maximum)	24-hr.	14.5	17.6	18.7	16.7	18.7	80
	Annual	2.9	3.5	3.7	3.3	3.7	40
Only Project run on coal	24-hr.	4.9	6.8	4.2	4.2	3.5	80
	Annual	0.4	1.3	0.7	0.8	0.4	40
Project run on coal + LNG based power plant run on NG + Matarbari power plant run on coal	24-hr.	10.20	12.6	9.9	11.8	11.3	80
	Annual	2.64	3.0	1.9	3.1	1.8	40
Only project + maximum baseline concentration	24-hr.	19.4	24.4	22.9	20.9	22.2	80
	Annual	3.3	4.8	4.4	4.1	4.2	40
Cumulative (Maximum Baseline concentration + 3 power plants operation)	24-hr.	24.7	30.2	28.6	28.5	30.0	80
	Annual	5.5	6.5	5.6	6.4	5.5	40

5.4.3.4.2 Sulfur Dioxide (SO_2)

Cumulative Case (Project Contribution + Background Concentration + Other Power Plant)

During cumulative analysis, highest baseline concentration, proposed 635 MW coal-based power plant operation and under construction Matarbari 600X2 MW coal-based power plant operation have been taken consideration. The proposed LNG based power plant has not been taken consideration since natural gas no sulfur content. **Table 5-27** shows that two coal based power plants operation will contribute 1-hourly maximum SO_2 GLC of 412 µg/m^3 (164.8% of national standard) to the airshed (384747.81m E 2400220.25 m N) at 5.0 km south direction from the proposed 635 MW coal-based power plant stack location and 150m north-east direction from Matarbari coal-based power plant stack location. The 24-hr maximum SO_2 will contribute 35.8 µg/m^3 (44.8% of national standard) to the airshed (386247.81 m E 2401820.25 m N) at 3.4 km south-east direction from the proposed 635 MW coal-based power plant stack location and 2.3 km north-east direction from Matarbari coal-based power plant stack location. Cumulative scenario (maximum baseline concentration and two power plant operations) shows that maximum 1-hourly GLC of SO_2 will be 445.7 µg/m^3 (178.3% of national standard). On the other hand, 24-hourly maximum SO_2 GLC will be 49.3 µg/m^3 (61.6% of national standard). It is found that the cumulative impact due to the two power plants operation exceed the 1-hourly national ambient air quality standard whereas 24-hourly maximum concentration is well within the standard. Short term impacts on health tend to be less severe than long term impacts (e.g. eye irritation versus increased mortality) and the maximum short-term concentration from the project whilst significant is unlikely to coincide with the maximum short-term contributions from other facilities. However, health impact assessment needs to be carried out before works commence to provide a baseline for monitoring health impacts and confirm no significant impact on human health. SO_2 Isopleths of 1-hourly and 24-hourly during cumulative scenario (two power plants operation) are shown in **Figure 5-18** and **Figure 5-19**.

Table 5-27: Results of Air Quality Modeling for SO_2 due to 2 Coal based Power Plants Operation

Scenario	Max. Concentration (µg/m^3)		Max. Concentration Location	APCR, 2022[a] (µg/m^3)	% of APCR 2022 standard
	Avg. Time	Max. Value			
Project run on coal + Matarbari power plant run on coal	1-hr.	412	384747.81 2400220.25	250	164.8
	24-hr.	35.8	386247.81 2401820.25	80	44.8
Baseline Concentration (µg/m^3)-Worst Scenario	1-hr.	33.7	386782.00 2407232.00	250	13.5
	24-hr.	13.5	386782.00 2407232.00	80	16.9
Cumulative (Project run on coal + Matarbari power plant run on coal+ Background Concentration)	1-hr.	445.7	-	250	178.3
	24-hr.	49.3	-	80	61.6

[a] Schedule-1 (Ambient Air Quality Standards), Air Pollution Control Rules 2022

Figure 5-18: SO_2 Isopleths- 1 Hourly Average Maximum GLC considering 2 Power Plants Operation in Matarbari

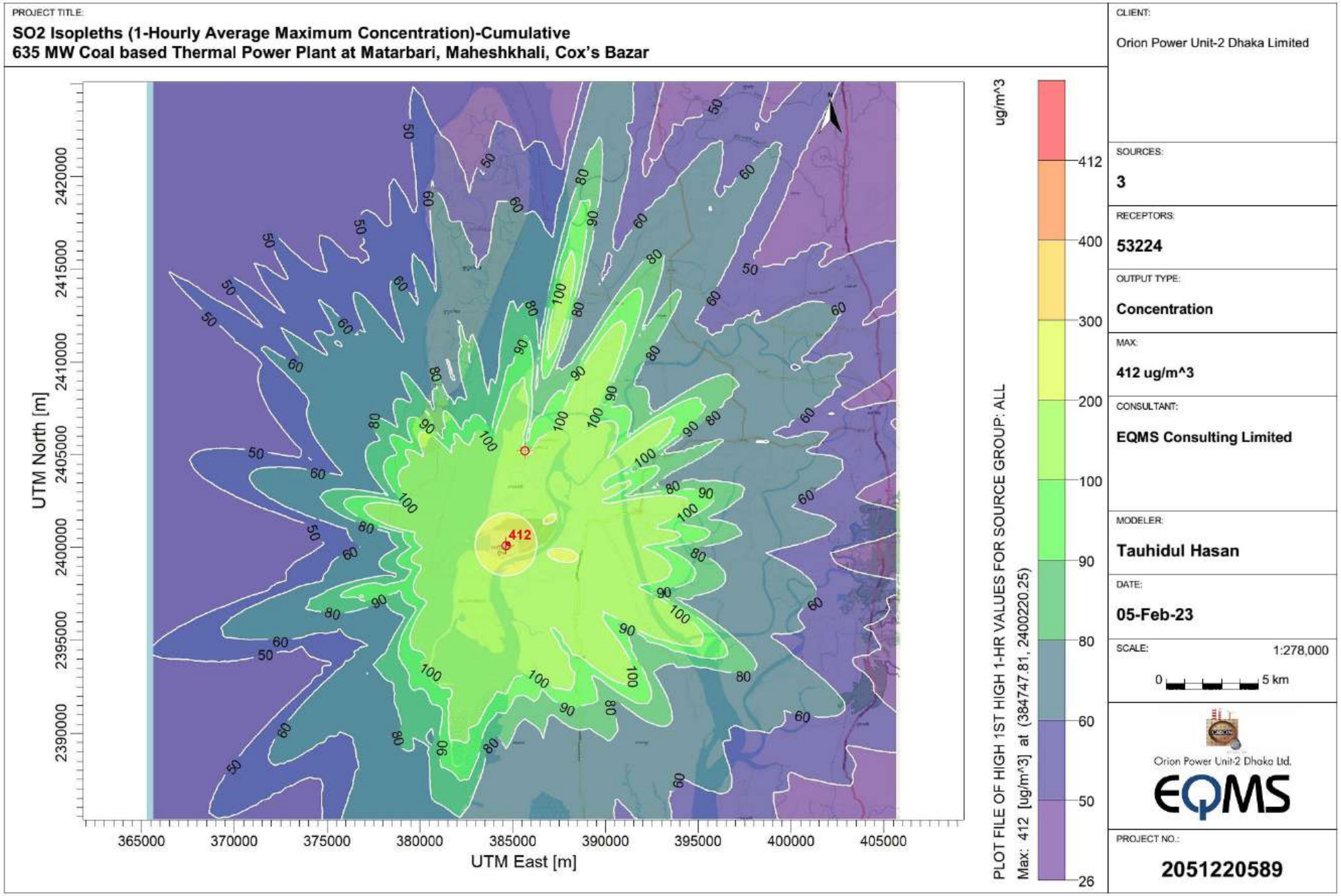
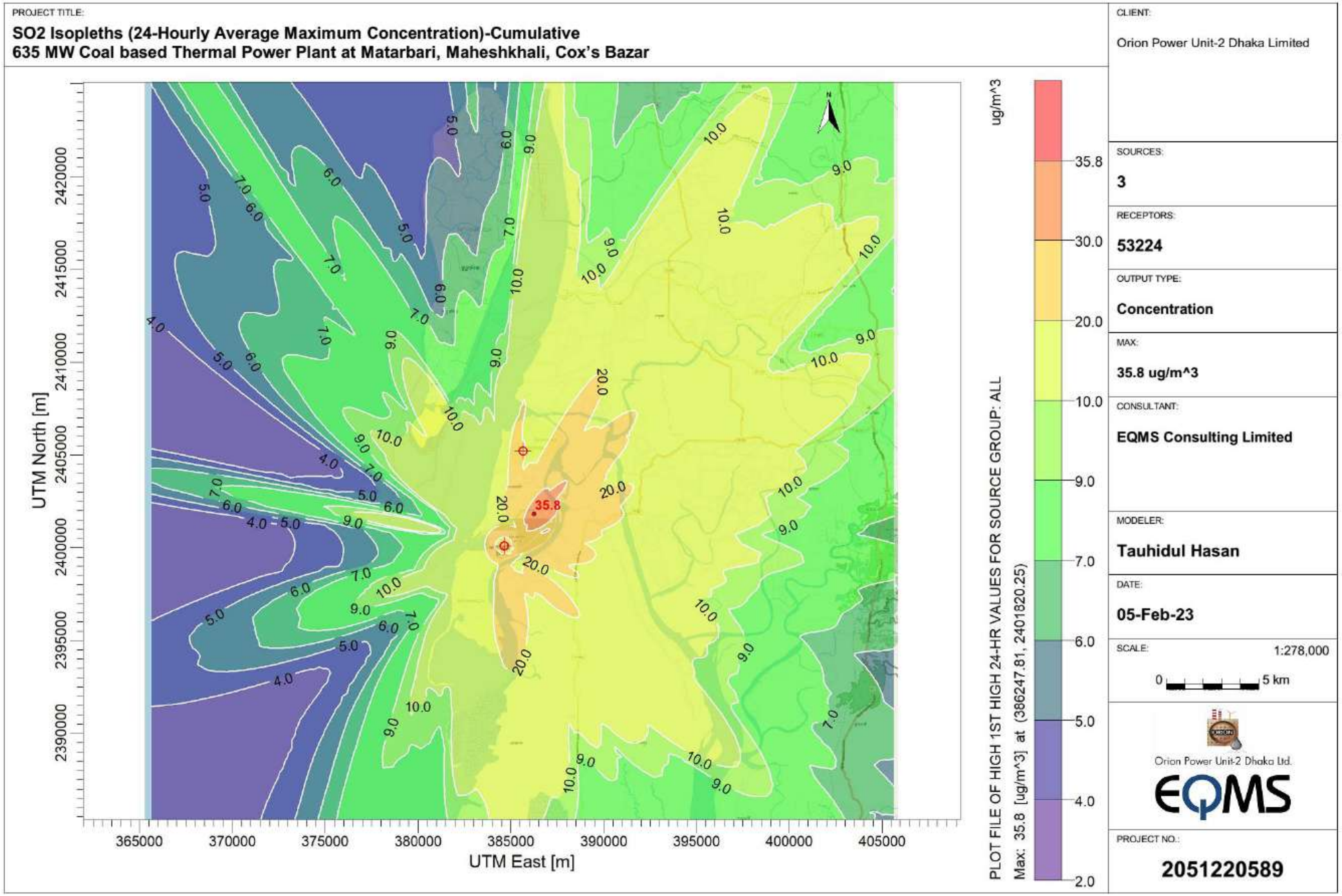


Figure 5-19: SO_2 Isopleths- 24 Hourly Average Maximum GLC considering 2 Power Plants Operation in Matarbari



Cumulative Contribution on Sensitive Receptors

Table 5-28 shows that two power plant operation will contribute 1-hourly and 24-hourly SO_2 in the range of 73.6 µg/m³ (AAQ3) – 122.6 µg/m³ (AAQ4) and 012.9 µg/m³ (AAQ3) – 20.9 µg/m³ (AAQ4) on the 5 air quality monitoring locations. In cumulative case (maximum baseline concentration+ 2 power plants operation) it has been found that 1-hourly SO_2 concentration on the receptors varied in between 105.6 µg/m³ (AAQ3) – 144.1 µg/m³ (AAQ5) whereas 24-hourly it varied 25.7 µg/m³ (AAQ3) – 32.3 µg/m³ (AAQ5). Among the 5 receptors, the maximum 1-hourly GLC of 105.6 ug/m³ (58.9 % of APCR) found at AAQ5 (Joynal Abedin House, Notun Ghuna Para, Badarkhali) and maximum 24-hr GLC of 32.3 ug/m³ (40.4% of APCR) was also found at AAQ5 (**Table 5-28**).

On the other hand, 1-hourly and 24-hourly cumulative (2 power plants operation) SO_2 concentration varied 35.1 µg/m³ -268.8 µg/m³ and 4.5 µg/m³ – 28.0 µg/m³ on the 338 sensitive receptors within the 20 km modelled area. The highest 1-hourly SO_2 concentration (268.8 µg/m³) was found on SR251 (Matarbari Coal Power Plant) at 4.75 km south direction from the proposed 635 MW coal-based power plant project boundary whereas 24-hourly highest concentration (28.0 µg/m³) was found on SR224 (Rajghat Government Primary School) at 1.8 km south direction from the project boundary. SO_2 concentration on sensitive receptors due to the operation of proposed power plant and other power plants is presented in **Appendix H-2**.

Table 5-28: Cumulative Concentration of SO_2 at Air Quality Monitoring Locations

Scenario	Avg. Time	Concentration (µg/m³)					APCR, 2022[a] (µg/m³)
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	
Baseline Air Quality (Maximum)	24-hr.	28.0	33.8	32.0	24.5	31.0	250
	Annual	11.2	13.5	12.8	9.8	12.4	80
Project run on coal + Matarbari power plant run on coal	24-hr.	106.1	93.3	73.6	122.6	113.1	250
	Annual	18.2	17.0	12.9	20.9	19.9	80
Cumulative (Maximum Baseline concentration + 2 power plants operation)	24-hr.	134.1	127.0	105.6	147.1	144.1	250
	Annual	29.4	30.5	25.7	30.7	32.3	80

5.4.3.4.3 Carbon Monoxide (CO)

Cumulative Case (Project Contribution + Background Concentration + Other Power Plant)

No CO related data has been found in the EIA report of proposed LNG based power plant and Matarbari 600X2 MW coal-based power plant. So, cumulative assessment has not been carried out for CO.

5.4.3.4.4 Particulate Matter (PM_{10})

Cumulative Case (Project Contribution + Background Concentration + Other Power Plant)

During the cumulative scenario analysis, highest background concentration, proposed 635 MW coal-based power plant, one LNG based power plant and under construction Matarbari 600X2 MW coal-based power plant have been taken into consideration. The proposed LNG based power plant will contribute less PM_{10} on the airshed since it will run on natural gas. **Table 5-29** shows that three power plants operation will contribute 24-hourly maximum PM_{10} concentration 2.2 µg/m^3 (1.5% of national standard) to the airshed (386247.81 m E 2401820.25 m N) at 3.4 km south-east direction from the proposed 635 MW coal-based power plant stack location and 2.3 km north-east direction from Matarbari coal-based power plant stack location. Annually PM_{10} maximum GLC of 0.4 µg/m^3 (0.9% of national standard) to the airshed (385697.81 m E 2402170.25 m N) at 3.5 km south direction from the proposed 635 MW coal-based power plant stack location and 2.3 km north-east direction from Matarbari coal-based power plant stack location. There is no human settlement at maximum ground level concentration location, and it is found to be salt pan area. Cumulative scenario (baseline and three power plant operations) shows that it will contribute 24-hourly PM_{10} maximum GLC of 46.7 µg/m^3 (31.1% of national standard). On the other hand, annual maximum GLC of 9.3 µg/m^3 (18.7% of national standard) of PM_{10} to the airshed (**Table 5-29**). PM_{10} Isopleths of 24-hourly and annual during cumulative scenario (three power plants operation) are shown in **Figure 5-20** and **Figure 5-21**. It is found that the cumulative impact due to the three power plants operation will meet the national ambient air quality standard.

Table 5-29: Results of Air Quality Modeling for PM_{10} due to 3 Power Plants Operation

<table>
<tr><th rowspan="2">Scenario</th><th colspan="2">Max. Concentration (µg/m³)</th><th rowspan="2">Max. Concentration Location</th><th rowspan="2">APCR, 2022[a] (µg/m³)</th><th rowspan="2">% of APCR 2022 standard</th></tr>
<tr><th>Avg. Time</th><th>Max. Value</th></tr>
<tr><td rowspan="2">Project run on coal + LNG based power plant run on NG + Matarbari power plant run on coal</td><td>24-hr.</td><td>2.2</td><td>386247.81 2401820.25</td><td>150</td><td>1.5</td></tr>
<tr><td>Annual</td><td>0.4</td><td>385697.81 2402220.25</td><td>50</td><td>0.9</td></tr>
<tr><td rowspan="2">Baseline Concentration (µg/m³)-Worst Scenario</td><td>24-hr.</td><td>44.5</td><td>391135.00 2405295.00</td><td>150</td><td>29.7</td></tr>
<tr><td>Annual</td><td>8.9</td><td>391135.00 2405295.00</td><td>50</td><td>17.8</td></tr>
<tr><td rowspan="2">Cumulative (Project run on coal + LNG based power plant run on NG + Matarbari power plant run on coal+ Background Concentration)</td><td>24-hr.</td><td>46.7</td><td>-</td><td>150</td><td>31.1</td></tr>
<tr><td>Annual</td><td>9.3</td><td>-</td><td>50</td><td>18.7</td></tr>
</table>

[a] Schedule-1 (Ambient Air Quality Standards), Air Pollution Control Rules 2022

Figure 5-20: PM_{10} Isopleths- 24 Hourly Average Maximum GLC considering 3 Power Plants Operation in Matarbari

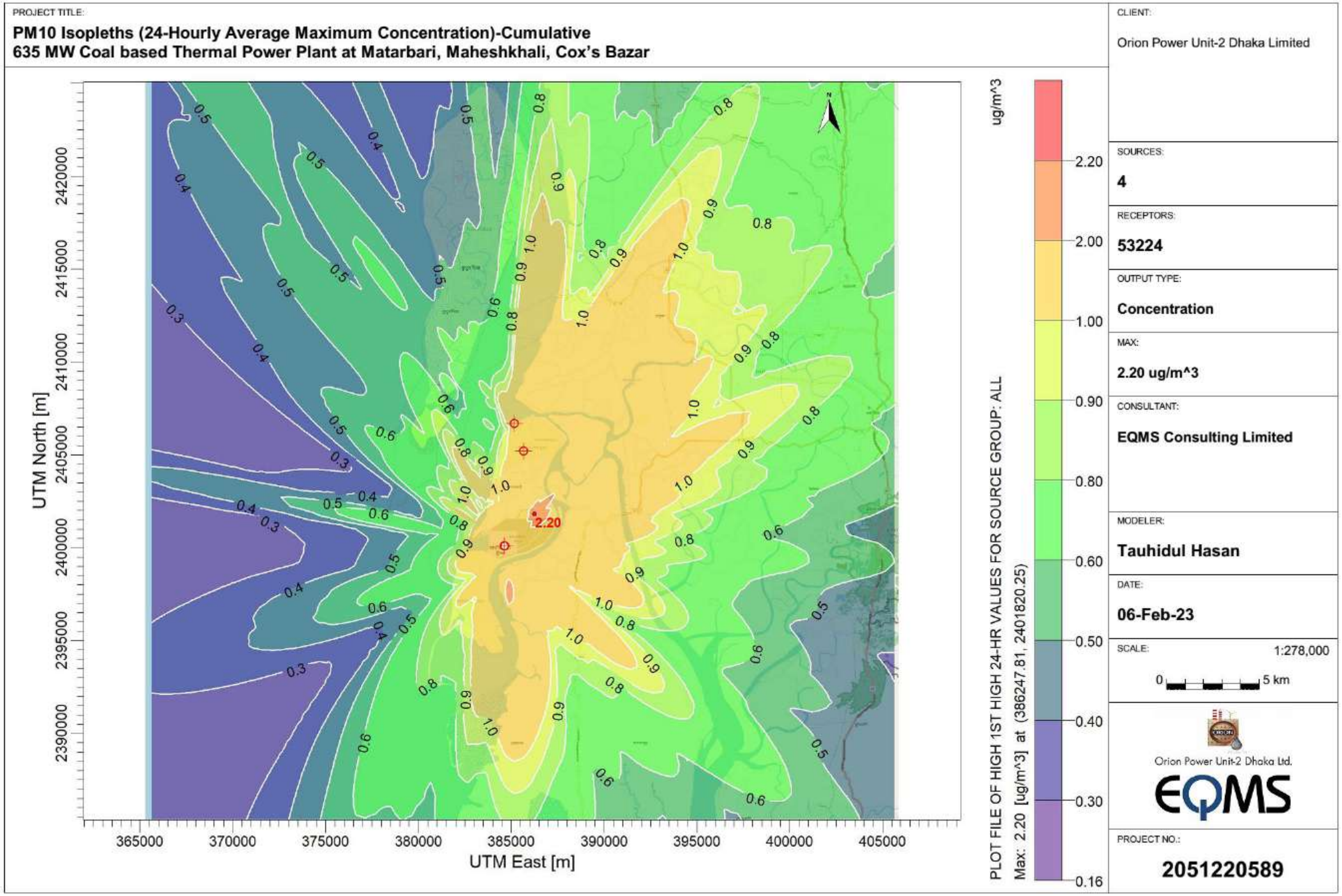
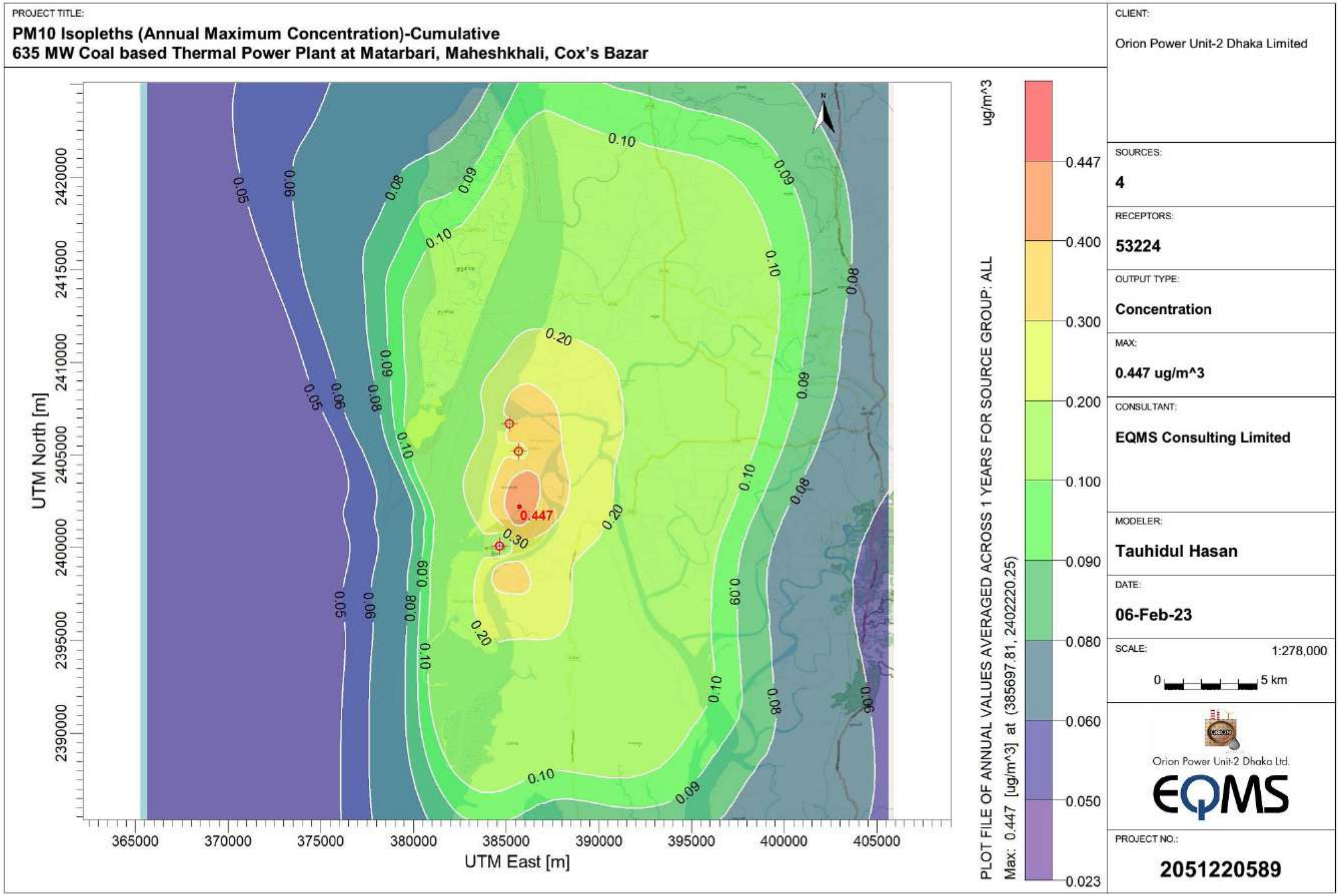


Figure 5-21: PM_{10} Isopleths- Annual Maximum GLC considering 3 Power Plants Operation in Matarbari



Cumulative Contribution on Sensitive Receptors

Three power plant operation will contribute 24-hourly maximum PM_{10} concentration on ambient air monitoring locations in between 1.1 µg/m^3 (0.7% of APCR) -1.4 µg/m^3 (0.9% of APCR). In cumulative case (maximum baseline concentration+ 3 power plants operation), it has been found that 24-hourly PM_{10} concentration on the air quality monitoring location varies in between 35.8 µg/m^3 (AAQ1) – 45.7 µg/m^3 (AAQ5) whereas annually it varies 7.3 µg/m^3 (AAQ1) – 9.1 µg/m^3 (AAQ5). Among the 5 receptors, the maximum 24-hr GLC of 45.7 ug/m^3 (30.5% of APCR) was found at AAQ5 (Joynal Abedin House, Notun Ghuna Para, Badarkhali) and the maximum annual GLC of 9.1 ug/m^3 (18.2 % of APCR) found at AAQ5 (**Table 5-30**). It shows that the baseline concentration is quite higher than the three-power plant contribution. Hence, the operation of power plant will contribute less compare the standard.

On the other hand, 24-hourly and annual cumulative (3 power plants operation) PM_{10} concentration varies 0.41 µg/m^3 – 1.72 µg/m^3 and 0.06 µg/m^3 - 0.42 µg/m^3 on the 338 sensitive receptors within the 20 km modelled area. The highest 24-hourly PM_{10} concentration (1.72 µg/m^3) was found on SR224 (Srijoni Kindergarten and Junior High School, Matarbari) at 2.68 km south direction from project boundary whereas annual highest concentration 0.42 µg/m^3 was found on SR219 (Matarbari Health & Welfare Centre) at 1.3 km south direction from the project boundary. Hence, the cumulative PM_{10} contribution on the sensitive receptors can be considered as very negligible compared to the standard. PM_{10} concentration on sensitive receptors due to the operation of proposed power plant and other power plants is presented in **Appendix H-4**.

Table 5-30: Predicted Concentration of PM_{10} at Air Quality Monitoring Locations

Scenario	Avg. Time	Concentration (µg/m^3)					APCR, 2022[a] (µg/m^3)
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	
Baseline Air Quality (Maximum)	24-hr.	34.7	42.3	39.7	40.5	44.5	150
	Annual	6.9	8.5	7.9	8.1	8.9	50
Project run on coal + LNG based power plant run on NG + Matarbari power plant run on coal	24-hr.	1.1	1.4	1.1	1.3	1.2	150
	Annual	0.3	0.4	0.2	0.4	0.2	50
Cumulative (Maximum Baseline concentration + 3 power plants operation)	24-hr.	35.8	43.7	40.8	41.8	45.7	150
	Annual	7.3	8.8	8.2	8.5	9.1	50

5.4.3.4.5 Particulate Matter ($PM_{2.5}$)

Cumulative Case (Project Contribution + Background Concentration + Other Power Plant)

During the cumulative scenario analysis, highest background concentration, proposed 635 MW coal-based power plant, one LNG based power plant and under construction Matarbari 600X2 MW coal-based power plant have been taken into consideration. **Table 5-31** shows that three power plants operation will contribute 24-hourly maximum $PM_{2.5}$ concentration as 2.2 µg/m^3 (1.5% of national standard) to the airshed (386247.81 m E 2401820.25 m N) at 3.4 km south-east direction from the proposed 635 MW coal-based power plant stack location and 2.3 km north-east direction from Matarbari coal-based power plant stack location. Annually NO_2 maximum GLC of 0.4 µg/m^3 (0.9% of national standard) to the airshed (385697.81 m E 2402170.25 m N) at 3.5 km south direction from the proposed 635 MW coal-based power plant stack location and 2.3 km north-east direction from Matarbari coal-based power plant stack location. There is no human settlement at maximum ground level concentration location, and it is found as salt pan area. Cumulative scenario (baseline and three power plant operations) shows that it will contribute 24-hourly $PM_{2.5}$ maximum GLC of 35.0 µg/m^3 (53.8% of national standard). On the other hand, annual maximum GLC of $PM_{2.5}$ found as 7.0 µg/m^3 (20.1% of national standard) (**Table 5-31**). $PM_{2.5}$ Isopleths of 24-hourly and annual during cumulative scenario (three power plants operation) are shown in **Figure 5-22** and **Figure 5-23**. It is found that the cumulative impact of $PM_{2.5}$ due to the three power plants operation will meet the national ambient air quality standard.

Table 5-31: Results of Air Quality Modeling for $PM_{2.5}$

Scenario	Max. Concentration (µg/m^3)		Max. Concentration Location	APCR, 2022[a] (µg/m^3)	% of APCR 2022 standard
	Avg. Time	Max. Value			
Project run on coal + LNG based power plant run on NG + Matarbari power plant run on coal	24-hr.	2.2	386247.81 2401820.25	65	3.4
	Annual	0.4	385697.81 2402220.25	35	1.3
Baseline Concentration (µg/m^3)-Worst Scenario	24-hr.	32.8	391135.00 2405295.00	65	50.5
	Annual	6.6	391135.00 2405295.00	35	18.9
Cumulative (Project run on coal + LNG based power plant run on NG + Matarbari power plant run on coal+ Background Concentration)	24-hr.	35.0	-	65	53.8
	Annual	7.0	-	35	20.1

[a] Schedule-1 (Ambient Air Quality Standards), Air Pollution Control Rules 2022

Figure 5-22: $PM_{2.5}$ Isopleths- 24 Hourly Average Maximum GLC considering 3 Power Plants Operation in Matarbari

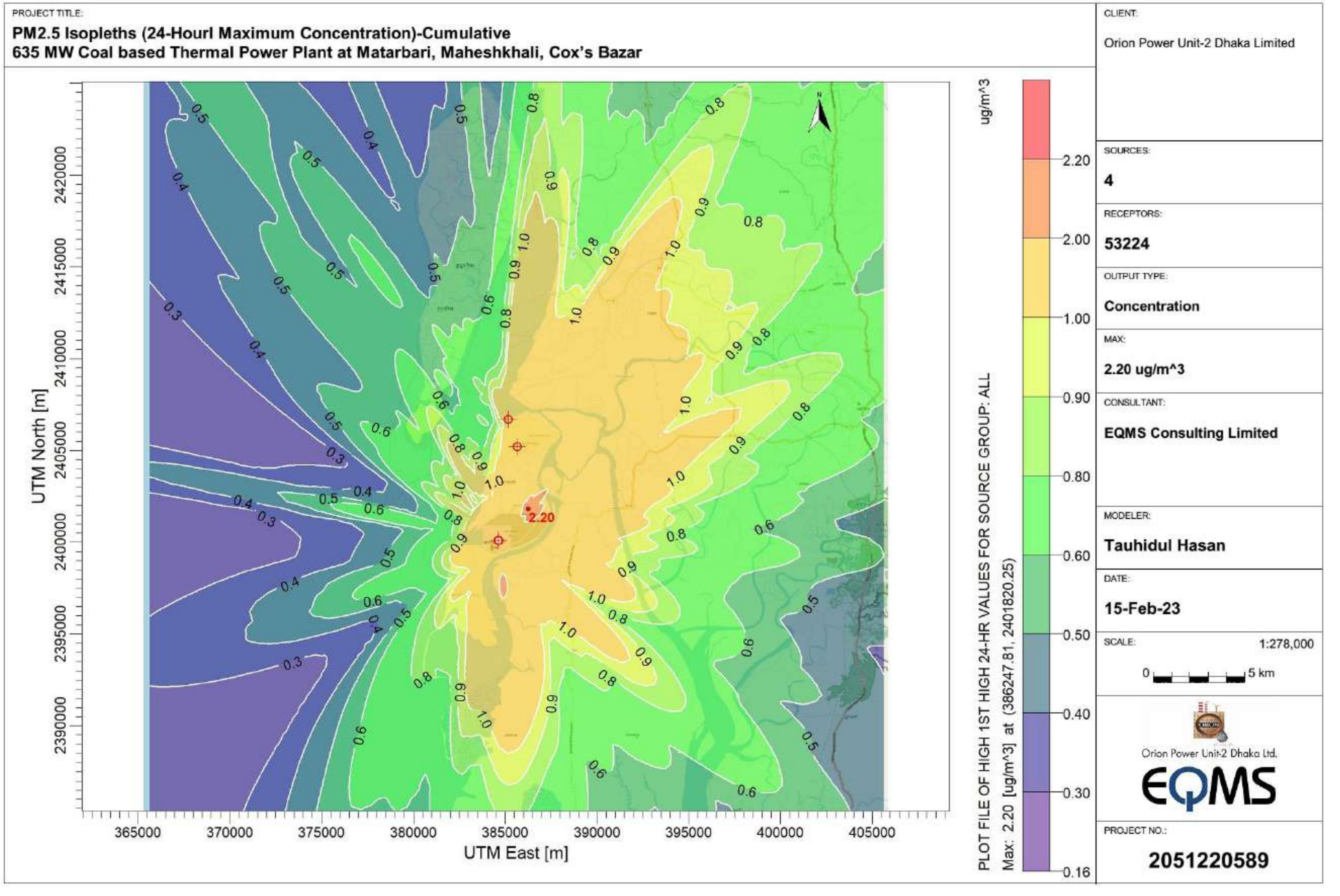
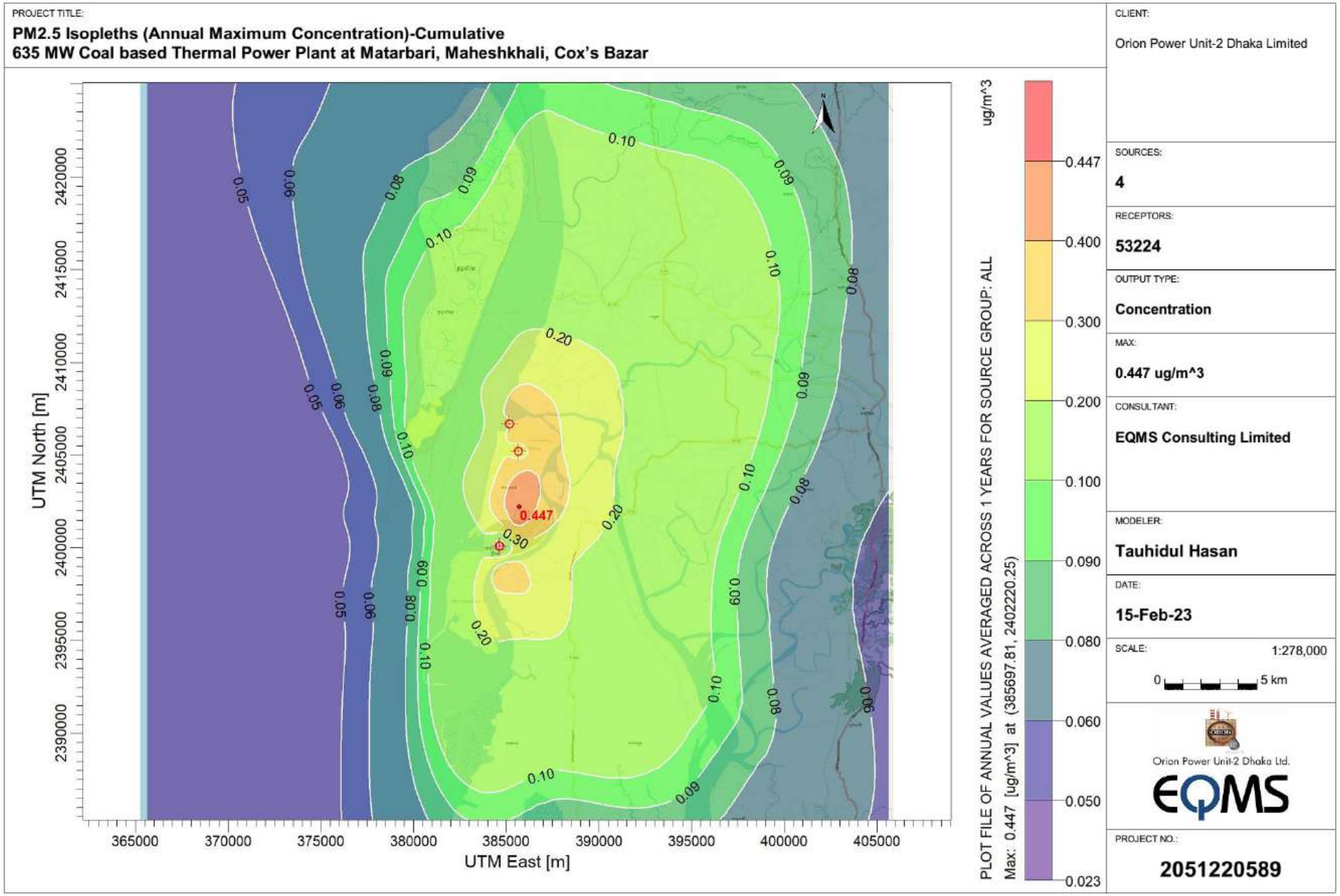


Figure 5-23: $PM_{2.5}$ Isopleths- Annual Maximum GLC considering 3 Power Plants Operation at Matarbari



Cumulative Contribution on Sensitive Receptors

Three power plant operation will contribute 24-hourly maximum $PM_{2.5}$ concentration on ambient air monitoring locations in between 1.1 µg/m³ (1.7% of APCR) -1.4 µg/m³ (1.9% of APCR). In cumulative case (maximum baseline concentration+ 3 power plants operation), it has been found that 24-hourly $PM_{2.5}$ concentration on the air quality monitoring location varies in between 26.7 µg/m³ (AAQ1) – 34.0 µg/m³ (AAQ5) whereas annually it varies 5.4 µg/m³ (AAQ1) – 6.8 µg/m³ (AAQ5). Among the 5 receptors, the maximum 24-hr $PM_{2.5}$ GLC of 34.0 ug/m³ (52.4% of APCR) was found at AAQ5 (Joynal Abedin House, Notun Ghuna Para, Badarkhali) and the maximum annual GLC of 6.8 ug/m³ (19.3 % of APCR) found at AAQ5 (**Table 5-32**). It shows that the baseline $PM_{2.5}$ concentration is higher than the three-power plant contribution. Hence, the operation of power plants will contribute less compared to the standard.

On the other hand, 24-hourly and annual cumulative (3 power plants operation) $PM_{2.5}$ concentration varies 0.41 µg/m³ – 1.72 µg/m³ and 0.06 µg/m³ - 0.42 µg/m³ on the 338 sensitive receptors within the 20 km modelled area. The highest 24-hourly PM_{10} concentration (1.72 µg/m³) was found on SR224 (Srijoni Kindergarten and Junior High School, Matarbari) at 2.68 km south direction from project boundary whereas annual highest concentration 0.42 µg/m³ was found on SR219 (Matarbari Health & Welfare Centre) at 1.3 km south direction from the project boundary. Hence, the cumulative $PM_{2.5}$ contribution on the sensitive receptors can be considered as very negligible compared to the standard. PM_{10} and $PM_{2.5}$ concentration on sensitive receptors due to the operation of proposed power plant and other power plants are considered same (**Appendix H-4**).

Table 5-32: Predicted Concentration of PM_{10} at Air Quality Monitoring Locations

Scenario	Avg. Time	Concentration (µg/m³)					APCR, 2022[a] (µg/m³)
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	
Baseline Air Quality (Maximum)	24-hr.	25.6	31.5	29.3	29.8	32.8	65
	Annual	5.1	6.3	5.9	6.0	6.6	35
Project run on coal + LNG based power plant run on NG + Matarbari power plant run on coal	24-hr.	1.1	1.4	1.1	1.3	1.2	65
	Annual	0.3	0.4	0.2	0.4	0.2	35
Cumulative (Maximum Baseline concentration + 3 power plants operation)	24-hr.	26.7	32.9	30.4	31.1	34.0	65
	Annual	5.4	6.7	6.1	6.3	6.8	35

The analysis of isopleths and 24-hour average concentrations indicate that the air quality in the region will meet the national ambient air quality standards for gaseous and particulate emissions. However, the incremental emission level of SO_2 exceeds the 1-hourly national standard. Incremental No2, CO, PM_{10} and $PM_{2.5}$ concentration are less than the baseline concentration. 1-hourly and 24-hurly incremental SO_2 concentrations are greater than the ambient concentration. On this basis, the potential air quality cumulative impacts due to the operation of the three proposed thermal power plants are predicted to be **High**.

Impact	*Air Quality Degradation due to operation of three power plants (cumulative)*		
Impact Nature	Direct	Indirect	Induced
Impact Scale	Surrounding area		
Frequency	Throughout the project lifecycle		

Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***High***				

5.4.4 Green House Gas Emission

The Kyoto Protocol – United Nations Framework Convention on Climate Change nominates the following GHGs:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs); and
- Perfluorocarbons (PFCs).

Inventories of GHG emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion. Typically, greenhouse gas emissions are reported in units of carbon dioxide equivalent (CO_2e). Gases are converted to CO_2e by multiplying by the gas global warming potential (GWP). The GWP of gases are as follows[32].

- GWP for CO_2 = 1
- GWP for CH_4 = 21
- GWP for N_2O = 310

When the global warming potentials are applied to the estimated emissions then the resulting estimate is referred to in terms of CO_2-equivalent (CO_2e) emissions.

GHG Estimation and Impact

The combustion of natural gas produces GHGs. The amount of GHGs emitted by a power plant is a measure of its contribution to global warming and can be estimated based on fuel consumption. In order to estimate GHG emissions, the IFC recommended Carbon Emission Estimation Tool (CEET model – Version February 2014)[33] has been used as set out below **Table 5-33**.

Table 5-33: Estimated GHG Emissions from the Plant

Sl.	Particulates	Unit	Value
A	Heat Rate (Coal)	kJ/kWh	8,637
B	Generation Capacity	kW	635,000
C	Plant load factor	%	80
D	Available generation capacity	kW	508,000
E	Operating Days	days	365

[32]Source: Intergovernmental Panel on Climate Change (IPCC) (1995), Second Assessment Report

[33]IFC Carbon Emissions Estimator Tool (CEET)

Sl.	Particulates	Unit	Value
F	Daily Operating Hours	hours	24
G	Total Annual Output (= D x E x F)	kWh	4450080000
H	Annual Fuel Consumption (= G x A)	kJ	$3.8X10^{13}$
		TJ	38,435.34
I	Annual Coal Requirement	T	1,475,444.95
J	Annual GHG Emission in Gas Turbine	tCO_2e/year	2,693,388

Source: OPDL-2 and Calculation done by IFC CEET tool

It is evident from **Table 5-33** that the estimated GHG emissions from the Plant while using coal as primary fuel will exceed the threshold of ADB SPS (100,000 tons CO_2e per year) and of IFC PS3 (25,000 tons CO_2e per year) that define them as significant GHG emission sources. Therefore, the Project is required to report annual GHG emissions.

As per the updated report (26 August 2021) of National Determined Contributions (NDCs) 2021 submitted by Bangladesh to the United Nations Framework Convention on Climate Change (UNFCCC)[34], electricity generation sector contribution to GHG emission in year 2012 was 2.098×10^7 tons CO_2e and projection of aggregate GHG emissions as business as usual scenario that the annual GHG emissions from this sector in year 2030 will be 9.514×10^7 tons CO_2e. Taking this into consideration, GHG emission contribution of the proposed Project in the year 2030 will be 2.83% of the electricity generation sector in Bangladesh. Considering this fact, the impact on GHG emissions will be **Medium Low**.

Impact	*GHG emission due to operation of the power plant*					
Impact Nature	Direct	Indirect		Induced		
Impact Scale	Regional					
Frequency	Throughout the project lifecycle					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-low***				

5.4.5 Impact on Ambient Noise Level

The assessment of the impacts of noise on the surrounding community depends upon:

- Characteristics of the noise source (instantaneous, intermittent, or continuous in nature, with the latter contributing the least to noise pollution);
- Time of day at which noise occurs; and
- Location of noise source with respect to noise sensitive receptor

For the purposes of predicting noise emissions impacts from the site, the noise emission sources were examined. During the normal operation phase, there are two types of noise generation sources:

[34] https://unfccc.int/sites/default/files/NDC/2022-06/NDC_submission_20210826revised.pdf

- Stationary sources: Steam Turbine Generators, Boiler feed pumps, other rotating equipment like, major and large pumps, air compressor, D.G. sets, ventilation fans, exhaust from steam line safety valves etc.
- Mobile sources vehicular traffic for staff mobilization, conveyer belt operation, material transport, liquid fuel transport to project site etc.

The typical noise emission limits are as follows:

- 85 dB(A) at 1 m from the turbine
- 60 dB(A) at 120 m from the turbine

The major stationary noise generating sources for the proposed power plant is provided in the **Table 5-34** below along with the respective noise generation levels. However, enclosures of steam turbine generator shall be designed for noise attenuation to reduce the noise level to 85 dB(A) at 1-meter distance. The ambient noise level at 120 meters from any part of the plant (far field) shall not exceed 60 dB (A).

Table 5-34: Major Noise Sources during Operation of the Power Plant

Name of Equipment	Noise Level, dB(A)
Turbine and Generator	85
Turbine basement	80
Boiler Feed Pump	85
Compressors	85
Compressor cabin	70
Boiler basement area	82
Coal feeder	80
Coal Mill	85
Primary Air Fan	85
Forced Draft Fan	85
Induced Draft Fan	82
Central Control Room	60
Exhaust Gas	80
Exhaust Steam	85
Coal Crushers	85
Conveyor Belts	80
Transformer	70
Fire Pump	70
Circulation water pump	85

Source: OPDL-2

The model has been run to predict day and nighttime noise level around the power plant during operation. The sound power level data has been estimated based on the sound pressure level data and approximate equipment sizes estimated from data provided by the project engineers or based on approximate dimensions illustrated on project plot plans and facility layout drawings.

Ambient Noise Level

Noise levels were recorded at five (5) locations in the study area during the monitoring period. The details of noise monitoring locations are given in **Table 4-7**. The purpose of ambient noise level measurement was to determine sound intensity at the monitoring locations. These locations are chosen in such a way that a representative data could be recorded all over the block. The sound level is recorded in the form of A-weighted equivalent continuous sound pressure level (Leq) values with the use of A-weighting filters in the noise measuring instrument (CENTER 322 data logger sound level meter). Noise level was measured for 24 hours at every location during day and nighttime.

Model Assumptions: The following assumptions have been made for the modelling assessment, and wherever possible, a conservative approach has been taken:

- Operation of equipment with 100% usage scenario was modeled to cover the operation phase of the power plant project;
- As a conservative approach to the assessment, atmospheric absorption during sound transmission was not included in the assessment;
- In addition, to represent a worst-case scenario for the assessment, all equipment was assumed to be operating simultaneously;
- In order to assess the impact on noise reflection/barrier due to the structures, buildings within the power plant complex and boundary wall have been taken into consideration;
- There is a 2.5 m wall around the entire project site;
- Equipment height has been based upon the plant layout plot plans and knowledge of similar projects;
- Noise sources have been modelled as point, area or line;
- The model does not incorporate features which might provide partial screening (e.g., columns, pipe racks, structural steelwork, and small equipment); and
- The model does not include noise from pipework or valves;

Noise Level Guidelines

Ministry of Environment, Bangladesh has set standard of noise level for different area of use. Noise standard as per Bangladesh Noise Pollution (Control) Rules, 2006 is presented in **Table 5-35**.

Table 5-35: Noise Standard for Bangladesh

Sl.	Category of area/zone	Decibel dB(A) Leq	
		[1]Day Time	Nighttime
1	Silent zone	50	40
2	Residential Area	55	45
3	Mixed zone	60	50
4	Commercial Area	70	60
5	Industrial Area	75	70

* Daytime is defined as the period 6.00 am-9.00 pm and night-time is defined as the period 9.00 pm-6.00 am.

International Finance Corporation (IFC) has also set EHS guidelines for ambient noise level. EHS noise guidelines of IFC are given in the following **Table 5-36**.

Table 5-36: IFC Noise Level Guidelines

Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Prediction of Impacts

Methodology: The environmental noise prediction model Sound PLAN 8.2 was used for modelling noise emissions from the power plant operation.

Noise Contour Map:

In order to predict the likely impact of operations of the thermal power plant on the ambient noise, it is necessary to estimate noise levels associated with equipment and components of the proposed plant, which will provide the basis for assessment of the impact of noise generation.

Noise model (mathematical model) was used for predicting impacts due to operations of the proposed plant on ambient noise. The proposed thermal power plant will have various in-house noises generating sources, such as turbines, generators, boilers, coal handling plant, fans, pumps etc.

Based on the noise propagation from the power plant noise contour map has been prepared using the modeling tool. Day and night time noise contour map for the power plant is shown in **Figure 5-24** and **Figure 5-25** respectively. Predicted noise level in the receptors point during operation of the power plant is shown in **Table 5-37**.

Table 5-37: Predicted Noise Levels at Receptors during Operation of OPDL-2 Power Plant

Receptor	Category of Area/Receptor	Baseline Sound Pressure Levels at Receptors, Leq (dBA)*		Predicted Sound Pressure Levels at Receptors, Leq (dBA)		Total Sound Pressure Level (Baseline + Predicted), Leq (dBA)		Applicable Standard, dB(A)**	
		Leqd	Leqn	Leqd	Leqn	Leqd	Leqn	Leqd	Leqn
NL1	Project site	47.6	38.2	57.2	56.4	57.7	56.5	55	45
NL2	Residential	53.2	39.8	48	47.5	54.3	48.2	55	45
NL3	Residential	52.1	40.6	51.7	51.3	54.9	51.7	55	45
NL4	Mixed	54.6	44.7	46.6	45.7	55.2	48.2	60	50
NL5	Mixed	52.9	42.5	40.7	40.2	53.2	44.5	60	50

* Ambient noise level as monitored during the baseline survey

** Noise Pollution Control Rules, 2006

Figure 5-24: Noise Contour for OPDL-2 Power Plant Operation during Daytime (Leq day)

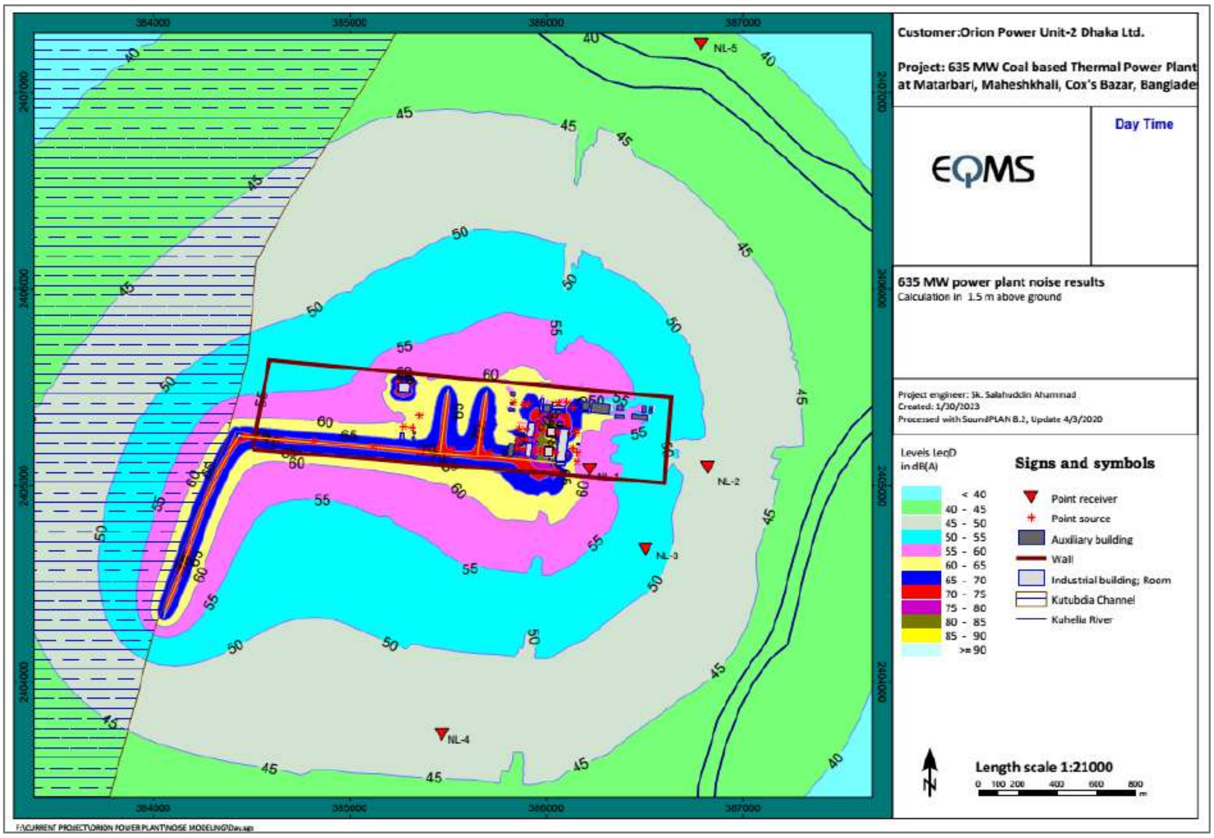


Figure 5-25: Noise Contour for OPDL-2 Power Plant Operation during Nighttime (Leq night)

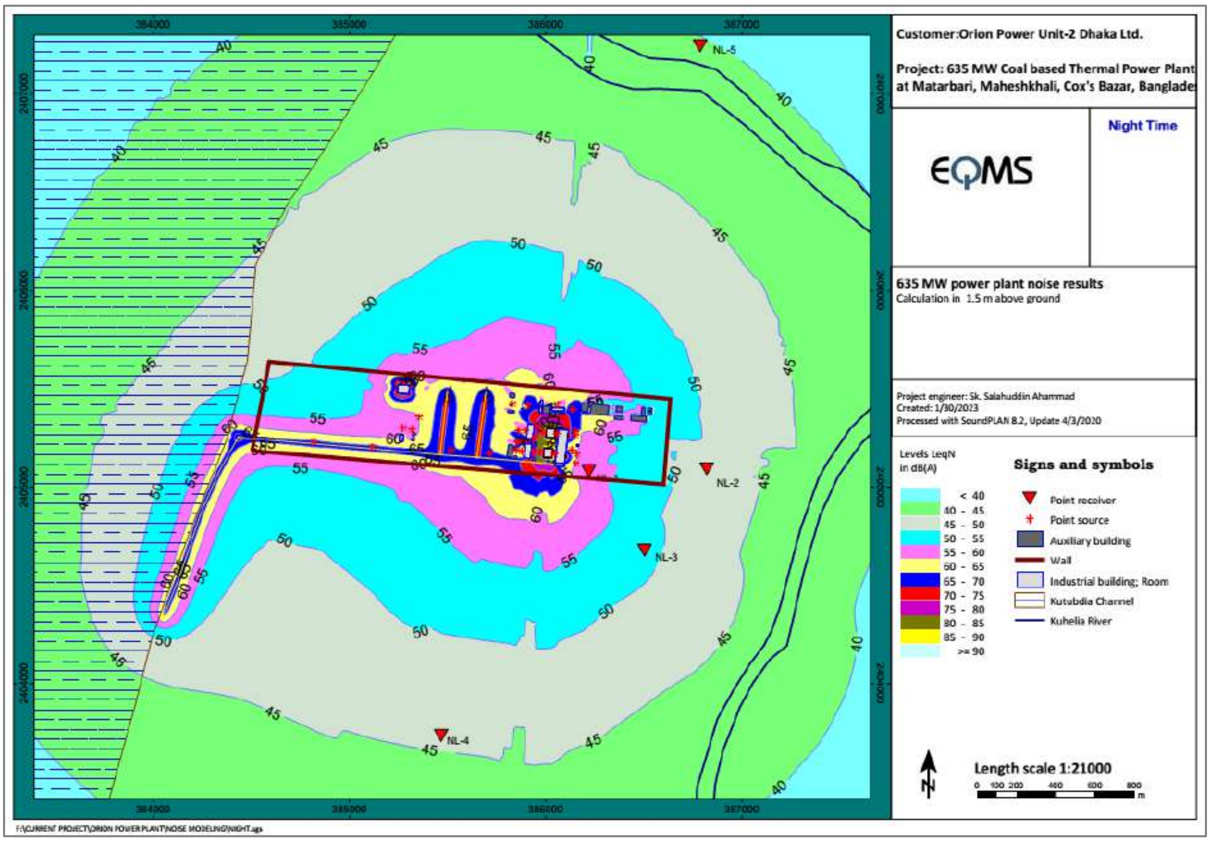


Table 5-37 shows that project site will experience high noise than baseline noise level. However, currently project site has been considered as residential area but operation period the project site will be considered as industrial area. The incremental noise will be within the standard of industrial zone (75 dB daytime and 70 dB nighttime). The NL-2 and NL3 locations which are residential area located 530 meters east and 380 meters south of the project boundary will experience more noise than nighttime standard value due to the plant operation. There is no house adjacent to the project boundary. There are residential houses within 1 km radius of the power plant. The household will also experience incremental noise level. However, the incremental noise level will be offset when all structures and greenbelt are established. Therefore, change in noise level around the power plant has been considered as **Medium High**.

Impact	*Impact on ambient noise level due to operation*					
Impact Nature	Direct		Indirect		Induced	
Impact Scale	In and around project site					
Frequency	Limited to operational phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss of Resources	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-low***				

5.4.6 Impact on Water Bodies

5.4.6.1 Impacts on Surface Water Quantity

The proposed 635 MW coal-fired thermal power plant is going to be established lest bank of Kutubdia Channel and downstream of the confluence of Matamuhuri-Kuhelia River and the Bay of Bengal. As a result, plenty of water is found in the channel round the year. The proposed project will get the benefits of the availability of water in the region. The power plant will be a once through colling system. Total 81,513 m^3/hr or 22.64 m^3/s water will be sourced from the sea. After cooling 81,259 m3/hr or 22.57 m^3/s water will be discharged back to the Kutubdia channel. Only 254 m^3/hr or 0.07 m^3/s water will be consumed by the power plant. The water flow rate of the Channel is 3,200 m^3/s[35]. The withdrawal rate (22.64 m^3/s) designed for the proposed project is insignificant (0.7%) considering the availability in the river. Considering the consumed water (254 m^3/hr or 0.07 m^3/s), it will be 0.002% of the water flow which can be considered as very insignificant. Hence, the impact on surface water quantity due to plant operation is assessed to be ***Very Low***.

Impact	*Impact on Surface Water Quantity*				
Impact Nature	Direct		Indirect		Induced
Impact Scale	Kutubdia Channel				
Frequency	Operation Phase				
Extent and Location	Project Site	Local	Regional	National	Trans Boundary
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation

[35] EIA of MAtarbari 2x600 MW Coal Fired Power Plant

Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		***Very Low***			

5.4.6.2 Impacts on Surface Water Quality

The wastewater/effluent streams from the plant will include effluents and process wastewater, domestic wastewater and runoff from process and other plant areas. The process effluents from the project will include regeneration waste from DM plant and condensate polishing unit, boiler blow down, service wastewater and coal pile and ash disposal area run offs. The quality of Kutubdia channel and sea may get impacted due to discharge of the above-mentioned effluents. Domestic wastewater may also impact surface water quality.

The loading, unloading and stacking of coal can contribute to changes in water quality due to interaction of water with dust fallout and coal spillage. The fuel oil will be transported through a jetty. The fuel transport and unloading may involve accidental release/spill due to rupture of fuel tank. The vessels transporting the fuels may discharge the ballast water into the river. Wastewater discharge in the river will impact on water quality which ultimately impact on aquatic ecology. The impact on surface water quality has been assessed to be ***Medium-Low.***

Impact	*Impact on Surface Water Quality*					
Impact Nature	Direct	Indirect		Induced		
Impact Scale	Bay of Bengal and adjacent river					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		***Medium-high***			

5.4.6.3 Discharge of Once through Cooling Water

The proposed coal-fired power plant will utilize a once-through cooling system for the condenser. A once-through cooling system carries off waste heat from the power plant by means of water flowing through the condenser and discharge it to the natural water body.

According to the feasibility report, the power plant will adopt once-through cooling system, with the maximum water consumption at about 81,513 m^3/h or 22.64 m^3/s (circulating water system). The nearest available water source is the Kutubdia Channel and the adjacent river, which is connected with the Bay of Bengal. The cooling water for the proposed power plant project will be taken from the water intake and pumped into the condenser. After the heat exchange in the condenser, the cooling water will be pumped to the waterspout through pipe. After cooling 81,259 m^3/hr or 22.57 m^3/s water will be discharged back to the Kutubdia. It is estimated that the outfall temperature will be raised to a maximum of 5°C than inlet water temperature. Without adequate mitigation measures, waters with elevated temperature differentials can potentially be harmful to sensitive habitats such as fisheries and aquatic ecosystem. However, a model study has been done to understand the heat water flow and dispersion conditions under high and low tides of dry and monsoon seasons with 5°C temperature increase. The detailed plume water modelling report is presented in **Appendix I**.

Topographic and Bathymetric Conditions

Global bathymetry SRTM15_V2.1 and some secondary (BWDB surveyed cross section data of the study area) data have been used to prepare the bathymetry of the model. Global bathymetry SRTM15_V2.1 data is mainly covered the sea part and secondary data are used in Kutubdia channel and Matamuhuri river. A 35km buffer area topographic and bathymetric conditions have considered.

MIKE 3 FM Model

MIKE 3 FM is a comprehensive modelling system for 3D water modelling based on a flexible mesh-finite volume method. The modelling system has been developed for application within oceanographic, coastal, and estuarine environments (DHI 2012). A detailed description of MIKE 3 FM is given in Rasmussen et al. (2009), Zhang et al. (2014), and Payandeh et al. (2015). The governing equations of MIKE 3 are continuity, momentum, temperature, salinity, and density. MIKE 3 assumes that the fluid is incompressible, and therefore its density depends only on temperature and salinity. MIKE 3 calculates free surface water by using the sigma-coordinate transformation method or the combination of sigma and z-level coordinate systems. The related equations for this model are summarized for Cartesian coordinates (DHI 2012).

2D Mesh Generation

Mesh generator tool is an inbuilt tool of MIKE 3 FM. The mesh generator can construct meshes that consist of both triangular and quadrangular elements. The approach being that the area of interest is divided into different regions (like road, flat land, low land, high land, river etc.) described through polygons. Each polygon may have distinct properties: maximum area of mesh, shape (triangular or a quadrangular), interpolation technique etc. In this study, water dynamics with heat exchange between sea and river will be simulated. Triangular mesh performs well in the sea and where flow direction is not defined. Thus, triangular mesh is used everywhere in this model domain. Detail mesh excluding land part has been generated is shown in the below **Figure 5-26**.

Figure 5-26: Detail Mesh of the River

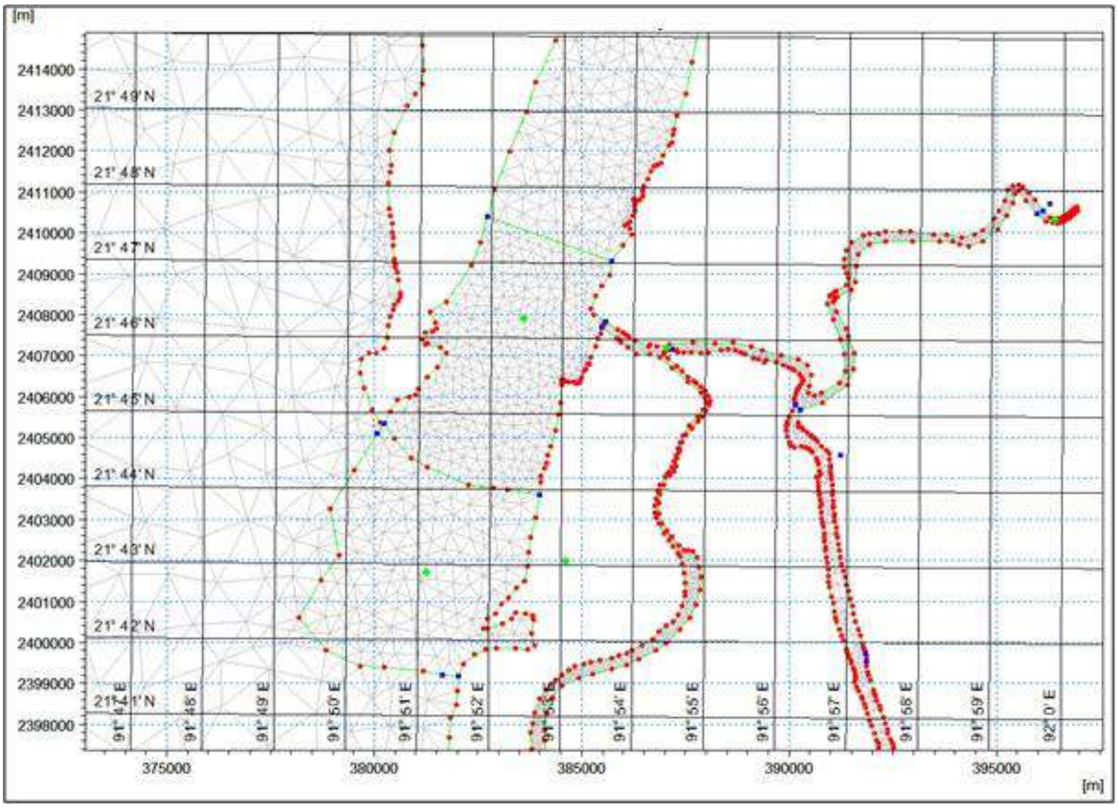
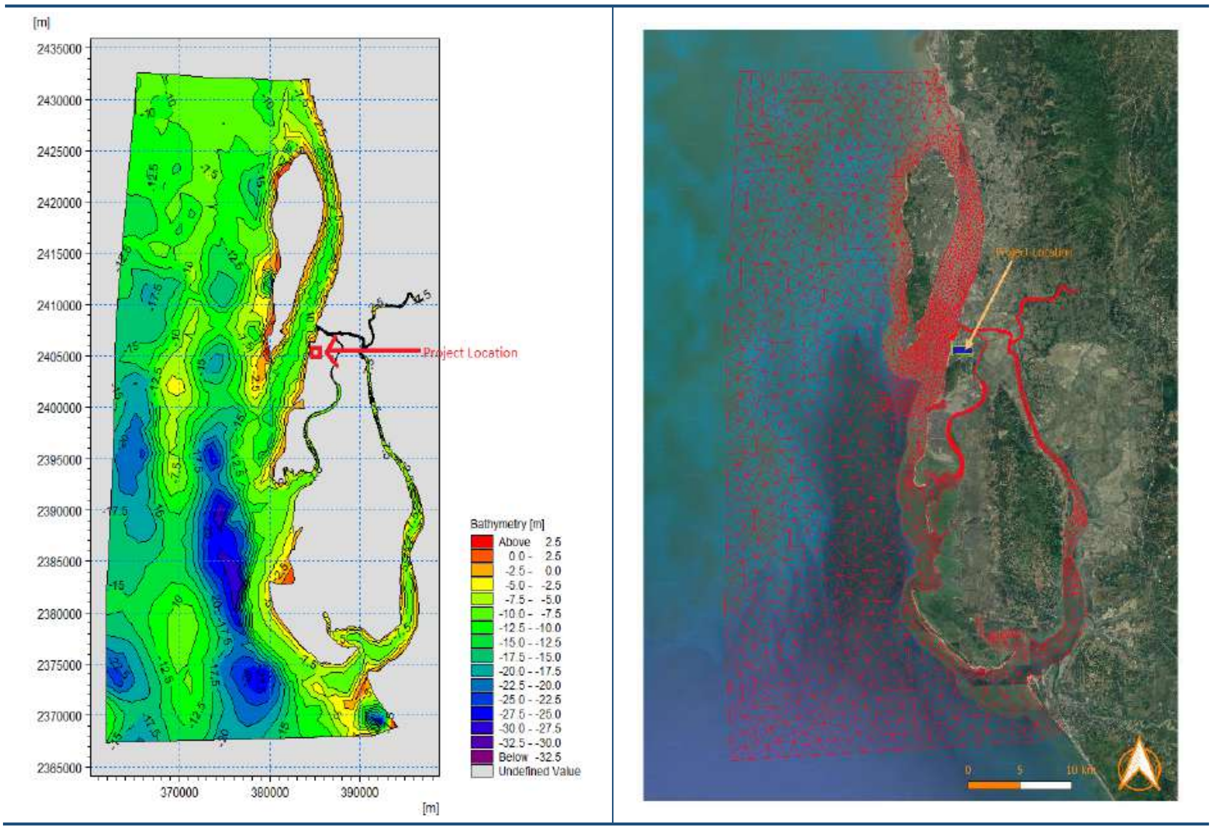


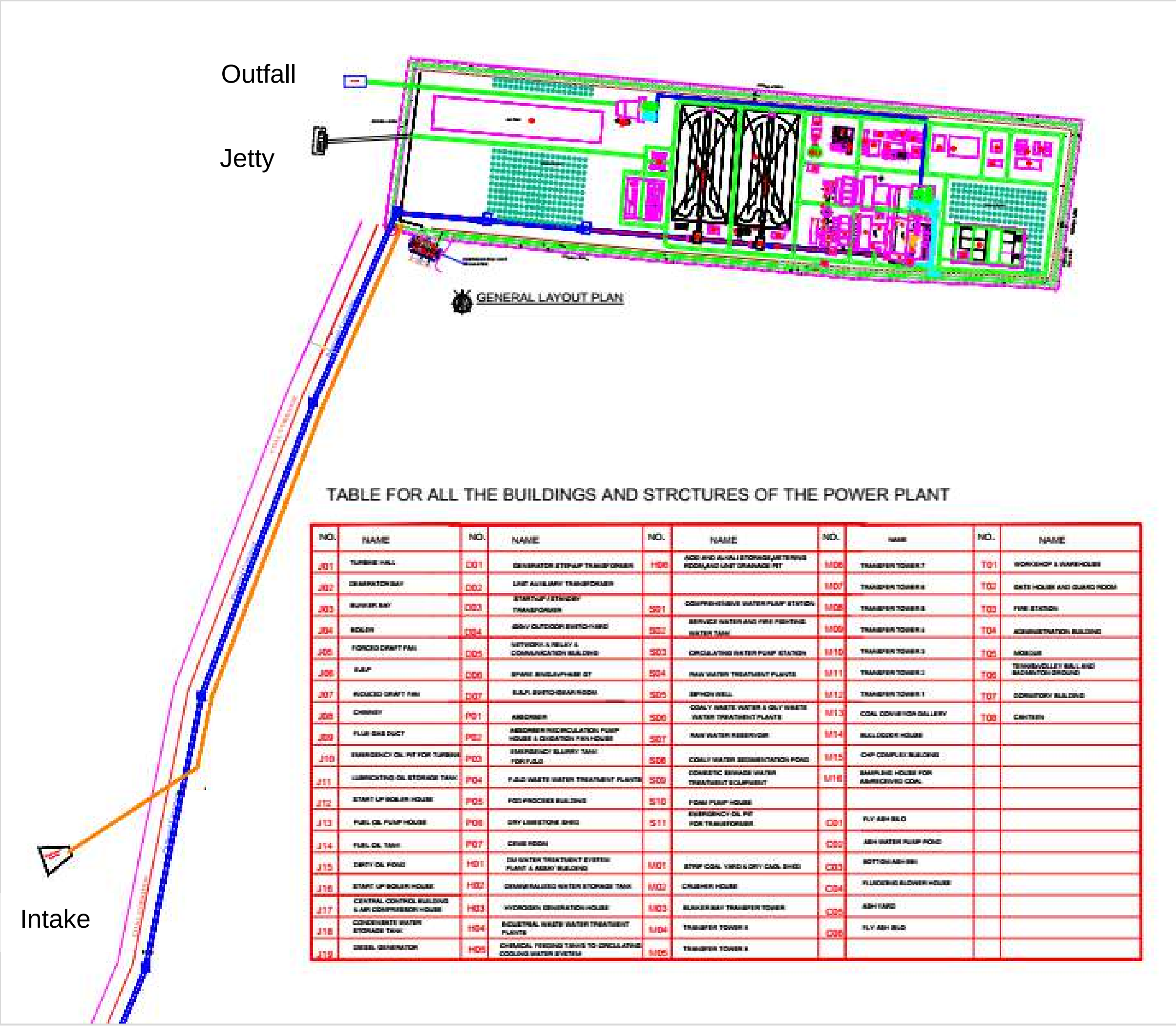
Figure 5-27: Mesh representing Bathymetric data for the Study Area used in the Model



Water Intake and Outfall

Required water will be taken from 1.92 km downstream of Jetty. Cooling water will be discharged though a 140 m upstream of the plant jetty location. The intake and outfall locations are presented in **Figure 5-28**.

Figure 5-28: Water Intake and Outfall Location



Summary of the Hydrodynamic Model

The summary of hydrodynamic model is presented in **Table 5-38**.

Table 5-38: Summary of Hydrodynamic Model

Items	Description
Flood and Dry	The drying depth was set to 0.005 m and the wetting depth to 0.01 m.
Coriolis Forcing	Domain varying option is selected; the Coriolis force has been calculated based on the geographical information given in the mesh file.
Wind Forcing	It is possible to consider the effect of the wind on the flow field, but wind force does not play significant role here for this reason it not included here.

Items	Description
Tidal Potential	High tide, low tide and stagnant conditions have been considered.
Infiltration	It is not applicable for this study.
Eddy Viscosity	This was kept as the same value as default, 0.08 m^2/s.
Bed Resistance	The bed resistance was represented by Manning's number, M. The values have been chosen default value (m=40)
Precipitation, Evaporation	Precipitation and Evaporation data have not been used.
Catchment Boundary for the Model	land boundaries have been chosen based on considering riverbank or Land part in the model domain area (Code-1). Code- 2 is Upstream of this model where it is represented inflow of Matamuhuri River inflow. Here, monthly average inflow of Matamuhuri River is used as inflow and Code-3 is a downstream boundary where water level data is used.
Sources	cooling water
Outlet Discharge	22.64 m^3/s
Inlet and Outlet	Intake: Easting: 383768.52and Northing: 2403428.28 Outfall: Easting: 384422.11 and Northing: 2405606.87

Hydrodynamic Model Simulation

This study model has been simulated for different scenarios. All scenarios are given in **Table 5-39**. Two scenarios have three sub scenarios except calibration scenarios. Ambient temperatures were measured in October 2022 and January 2023.

Table 5-39: Calibration, Validation, and different Scenarios for the Study

Simulation Name	Item	Temperature Rise (℃)	Ambient Temperature (℃)	Period
Calibration	Water Level	Atmospheric	Monthly Average Water Temperature	01 Jan to 02 Mar 2022
Calibration	Temperature	Atmospheric	Monthly Average Water Temperature	12 Dec to 15 Dec 2022
Scenario-1	Monsoon high and low tide	5	28.5	01 Jul to 30 Aug 2022
Scenario-3	Dry season high and low tide	5	26.3	01 Jan to 28 Feb 2022

Result of Simulation/Model

It is estimated that maximum 5°C temperature will be increased than the intake water temperature during discharge. Summary of the temperature rise scenario is presented in **Table 5-40**.

Table 5-40: Summary of the Temperature Rise Scenario

Distance from Outfall (m)	Summer (Monsoon Season)						Winter (Dry Season)					
	5℃ temp. Rise						5℃ temp. Rise					
	High Tide			Low Tide			High Tide			Low Tide		
	To North	To South	To West	To North	To South	To West	To North	To South	To West	To North	To South	To West
50	2.69	0.55	1.05	0.67	2.85	2.55	2.77	0.64	1.4	0.48	2.75	2.03
100	2.02	0.55	0.58	0.59	2.78	2.11	2.25	0.63	0.7	0.42	2.37	0.64
200	1.47	0.55	0.54	0.56	1.97	0.68	1.69	0.62	0.57	0.38	1.55	0.37
300	1.23	0.55	0.54	0.53	1.44	0.57	1.37	0.61	0.53	0.37	1.25	0.36
400	1.1	0.55	0.53	0.51	1.05	0.57	1.12	0.61	0.67	0.36	0.93	0.33
500	0.98	0.55	0.52	0.5	0.97	0.56	0.99	0.61	0.46	0.36	0.83	0.31
600	0.95	0.55	0.52	0.51	0.85	0.56	0.96	0.6	0.41	0.36	0.77	0.29
700	0.90	0.55	0.51	0.51	0.81	0.56	0.92	0.6	0.38	0.36	0.71	0.26
800	0.85	0.55	0.50	0.51	0.78	0.56	0.86	0.59	0.35	0.36	0.67	0.24
900	0.81	0.55	0.50	0.53	0.77	0.56	0.81	0.59	0.31	0.35	0.64	0.23
1000	0.72	0.55	0.49	0.52	0.72	0.55	0.75	0.58	0.29	0.32	0.53	0.2
1500	0.60	0.55	0.48	0.55	0.71	0.53	0.51	0.56	0.23	0.25	0.31	0.13
2000	0.45	0.46	0.42	0.51	0.73	0.49	0.28	0.32	0.21	0.21	0.09	0.07
2500	0.43	0.37	0.34	0.48	0.67	0.45	0.22	0.19	0.19	0.27	0.07	0.03
3500	0.43	0.25	0.22	0.48	0.47	0.39	0.15	0.12	0.11	0.26	0.04	0

Scenario –1: 5℃ Temperature Rise during High and Low Tide in Summer Season

The 5-degree centigrade rise of temperature from the ambient water temperature (28.5℃) at the outfall location is simulated in this scenario on 17 August 2022. The maximum 2.69℃ temperature rise has been found at 50 m north direction from the outfall location. **Table 5-40** shows that the temperature has been dropped down less than 1℃ within 500 meters at north direction during high tide in summer season. At north direction, 0.98℃- 2.69℃ temperature will be varied within 500 meters whereas insignificant temperatures will disperse towards south and west direction during high tide in summer season. The horizontal temperature distribution in different direction during high tide on 17 August 2022 (Maximum) is shown in **Figure 5-29** and **Figure 5-30**.

The maximum temperature rise at 50 m distance towards south direction from outfall location was found as 31.35℃ during low tide in summer season which is 2.85℃ higher than the ambient temperature. The temperature will be dropped down less than 1℃ after 500 meters at south direction during low tide in summer season. The temperature will be dropped less than 1℃ at 200 meter in west direction whereas insignificant temperature will be dispersed to the north direction. Highest temperature will be varied within 500 meters towards south direction in a range of 0.97℃- 2.85℃. It is evident that during low tide temperature will be raised higher than high tide. The horizontal temperature distribution in different direction during low tide on 17 August 2022 (Maximum) is shown in **Figure 5-31** and **Figure 5-32**.

Figure 5-29: Maximum Horizontal Temperature Distributions during High Tide in Summer Season

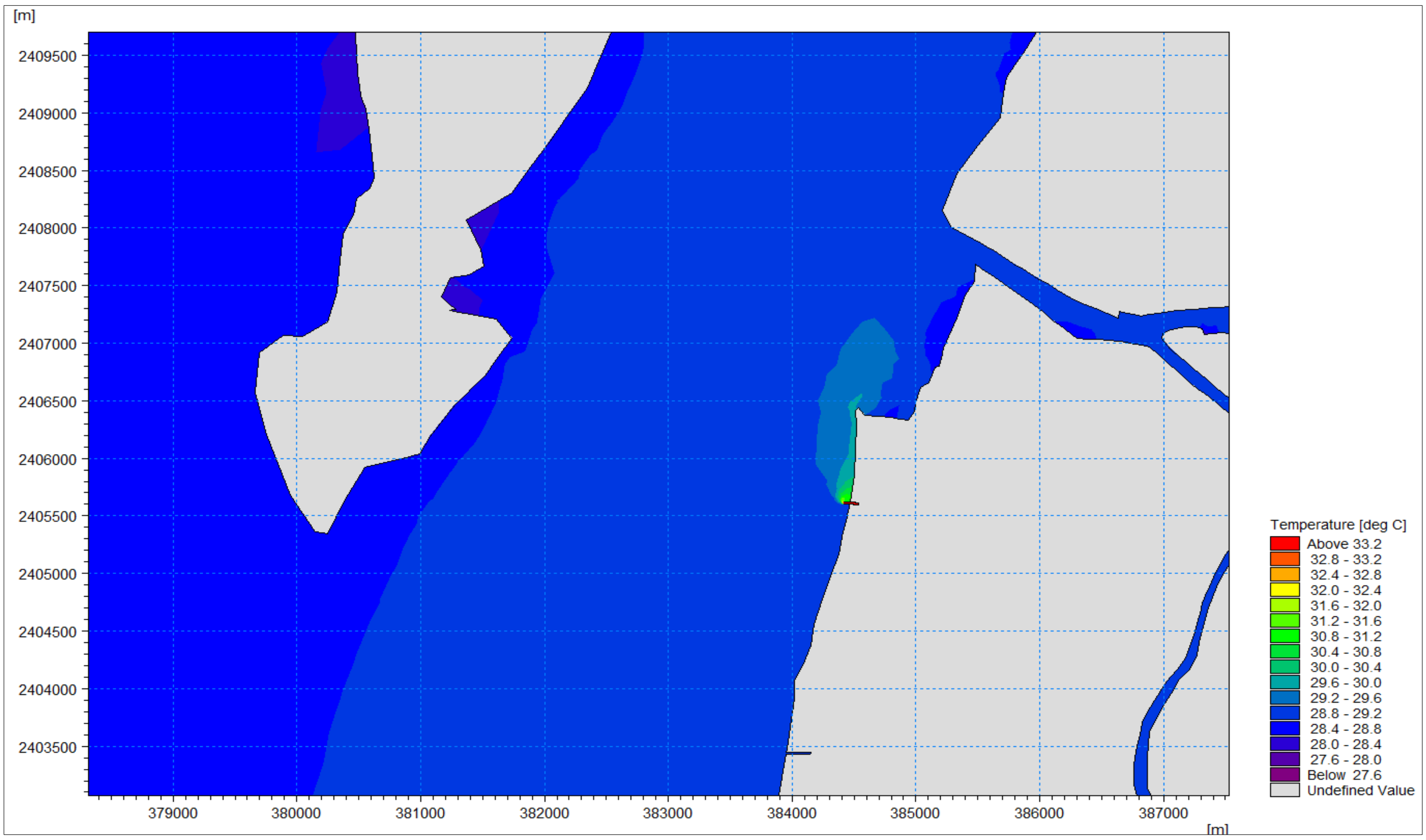


Figure 5-30: Maximum Horizontal Temperature Distributions Contour Line during High Tide in Summer Season

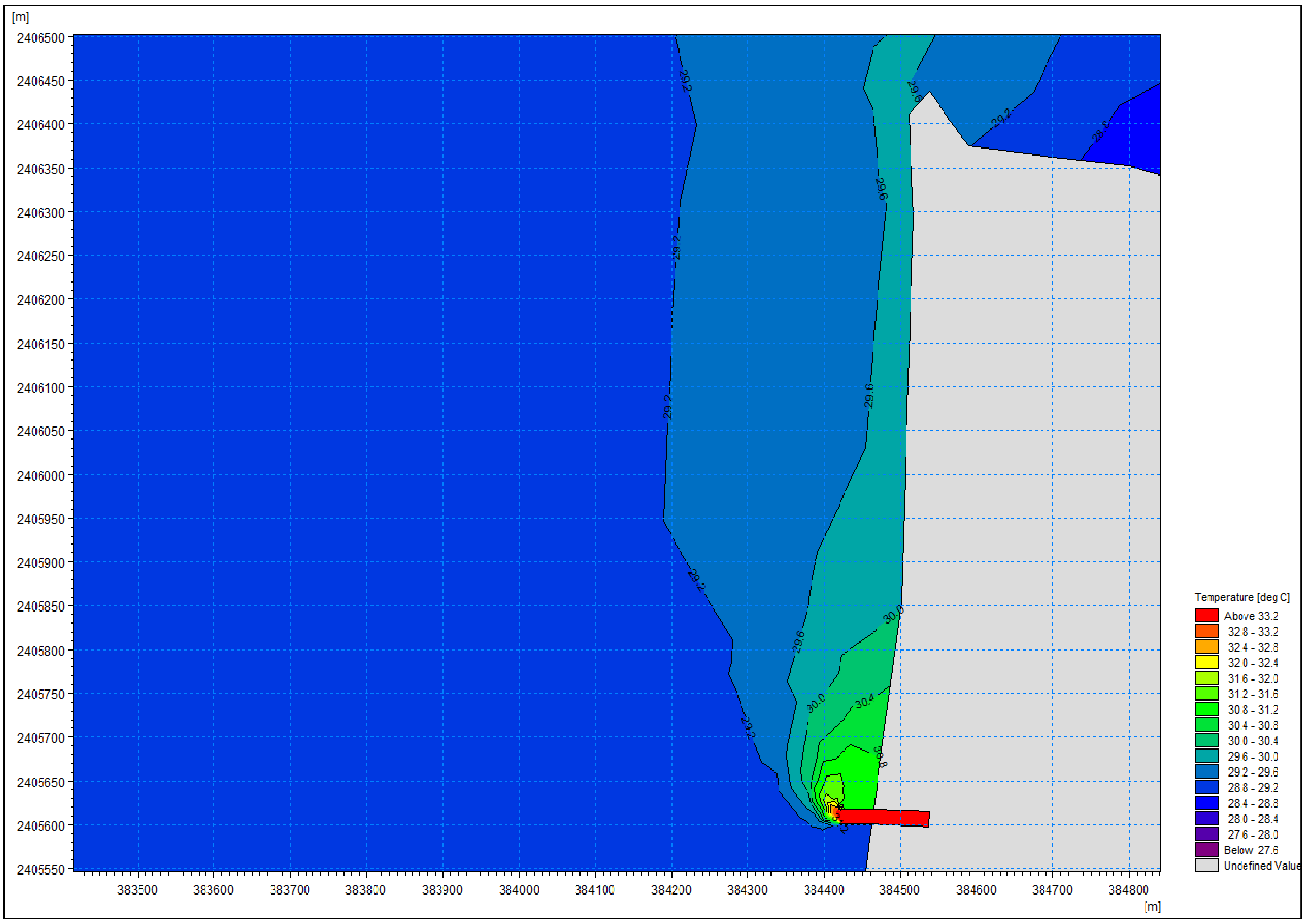


Figure 5-31: Maximum horizontal Temperature Distributions during Low Tide in Summer Season

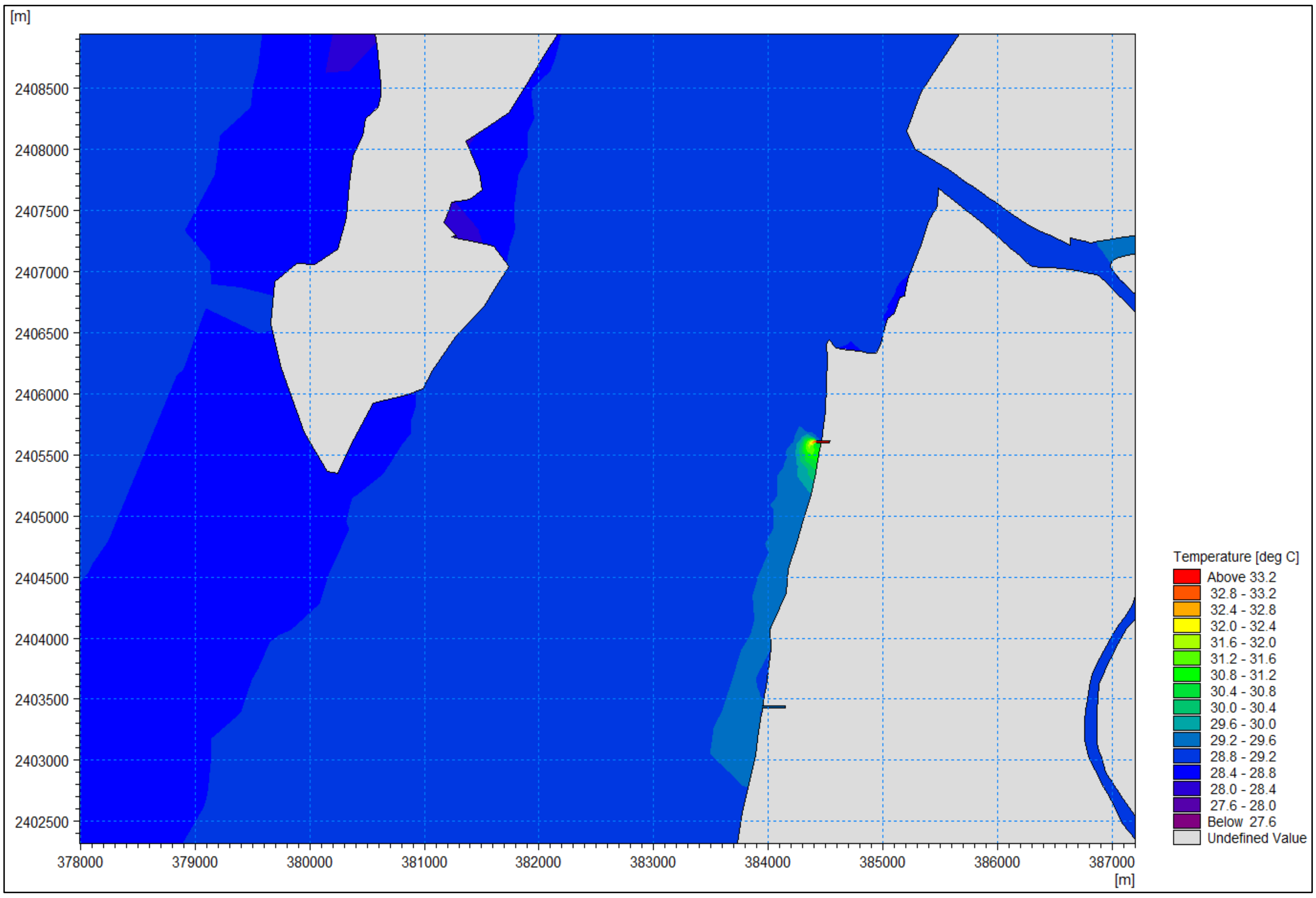
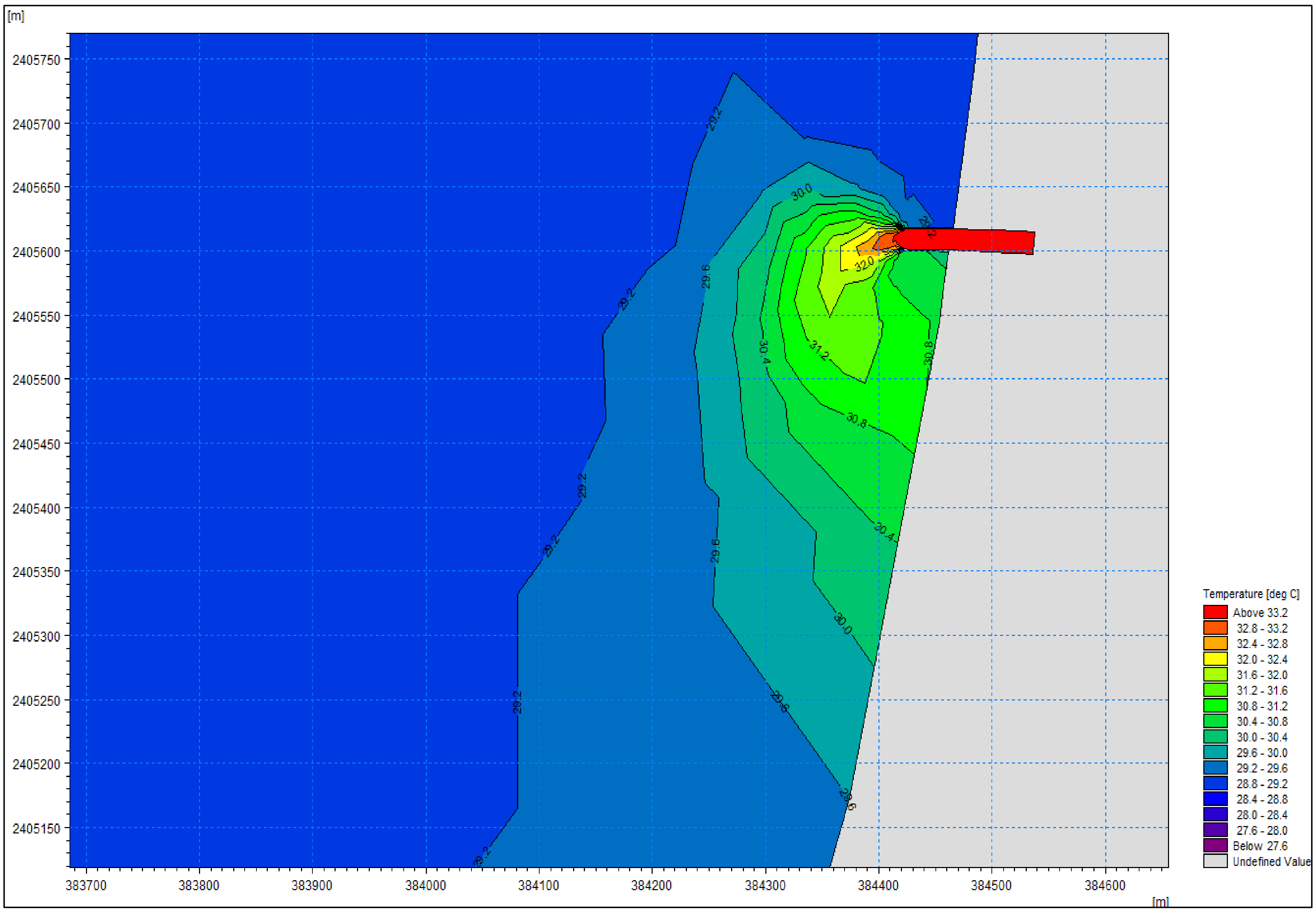


Figure 5-32: Maximum Horizontal Temperature Distributions Contour Line during Low Tide in Summer Season



Scenario – 2: 5℃ Temperature Rise during High and Low Tide in Dry Season

The 5-degree centigrade rise of temperature from the ambient water temperature (26.3℃) at the outfall location is simulated in this scenario on 13 December 2022. The maximum temperature rises at 50 m away towards north direction has been found from outfall location as 29.07℃ which is 2.77℃ higher than the ambient temperature. **Table 5-40** shows that the temperature will be dropped down less than 2℃ after 100 m and 1℃ after 500 meters during high tide in winter season. The maximum temperature will be dispersed at 500 m towards north direction in the range of 0.99℃- 2.77℃. The insignificant temperature will be raised towards south and west directions during low tide in winter season. The horizontal and vertical temperature distribution in different direction during high tide on 13 December 2022 (Maximum) is shown in **Figure 5-33** and **Figure 5-34**.

The maximum temperature rises at 50 m away towards south direction from outfall location was found as 29.05℃ during low tide which is 2.75℃ higher than the ambient water temperature. The temperature was dropped down less than 2℃ after 200 m and 1℃ after 300 meters during low tide in winter season. Insignificant water temperature will be raised towards north and west direction during low tide in winter season. The horizontal and vertical temperature distribution in different direction during low tide on 13 December 2022 (Maximum) is shown in **Figure 5-35** and **Figure 5-36**.

Figure 5-33: Maximum Horizontal Temperature Distributions during High Tide in Dry Season

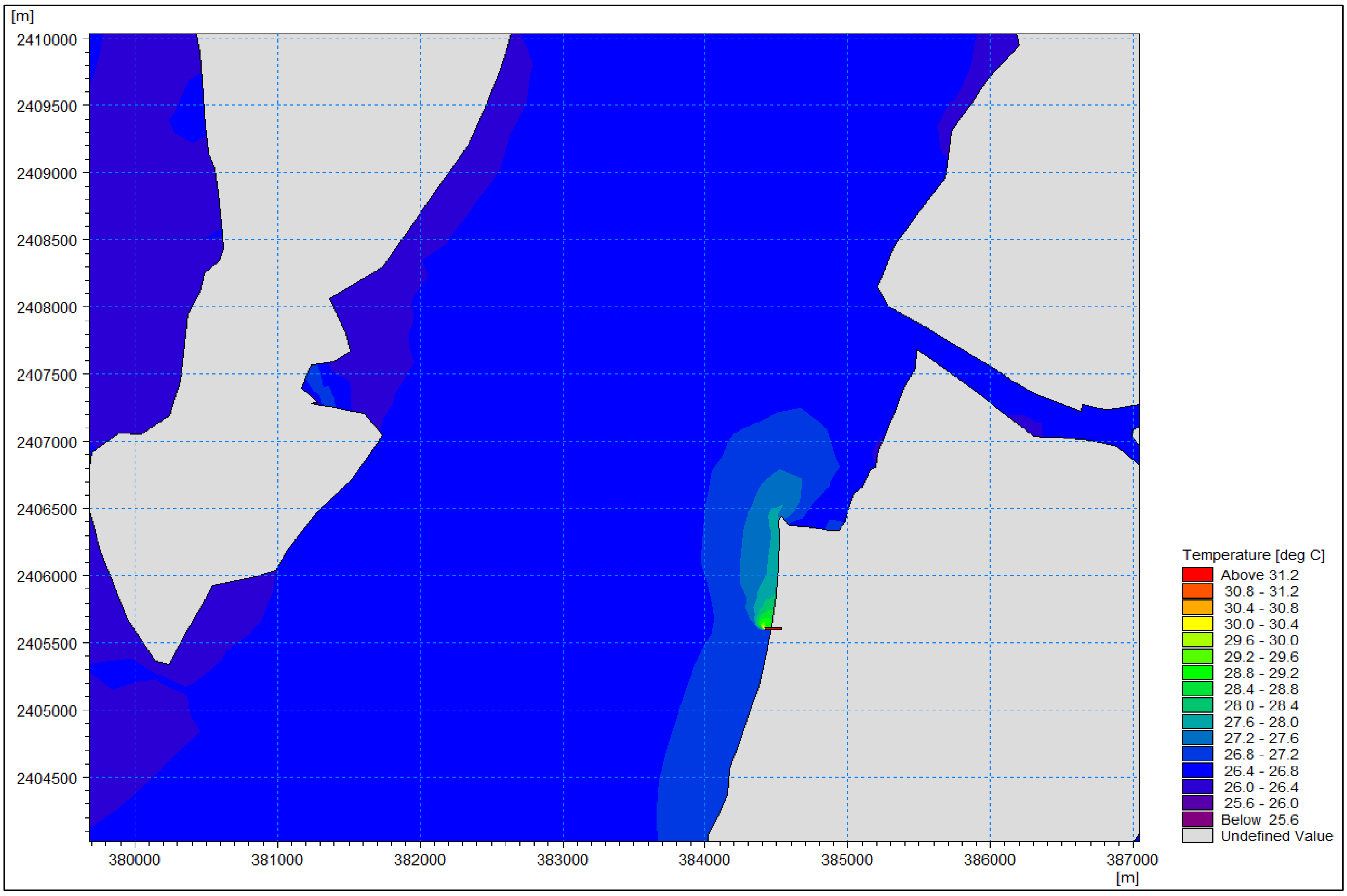


Figure 5-34: Maximum Horizontal Temperature Distributions Contour Line during High Tide in Dry Season

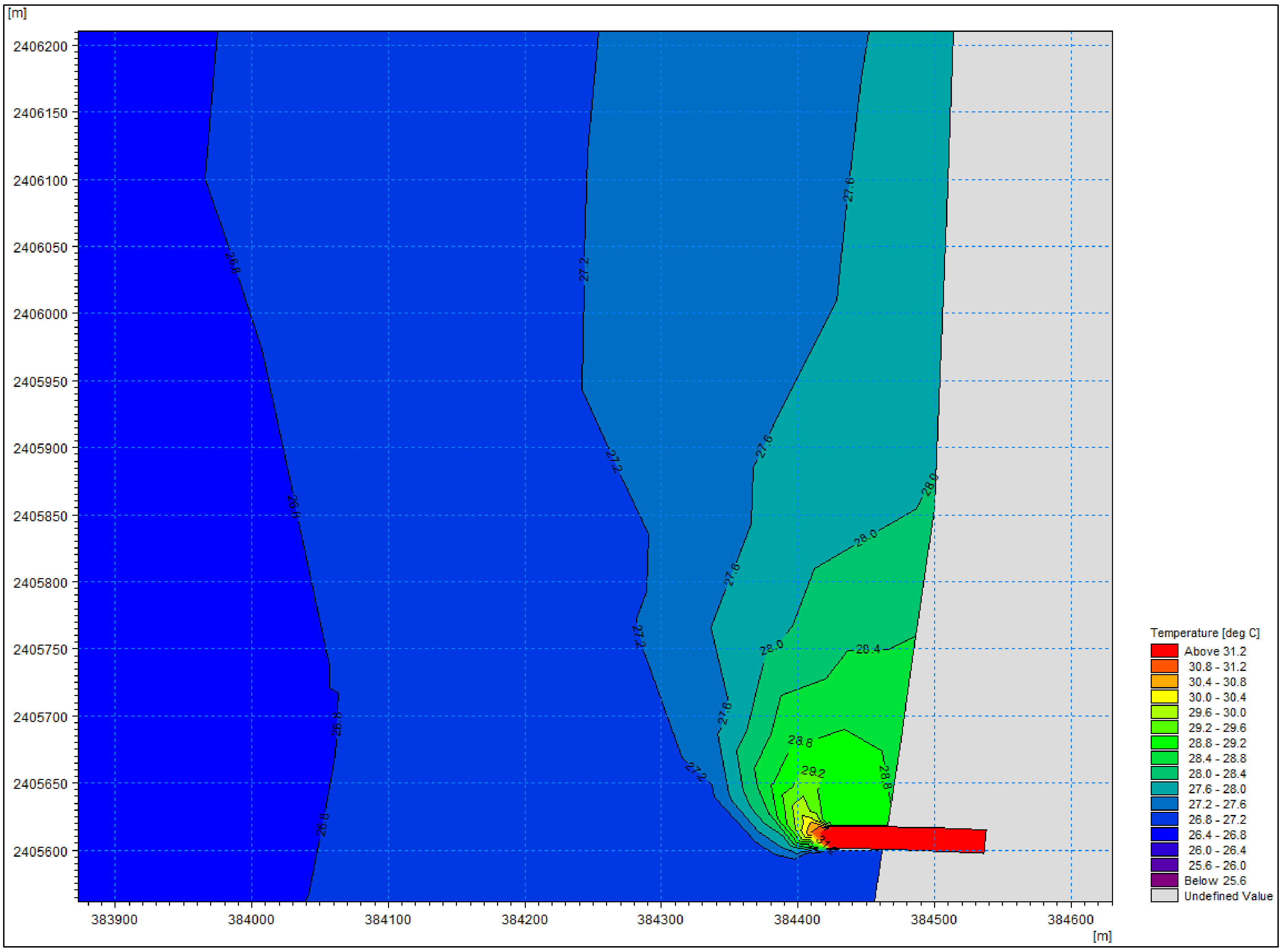


Figure 5-35: Maximum Horizontal Temperature Distributions during Low Tide in Dry Season

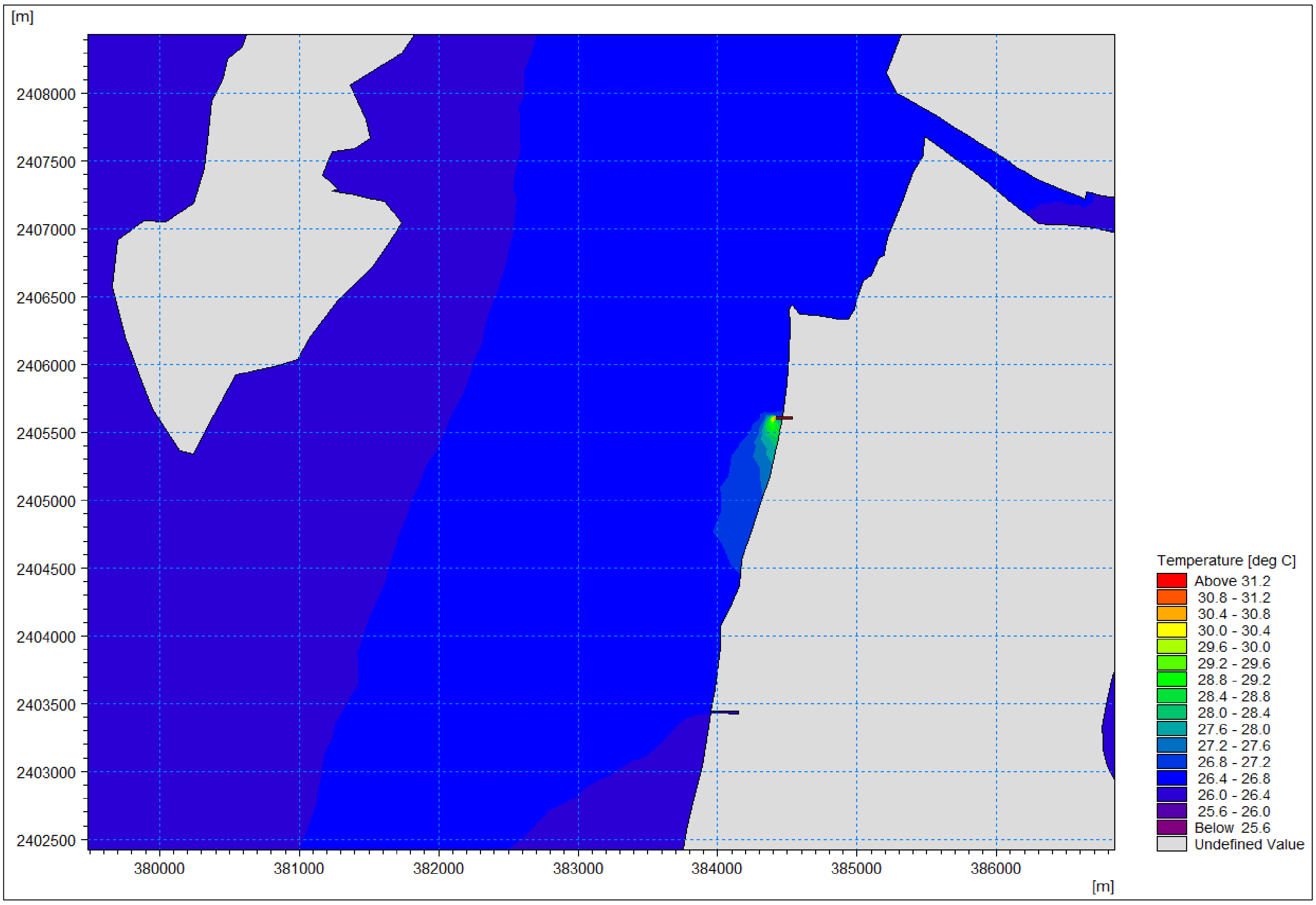
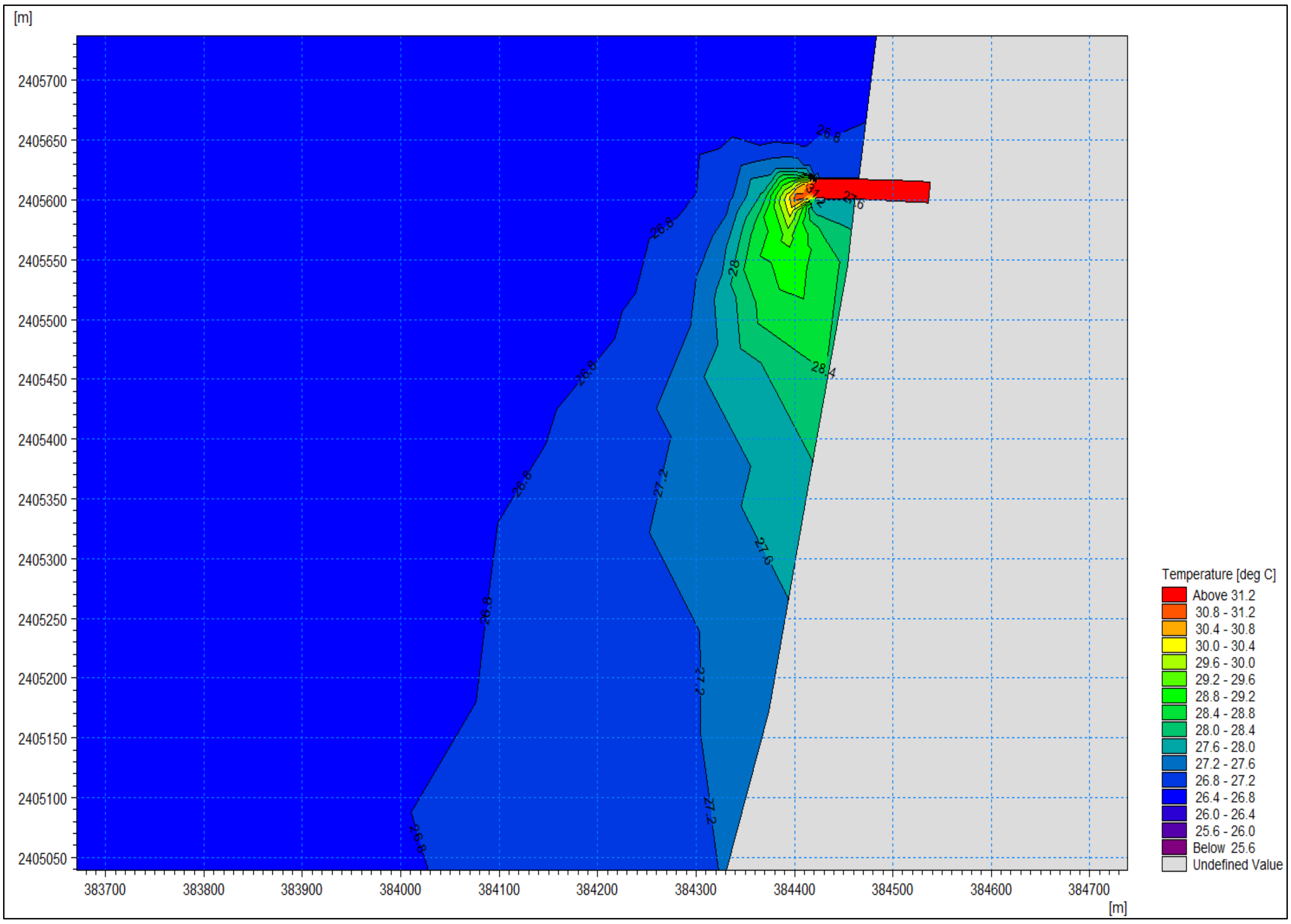


Figure 5-36: Maximum Horizontal Temperature Distributions Contour Line during Low Tide in Dry Season



From the above discussion it is found that temperature will rise more during summer season than winter. Highest temperature found during low tide in summer season. **Table 5-40** shows that temperature will be dropped less than 2°C within 200 meters whereas less than 1°C within 500 meters. It is found that the highest temperature at 50 m distance will be less than 10% of ambient water temperature. The mixing zone can be defined 500 m from the outfall location. The warm water will disperse towards north direction during high tide and south direction during low tide. Insignificant water temperature will rise towards west direction during both seasons. The detail modelling is presented in **Appendix I- Plume Water Modelling Report**.

According to the current World Bank Group EHS Guidelines for Thermal Power Plants, thermal discharges should be designed to ensure that discharge water temperature does not result in exceeding relevant ambient water quality temperature standards outside a scientifically established mixing zone. Further, the WBG General EHS Guidelines state that the temperature of wastewater prior to discharge should not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations. The 3°C temperature raise will not occur at the edge of the mixing zone.

Environment Conservation Rule, Schedule 4 restricts release of industrial water above 5°C and with this rise of temperature the cooling water discharge would never reach this limit. The rise of temperature will not exceed the permissible guidelines of the ECR 2023 (Schedule 4). However, the temperature increase of ambient water due to discharge of cooling water is assessed to be **Medium High**.

Impact	*Impact on Water bodies due to discharge of once-through cooling water*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Bay of Bengal and Kutubdia Cannel					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium High***				

5.4.7 Impact due to Waste Generation and Disposal

5.4.7.1 Solid Water Disposal

Ash is the main solid waste generated in the coal-based thermal power plant. The waste includes fly ash, bottom ash and boiler slag. According to the feasibility report, coal consumption has been estimated as 4042 tons/day in the proposed project. Approximately 363.8 tons/day fly ash and 72.8 tons/day will be produced. The bottom ash including slag is coarser and heavier. Consequently, fugitive fly ash may cause pollution to the surrounding. Ash and slag generated from the coal-fired thermal power plant would be stored only temporarily. The ash residues may contain heavy metal and some organic compounds or potentially hazardous materials. Improper management of ash will lead to air, water and soil pollution.

During operation, it has been estimated that approximately 40 tons/annum household waste will be generated. The generated household waste will be collected through a process from the residential area of the proposed power plant. Improper disposal of this waste would create soil and water pollution, odour problem, nuisance and aesthetic problem. This impact would be on the project site. Hence, the impacts due to solid waste generation and disposal is assessed to be ***Medium-Low***.

Impact	*Impact due to solid waste disposal*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Project Site and surrounding					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-low***				

5.4.7.2 Impacts due to Wastewater Generation and Disposal

The main issues related to wastewater during the operational phase of the proposed coal-fired power plant include domestic (including sanitary) wastewater, oil-contaminated and/or chemical-containing wastewater and stormwater run-off. The wastewater streams in the power plant would include wastewater from ash handling and storage runoff, boiler blowdown and cleaning waste, backwash from demineralization plant, wastewater from ESP wash, cleaning wastewater, storm drains, laboratory wastes and wastewater from water purification and wastewater treatment units and sewage and other sanitary wastewater. The potential impacts that may result from these is described below.

Water consumption for daily activity used in the administration office and the colony (accommodations for workers on site) during plant operation is pegged at approximately $0.2m^3$ per person per day. If approximately 135 workers are present on site, this will generate a daily sewage effluent volume of about 27 m^3/day for treatment. It is estimated that the proposed project will generate approximately 9,855 tons/annum sewage during the operation period. Improper design of the sewage treatment plant and/or noncompliance with the wastewater quality regulations of ECR 2023 could have detrimental effects on surface water quality. The sewerage would be generated from the staff and officers residential area. Sanitary sewage will have an adverse impact on the natural environment if not properly managed.

Oil will be used in the proposed power plant in different equipment, e.g. bearing, turbine hydraulic system, etc. Wastewater or drained water from the turbine hall, substation yard, etc. may contain oil and oily water. However, the proposed plant considers installing an Oil Water Separation Unit integrated with a central wastewater treatment plant. Therefore, the impact would be insignificant. Concentrated sludge would be generated from water pre-treatment plant, demineralization plants, wastewater treatment plants and oily water separation unit. This sludge would go to the sludge sump for dewatering and thickening. If the sludge not properly managed, it would be contaminated groundwater and surface water.

Generally, wastewater of coal power plant contaminated with Chlorine, Chromium, Copper, Iron, Zinc, and heavy metals. If the wastewater disposed to the water body without proper treatment, the Bay of Bengal and Kutubdia channel might get impacted due to the discharged of the above-mentioned effluents. Hence, the impacts on environment due to wastewater generation and disposal is assessed to be **Medium-High**.

Impact	*Impacts on environment due to wastewater generation and disposal*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Project operation area and adjacent river					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-high***				

5.4.8 Soil and Agriculture

Soils play a fundamental role in biodiversity conservation thus changes to the structure and chemical composition can have subsequent effects on vegetation structure and composition as well as altering watercourses. During the operation phase of the proposed project will generate fugitive dust and gas emissions. The soil, vegetation and agricultural crops will undergo perceptible qualitative changes due to the deposition of dust particles. The dust particles depending upon the size and weight settle down at varying distances on vegetation in the prevailing wind direction. Foliar deposition of dust interrupts gaseous exchange through stomatal clogging, thereby affecting plant growth.

Soil contamination is also a potential impact considering the project features especially coal storage, coal ash storage and wastewater disposal and chemical and hazardous substances management. These materials potentially could seep into the soil leaving heavy metals and other hazardous substances in the soil and further into ground water. Solid wastes, oil leakage and waste oils will emanate from the project's activities due to the high influx of personnel and activities in the area. Solid waste materials expected include cans, wrappings, paper and plastics waste, among others. Petroleum, oil leakage and waste oils may spill on the ground and ultimately into the soil and degrade the ecosystem.

There is no agricultural land adjacent to the project site. Matarbari area is prominent for salt and shrimp cultivation. Northern side land of project site has already been acquired for industrial development and southern side land is used for salt and shrimp cultivation. Since, there is no major agricultural land around the project site hence, no significant impact on agriculture is expected from the operation of the proposed project. The impacts on soil and agriculture are assessed to be ***Low***.

Impact	*Impact on Soil and Agriculture*				
Impact Nature	Direct	Indirect	Induced		
Impact Scale	Surrounding land of the project site				
Frequency	Operation Phase				
Extent and Location	Project Site	Local	Regional	National	Trans Boundary
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation
Impact Intensity	Insignificant	Low	Medium	High	Very High
Potential for Irreplaceable Loss	Low	Medium	High		

Probability of Impact	Unlikely	Low		Medium	High	Definite
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		***Low***			

5.4.9 Impact on Ground Water

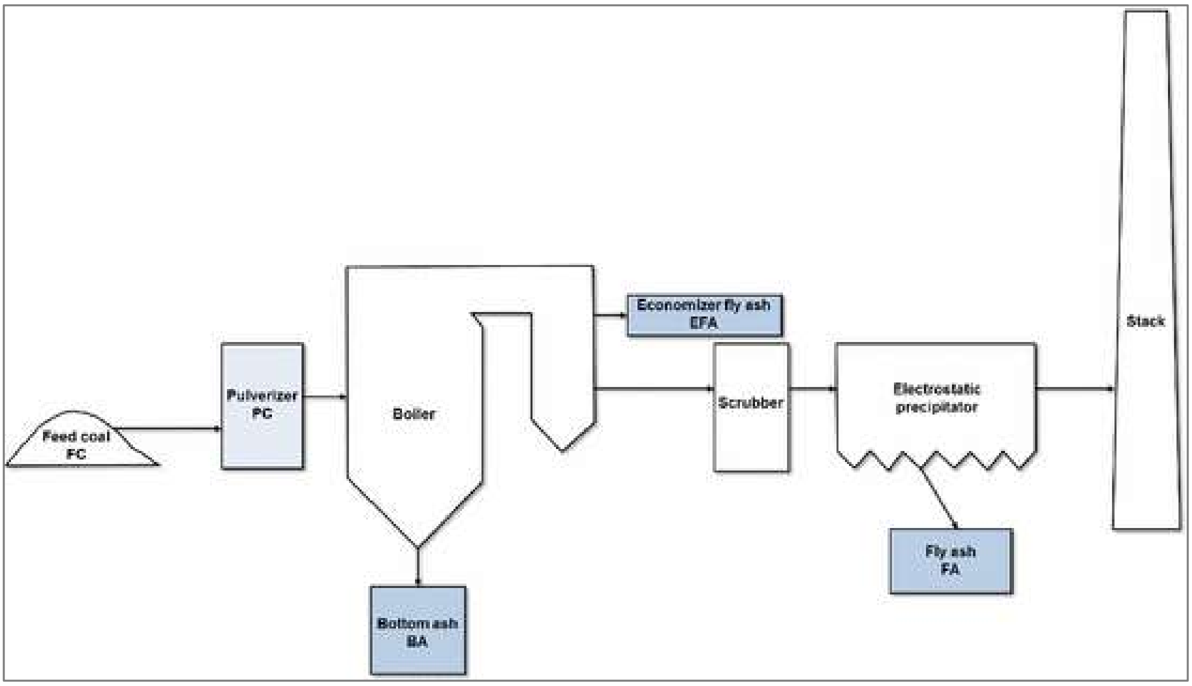
During the operational phase of the proposed project, surface water will be intake from the Kutubdia Channel and will be used in entire project operation. According to the OPDL-2, no groundwater will be extracted for the operation of the proposed project. However, the proposed coal-fired power plant will store fly ash, bottom ash and wet gypsum in the ash yard, which is located on the north-west side of the project. If the design of the ash yard does not include impermeable layers of protection, leachate from the ash yard could percolate into the sub-surface and potentially contaminate the groundwater. Any leachate in the groundwater would have adverse impacts on the hydrology. The upper sub-surface geology is vulnerable to the infiltration of pollutants from coal ash yard. If the sanitary and industrial wastewater is not properly handled correctly or discharged accidentally or not treated properly, it will potentially impact on aquatic environment, groundwater quality and surface water quality. The impacts on groundwater resources by the project activities is assessed to be ***Medium-low.***

Impact	*Impact on Groundwater*					
Impact Nature	Direct		Indirect		Induced	
Impact Scale	Ash storage area, waste storage, treatment and disposal site					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		***Medium-low***			

5.4.10 Impact due to Ash Disposal

Without any beneficial use, fly ash, bottom ash and wet FGD gypsum are classified as wastes. During the combustion of coal in the furnace, the inorganic material will be decomposed. Part of the non-combustible material is retained in the furnace as bottom ash whereas the majority of the inorganic material will be carried out of the furnace with the flue gases and will be collected downstream by Electrostatic Precipitators (ESPs) as Fly Ash (**Figure 5-37**). One dense phase pneumatic conveying pump will be installed under each ESP and ECO hopper. Fly ash collected from ESP hoppers will be transported to the fly ash silo and fly ash from ECO hoppers will be transported to bottom ash bin by compressed air through the transfer pumps. Pressurized air will be supplied by conveying air receivers near the common compressor house. It is anticipated that about 80% of the residues will be collected as fly ash and 20% will be collected as bottom ash. Approximately 363.8 tons/day fly ash and 72.8 tons/day will be produced. Fly ash, bottom ash and wet FGD gypsum will be disposed of in the on-site ash yard. The lack of a properly designed ash yard could potentially lead to sub-surface and groundwater contamination. A further potential impact associated with the generation of fly ash concerns the release of fly ash material into the environment. Due to its low density and fine particulate size, it has the potential to travel relatively large distances. Fly ash could deposition on the plant leaf surface and hamper photosynthesis.

Figure 5-37: Detail of Ash Generation



Coal and coal waste products, including fly ash, bottom ash and boiler slag, contain many heavy metals, including arsenic, lead, mercury, nickel, vanadium, beryllium, barium, cadmium, chromium, selenium and radium, which are dangerous if released into environment. A major portion of these heavy metals may remain with ash. Mercury emission from coal burning is converted into methylmercury, a toxic compound that harms people who consume freshwater fish. Failure of waste management and ash management system may cause release of these hazardous wastes to environment that might also contaminate food chain. The impacts due to ash disposal are assessed to be ***Medium-High***.

<table>
<tr><td>Impact</td><td colspan="9">Impact due to ash disposal</td></tr>
<tr><td>Impact Nature</td><td colspan="2">Direct</td><td colspan="4">Indirect</td><td colspan="3">Induced</td></tr>
<tr><td>Impact Scale</td><td colspan="9">Surrounding environment</td></tr>
<tr><td>Frequency</td><td colspan="9">Operation Phase</td></tr>
<tr><td>Extent and Location</td><td>Project Site</td><td colspan="2">Local</td><td colspan="2">Regional</td><td colspan="2">National</td><td colspan="2">Trans Boundary</td></tr>
<tr><td>Impact Duration</td><td>Short Term</td><td colspan="2">Medium Term</td><td colspan="2">Long-term</td><td colspan="2">Permanent-mitigated</td><td colspan="2">Permanent-no mitigation</td></tr>
<tr><td>Impact Intensity</td><td>Insignificant</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Very High</td></tr>
<tr><td>Potential for Irreplaceable Loss</td><td colspan="3">Low</td><td colspan="3">Medium</td><td colspan="3">High</td></tr>
<tr><td>Probability of Impact</td><td>Unlikely</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td><td colspan="2">Definite</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Very Low</td><td>Low</td><td colspan="2">Medium-low</td><td colspan="2">Medium-high</td><td colspan="2">High</td><td>Very High</td></tr>
<tr><td colspan="9">Significance of impact consider Medium-high</td></tr>
</table>

5.4.11 Impact on Ecology

5.4.11.1 Impact on Terrestrial Flora

During the operation phase, activities that might impact on terrestrial flora include, operation of boiler, turbine and generator, coal conveying, disposal of fly ash and bottom ash, hazardous and domestic waste disposal.

The major pollutants from the operation of coal based thermal power plants are PM, SO_2 and NO_2. Accidental dispersion of flue gas, fly ash and bottom ash might create impacts of terrestrial flora. Nitrogen and Sulphur containing air pollutants can affect plants health indirectly, via chemical reactions, or directly after being deposited on plant leaves. The direct impact of airborne nitrogen is due to toxic effects, eutrophication, and acidification. Stack emissions such as Sulphur dioxide, nitrogen oxides, carbon monoxide and heavy metals (such as mercury) may contribute to acid rain, which in turn pollute and affect plants growth by corrosion of their surfaces and causes acidification of terrestrial ecosystems. Coal unloading and conveying will also generate particulate matter. Dust for instance will affect plants growth by interrupting physiological processes like transpiration when lodged on leaf surfaces thereby blocking their stomata.

The project site is in an open area and there is no significant terrestrial flora around the project site. Considering the project activities and potential biological receptors within the project AOI, the impact on terrestrial flora during the operation phase might be less significant and is assessed to be **Medium-low**.

Impact	*Impact on Terrestrial Flora*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Project Area of Influence					
Frequency	Limited to Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity/ Severity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact	***Medium-low***				

5.4.11.2 Impact on Terrestrial Fauna

Noise generation from turbines, generators, compressors, pumps, fans, coal conveyer and coal handling plant, light generation due to operational activities, emission of dust from vehicle movement and coal handling system are the key source of possible consequences on terrestrial fauna in the proposed project.

The higher noise level produced from different activities may cause disturbance and behavioral changes of the faunal species like shore bird species found north-western and north-eastern part from the proposed project site. Artificial lighting may result in the attraction of some wildlife living in the project adjacent area, leading to their disoriented movement and confusion behavior.

Vehicles will be operated for transporting workers and the number of vehicles will be increase in the project area. Movement of vehicles will be created dust emission and exhaust emissions from the burning of fossil fuels. Dust emissions from the operational activities might impact respiration of the fauna and avifaunal species.

According to the baseline, North and northwestern mudflat of Matarbari shoreline would be the potential feeding and foraging ground of shore birds. Artificial lights will hamper the feeding and foraging activity of migratory and shore bird species as well as their migration orientation.

However, considering the project activities the impact on terrestrial fauna during the operation phase might be less significant and is assessed as ***Medium-low***.

Impact	*Impact on Terrestrial Fauna*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Project Area of Influence					
Frequency	Limited to Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Medium-low***					

5.4.11.3 Impacts on Aquatic Flora and Fauna

The proposed power plant is going to be established on the left bank of Kutubdia channel and north-western side of Kohelia River. According to the baseline study, there is no remarked breeding ground of Hilsha. Consultation with Fishermen and Marine Fisheries Officer of Kutubdia Upazila indicate that, some shrimp species breed in the Kutubdia Channel. However, Fisheries Resource of this area is diversified. Based on the baseline study, fifty-nine (59) species of fish and Fifteen (15) species of crustaceans were recorded.

During the operation phase of the proposed project, required water for the power plant operation will be intake through submerged intake open channel from the Bay of Bengal and heated cooling water will be discharged into the Kutubdia Channel through discharge outlet. Total water requirement for the proposed project is around 81,513 m^3/hour and the discharged water will be 81, 259 m^3/hour during its operational phase. The proposed power plant is adopting once-through cooling system, so the thermal discharge has direct impact on aquatic organisms (fish, crustaceans, plankton, benthos, marine turtles etc.) diversity and may lead to bring permanent change to diversity and composition. It has been assumed that maximum 5℃ temperature would be increase than ambient water temperature during discharge to the Kutubdia hannel. According to the thermal plume dispersion modelling, at 5℃ temperatures raise in outlet points scenario, maximum temperature raise is found 31.35℃ from ambient temperature (28.5℃) within 50m of the outlet point during low tide of summer season whereas 31.19℃ temperature will be found within 50 m during high tide in summer season. Maximum 29.07℃ temperature is found during high tide in winter season at 50 meters of outlet point towards north direction. It is found that temperature will drop less than 2°C within 200 meters whereas less than 1°C within 500 meters.

According to the baseline, Dhalghata sea beach and Hacher Char is the potential nesting habitat of marine turtles especially Olive Ridley Turtle (*Lepidochelys olivacea*) which is listed as Vulnerable in IUCN Red List of Threatened species of Bangladesh (2015), and Global IUCN Red List (Version 2022-2). Dhalghata sea beach and Hacher Char are far from the project site. According to local people, Olive Ridley Turtle rarely come to the Matarbai sea beach during winter season. A total of 11 species of phytoplanktons, 9 species of zooplankton and 14 species benthos were observed in the AOI (**Refer section 4.6.3.3.2**).

High thermal exposure will directly indirectly impact the aquatic organism's biology. Water temperature is one of the most common abiotic stress factors in the case of crustacean species. Higher temperature has a profound effect on growth, sex determination and maturation of crustaceans[36]. Higher growth

[36] Rigaud, T., Antoine, D., Marcade, I., Juchault, P., 1997. The effect of temperature on sex ratio in the isopod *Porcellionides pruinosus*: environmental sex determination or a byproduct of cytoplasmic sex determination? Evol. Ecol. 11, 205–215.

rates and shorten maturation period but lower survival was indicated with increasing temperatures up to 32℃. Higher temperature can significantly increase the expression of female sex determining genes to produce larger proportions of females in crustaceans (shrimp) that in turn can help to improve aquaculture production[37]. However rapid temperature change may result in thermal shock to aquatic life, cause reproduction difficulties and lower disease resistance.

The thermal discharge is responsible for altering the water temperature, which in turn has a negative impact on the fish population by reducing species richness. In addition, the temperature of the water has a significant impact on various aspects of fish, including their ability to survive, their distribution, metabolism, immunity, and natural reproduction. Increased temperature of the water may degrade their potential habitat. However, Fish in tropical regions have adapted to a typical range of water temperature between 25℃ to 35°C[38]. Hence, the impact on fish species will not be significant due to the highest temperature of thermal discharge will be 31.35℃.

Increases in seawater temperature caused by thermal discharge affect plankton communities by increasing the metabolic rate of the organisms and reducing the DO concentration. The elevated seawater temperature at the bottom might not be high enough to significantly affect the macrobenthos, but significantly affected the phytoplankton and zooplankton communities[39]. The maximum temperature tolerance of native Mollusca species lies in the range of 24℃ to 32℃[40]. The increase in temperature will limit up to 500m in cross direction and will be up to 31.35℃, which can be tolerated by the species of Mollusks found in Marine ecosystem.

Extreme water temperature also affects the movement and embryonic development of sea turtles. Sea turtle embryos are sensitive to overheating, and offspring viability is expected to decrease rapidly above 30℃ to 35℃[41]. Thermal discharge from once through process may demotivate the turtle species to come in Matarbari beach area due to high temperature exposure.

Accidental discharge of surface runoff with high sediment load, spilled oil, etc into the waterbody have the potential to affect the water quality by leading to an increase in turbidity, organic matter content, oil content etc.

Accidental spillage of oil and lubricants from secondary fuel transportation vessels and wastewater disposal from the powerplant can deteriorate the water quality of discharged area and affect the diversity of aquatic species. Reduced oxygen levels in water, exposure to harmful pollutants, and changes in temperature and pH levels due to water pollution can all negatively impact the health and survival of plankton, benthic organisms as well as fisheries resources.

According to the project description, required water (81,513 m^3/hr) for once through cooling system will be sourced from Bay of Bengal and discharged into Kutubdia Channel. Water intake systems can create strong currents and turbulations in the surrounding water which can disorient and trap fish and other

[37] Rahi, M. L., Mahmud, S., Dilruba, K. J., Sabbir, W., Aziz, D., & Hurwood, D. A. (2021). Temperature induced changes in physiological traits and expression of selected candidate genes in black tiger shrimp (*Penaeus monodon*) larvae. Aquaculture Reports, 19, 100620.

[38] Ashaf-Ud-Doulah, M., Islam, M. S., Ryhan, N. B., Al Mamun, S. N., Taiyebi, K. A., Majlish, S. K., & Biplob, M. S. H. (2021). High temperature tolerance limits and changes of hemato-biochemical parameters of mrigal, *Cirrhinus mrigala*.

[39] Lin, J., Zou, X., & Huang, F. (2018). Effects of the thermal discharge from an offshore power plant on plankton and macrobenthic communities in subtropical China. Marine pollution bulletin, 131, 106-114.

[40] Verbrugge, L. N., Schipper, A. M., Huijbregts, M. A., Van der Velde, G., & Leuven, R. S. (2012). Sensitivity of native and non-native mollusc species to changing river water temperature and salinity. *Biological Invasions*, *14*, 1187-1199.

[41] Ackerman, R. A. (2017). The nest environment and the embryonic development of sea turtles. In *The biology of sea turtles* (pp. 83-106). CRC Press.

aquatic organisms[42]. Small fish species, fish and shrimp larvae and juveniles are vulnerable enough to swim against the current and can be swept into the intake system and get impingement. Moreover, the moving screens used to filter out debris and other large objects can pose a danger to fish, which may become entrained in the screens and die as a result.

Hence, considering the project activities and potential biological receptors within the project AOI, the impact on aquatic flora and fauna during the operation phase might be significant and is assessed as ***Medium-High***.

Impact	*Impact on Aquatic Ecosystem*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Aquatic ecosystem of Bay of Bengal and Kutubdia channel					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium High***				

5.4.12 Impact on Occupational Health

According to the OPDL-2, during the operation of the proposed power plant, there may be up to 135 workers. The operation of the power plant, may cause a number of occupational health and safety risks and impacts, which may include non-ionizing radiation, heat, noise and vibration, working in confined spaces, electrical hazards, fire outbreaks due to electrical faults and explosion hazards, chemical hazards, mishandling of flammable substances, occupational illness due to exposure to dust, being struck by falling or moving objects, vehicle related accidents and accidents associated with lifting equipment. The receptors for occupational health and safety impacts include direct workers of the power plant and sub-contractors visiting to work at the plant.

The occupational health and safety risk associated with the project are as follows:

Non-ionizing radiation- The proposed plant workers are susceptible to higher exposure to electric and magnetic fields (EMF) than the general public due to working in proximity to the electric power generator, equipment and connecting high-voltage transmission lines.

Heat- Occupational exposure to heat may occur during the operation and maintenance of combustion units, pipes and related hot equipment.

Noise- Noise sources in combustion facilities include the turbine generators and auxiliaries; boilers and auxiliaries, such as pulverisers; diesel engines; fan and ductwork; pump; compressors, condensers, precipitators including rappers and plate vibrators, piping and valves; motors; transformers; circuit breakers.

Confined Spaces- Specific areas for confined space entry may include coal ash containers, turbines and condensers.

Electric Hazards- energized equipment and power lines may pose electrical hazards for workers.

[42] Hadderingh, R. H. (1979). Fish intake mortality at power stations the problem and its remedy. *Hydrobiological Bulletin*, 13(2-3), 83-93.

Fire and Explosion Hazards- Storage of fuel may lead to fire and explosion hazards.

Chemical hazards- The plant will utilize hazardous materials such as chlorine gas for treatment of wase water and boiler water.

Dust- Dust from coal and ash loading/unloading areas, storage area, fugitive emissions during coal and ash conveyance. Dust may contain silica (associated) with silicosis), arsenic (skin and lung cancer), coal dust (black lung), and other potentially harmful substances.

Without adequate controls, there will be potential adverse impacts on workers arising from inconsistent management of occupational safety and health. There may also be industrial hygiene hazards that workers could potentially be exposed to such as chemical handling without the use of proper personal protective equipment or studying the Safety Data Sheet (SDS) for the chemical on safe handling. The above hazards and risks associated with the operational phase may arise from the lack of a comprehensive written health and safety plan drawn up by the OPDL-2 for the operation phase of the project. Operation of the power plant and affiliated facilities may cause dust and noise nuisance to the worker and could lead to respiratory problems and hearing lose respectively. Additionally, ground level gas concentration may be significantly high and could cause nuisance to the worker. The impact on occupational health and safety is assessed to be ***Medium-High***.

Impact	*Impact on occupational health and safety*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Workers inside the project boundary					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Medium-high***					

5.4.13 Impact on Public Health and Safety

The different structures of the power plant project may cause an environmental hazard, which may eventually affect the health profile of this area. Some of the hazards may arise from ash, NO_2 and SO_2 dispersion if mitigation measures are not properly implemented. Other community Health and Safety risk include noise and vibration nuisance, non-ionizing radiation generated by the power transmission grid, dust emission, improper management of waste (solid, liquid, hazardous), improper drainage from the workers camp, accidents and injuries associated with increases in vehicular traffic, workers and pedestrians on existing roads, visual impact of changed landscape and traffic nuisance and the consequence potential health risk due to degraded air quality, visual impact and resulting emotional stress and increased public insecurity.

The effects of housing include an increase in the incidence of vector-borne diseases, respiratory illnesses, food supply and quality issues, injuries, and solid/liquid waste disposal issues for sanitary and non-sanitary wastes. Malaria and dengue fever are examples of vector-borne diseases spread by mosquitos. The influx of migrant workers, both domestic and international, into communities creates significant social challenges, including social vices. Employees working in operation phase could be carries of contagious disease, which could lead to health problems in the community. In addition, the community's population would grow, increasing demand for community health and educational facilities. The impacts of the project on public health and safety are assessed to be **Medium-Low**.

Impact	*Impact on Public health and safety*					
Impact Nature	Direct		Indirect		Induced	
Impact Scale	Inhabitant of project surrounding area					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Medium-low***					

5.4.14 Impact on Traffic Movement

The influx of workers in the project area will entail an increase in the traffic to and from the project site. During the operational phase of the project, increased traffic levels will be caused by public transport vehicles used by workers as well as service contractor vehicles leaving and entering the power plant. In addition, business and employment opportunities and better road conditions will result in an increase in number of vehicles and number of accidents. It is expected that, on an average of 15 to 20 vehicles per day will mobilize in the project site. Increases in the volume of traffic have the potential to increase the risk of accidents and noise levels along the access road. Movement of vehicles will generate dust and impact on terrestrial flora and fauna. The coal required for the proposed project will be transported by the waterway and unloaded in the Matarbari port then coal will be transported to coal yard through 4.7 km conveyer belt, so no impact is expected on road traffic due to the transportation of coal. During operation of the power plant, traffic nuisance is expected to be negligible as therefore would be very limited transportation. The impact on traffic movement is assessed to be ***Low***.

Impact	Impact on Traffic Movement					
Impact Nature	Direct		Indirect		Induced	
Impact Scale	Project surrounding area					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider ***Low***					

5.4.15 Social Impact

5.4.15.1 Impact on Demographic Pattern

The plant's operation will necessitate the importation of a significant number of skilled and semi-skilled workers from outside the study area. Furthermore, a large number of service class people who are directly connected with the plant's operating personnel, such as house servants, washer men, barbers, shopkeepers, and so on, will flow in from the surrounding areas. Because the plant and its ancillary facilities serve as an active hub of activity, a shift in population will occur within the study area. This would cause a shift in the local demographic patterns. The literacy level of people and their families involved in the operation of the plant would certainly enhance the overall literacy rate within the study area. The population density in the peripheral zone will also tend to rise, though very marginally.

5.4.15.2 Employment Generation and In-Migration of Skilled Workforce

The proposed 635 MW coal-fired power plant project is envisaged to generate direct and indirect employment opportunities, enhance skills development for both skilled and unskilled workers in the Matarbari, Cox's Bazar. During the operation of the proposed 635 MW power plant, about 137 personnel will be required for operation, maintenance and administration purposes. Furthermore, the project would contribute to providing meaningful job opportunities for the locals within the local communities and economic empowerment for the surrounding communities.

The project would also provide additional electricity to the national grid; contributing to meeting electric power shortfall in Bangladesh and promote local economic development while stimulating the development of related industries such as manufacturing, transportation and commerce. The project would also contribute to the foreign direct investment inflow and contribute directly and indirectly to national revenue generation and export. Additionally, the project would create provisions for infrastructure development such as roads, schools and health facilities, impact on the potential land use in the area and also boost local economy.

Considering the limited number of staff in operation stage, the project's contribution to the overall impact of demand for lodging, housing, and other services is minimal. Although the number of jobs created during this phase is likely to be small, there are likely to be some indirect positive effects on the local community as a result of the workers renting houses and rooms and the need for transportation services, which includes the regular requirement for commuting short-term visitors and industrial provisioning of a variety of materials. The effects in terms of job creation will have a positive impact on the employment situation.

5.4.15.3 Impact on Economic Enhancement

This project will definitely alter the simple and quiet rural nature of the locality, which exists today. As there will be flow of financial and material resources, there remains a large possibility of growth of population in the business, trade, commerce, and service sector. The large inflow of financial and material resources accompanied with the urban culture complete with technological inputs as modern housing, water closets, radio, television, synthetic fibers, use of steel and aluminum, use of LPG/electricity for domestic cooking would all contribute towards changing the socioeconomic environment of the areas as this would introduce a mixed culture emphasizing urban traits in place of traditional, prevalent rural customs. The economic, cultural, and technological changes are likely to induce social stress and ethical changes. All these would change the local lifestyle and standard of living. Thus, a simple backward community may be transformed into a semi-urban complex within a short timeframe. Such impacts are inevitable, that could also be felt in case of the proposed project; however, these would be attempted to be controlled and minimized by ensuring suitable human management, stable working conditions, security, and the provision of adequate compensation.

As the impact of economic enhancement duration is long term, probability of impact assessed as medium thus the significant of impact has been assessed positive impact.

5.4.15.4 Increased Affordability, Reliability and Stability of Electricity Supply

The proposed project is anticipated to inject about 635 MW of electricity into the national grid. as well as bring down the average cost of power generation for the Bangladesh Power Development Board. This is expected to:

- Increase BPDB's outreach and connectivity with an emphasis on rural electrification, educational institutions, health institutions and micro-enterprises.
- Reduce the cost of electricity generation.
- Address the current power shedding outages experienced nationally.

5.4.15.5 Disruption and Loss of Livelihood

The local people of the area are doing small scale fishing activity adjacent to the coastal area. They used to catch Wild shrimp Post Larvae in the Kutubdia channel and estuary of Matamuhuri River and Bay of Bengal. Hot water discharge may reduce the shrimp post larvae as a result the proposed project may adversely impacts on fish capture sites, fish migration in the river, availability of fish, restriction on fishing near the jetty, restriction on boat movement and poisoning of fish through hazardous discharges into the sea by the power plant. An expressed concern was that project activities would destroy current fishing activities adjacent to the project site (Kutubdia Channel and along the coast of Bay of Bengal-Matarbari beach site) and impact on breeding and migration of Hilsa fish. Since, there are limited scale fishing along the coast and fisherman used to go for deep sea fishing, the impact on fishing livelihood will not be affected significantly. Hence, the impact significant has been accessed as **Medium Low**.

Impact	*Loss of Livelihood*					
Impact Nature	Direct	Indirect	Induced			
Impact Scale	Local people depending on coastal fishing					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low	Medium	High			
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-low***				

5.4.16 Impact due to Transportation of Primary Fuels

The required coal (1.47 million tons per annum) for the power plant will be imported from Indonesia and Australia. Coal will be transported from source point to the Matarbari deep seaport directly since the port has sufficient draft to berth 60000-70000 dwt ship. Hence, there will no requirement of be no transshipment. Coal will be unloaded in the Matarbari port and transported to the plant's coal yard through 4.7 km long conveyer belt.

Dust will be generated during the coal unloading at jetty area, coal conveying and coal handling area. Windblown dust will impact on the surface water quality as well as the aquatic environment. Air quality will be impacted due to the emission from the combustion of fuels. Noise may generate from operation of these ships/vessels. Noise will also generate from the coal conveying system. Similarly, coal unloading system and handling system may also generate noise. Generally, different types of wastes are produces from ships. The waste includes residue of the bulk (coal in this case), ballast water, bilge water, oil, lubricant, garbage, domestic waste, food and kitchen waste, slurry of seawater, sewage, etc. Surface water may be polluted due to oil spillage, coal spillage and other malpractice like waste discharge, discharge of ballast and bilge water, etc., which are prohibited by IMO conventions. Hence, the impacts due to transportation of primary fuels is assessed to be ***Medium-Low***.

Impact	*Impact due to transportation of primary fuel*		
Impact Nature	Direct	Indirect	Induced

Impact Scale	Coal transportation route and handling area					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss	Low		Medium	High		
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider	***Medium-low***				

CHAPTER 6

Evaluation of Impacts

6 EVALUATION OF IMPACTS

Impact evaluation will help the decision makers to find out the significance of the impact due to the different activities during the construction and operation phases and to take further policy initiatives. The environmental and social impacts during pre-construction, construction and operation phase of the proposed project have been analysed and evaluated considering without mitigation measures in section 5. The impacts evaluation has been done following the methodology presented in section 1.10.2.4.2. In this section impact evaluation is done considering without mitigation and with mitigation measures. The mitigation measures for the assessed impact are presented in section 7. Those mitigation measures are considered during the impact evaluation with mitigation case. The following Table 6-1, Table 6-2 and Table 6-3 present the impact evaluation during pre-construction, construction and operation phase.

Table 6-1: Impact Significance during Pre-Construction Phase

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
Impact on Landform	5.2.1	Changes of Land use	Negative	Without Mitigation	Direct	Project site	Permanent no-mitigation	Medium	Medium	High	Medium-High
				With Mitigation	Direct	Project site	Long Term	Low	Medium	Medium	Low
Impact on sites from where material would be collected	5.2.2	Ambient air quality and aquatic ecosystem	Negative	Without Mitigation	Direct	Local	Short Term	Medium	Medium	Definite	Medium-High
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Drainage Pattern	5.2.3	Change of drainage network	Negative	Without Mitigation	Direct	Local	Long Term	High	Medium	High	Medium-High
				With Mitigation	Direct	Local	Short Term	Medium	Low	Medium	Low
Air Quality	5.2.4	Dust and exhaust emission	Negative	Without Mitigation	Direct	Local	Short Term	Medium	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Noise Level	5.2.5	Impact on resident and aquatic ecosystem	Negative	Without Mitigation	Direct	Local	Short Term	Medium	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Water Bodies	5.2.6	Water quality degradation	Negative	Without Mitigation	Direct	Local	Short Term	Medium	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
Soil	5.2.7	Soil quality degradation	Negative	Without Mitigation	Direct	Local	Short Term	Low	Medium	Medium	Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Social Impact	5.2.8.1	Land Loss	Negative	Without Mitigation	Direct	Local	Long Term	Medium	Medium	Medium	Medium-Low
				With Mitigation	Direct	Local	Long Term	Low	Low	Low	Very Low
	5.2.8.2	Livelihood Loss	Negative	Without Mitigation	Direct	Local	Permanent-mitigated	Medium	High	Definite	High
				With Mitigation	Direct	Local	Long Term	Low	Medium	Low	Low
	5.2.8.3	Physical Displacement	Negative	Without Mitigation	Direct	Local	Long Term	Medium	Medium	High	Medium-High
				With Mitigation	Direct	Local	Medium Term	Low	Low	Low	Very Low
Ecosystem and Biodiversity	5.2.9.1	Terrestrial Flora	Negative	Without Mitigation	Direct	Local	Short Term	Low	Low	Medium	Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
	5.2.9.2	Terrestrial Fauna	Negative	Without Mitigation	Direct	Local	Short Term	High	Medium	High	Medium High
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
	5.2.9.3	Aquatic Ecosystem	Negative	Without Mitigation	Direct	Local	Short Term	Medium	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
Occupational health and Safety	5.2.10	Workers Health, Sanitation and Safety	Negative	Without Mitigation	Direct	Local	Long Term	Medium	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low

Table 6-2: Impact Significance during Construction Phase

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
Land Use	5.3.1	Changes of Land use	Negative	Without Mitigation	Direct	Project site	Long Term	High	Medium	High	Medium-High
				With Mitigation	Direct	Project site	Long Term	Low	Medium	Medium	Low
Natural Resources	5.3.2.1	Agricultural Resources	Negative	No impact expected on agricultural resources since project site only used for salt and shrimp cultivation.							
	5.3.2.2	Impact on Fisheries	Negative	Without Mitigation	Direct	Local	Short Term	High	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
	5.3.2.3	Impact on forest	Negative	Without Mitigation	Direct	Project Site	Short Term	Medium	Medium	Medium	Low
				With Mitigation	Direct	Project Site	Short Term	Low	Low	Low	Very Low
	5.3.2.4	Impact on Livestock	Negative	No impact expected on livestock since project site only used for salt and shrimp cultivation.							
Ambient Air Quality	5.3.3		Negative	Without Mitigation	Direct	Local	Short Term	Medium	Medium	Medium	Low

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
		Dust and exhaust emission		With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Ambient Noise Level	5.3.4	Impact on resident and aquatic ecosystem	Negative	Without Mitigation	Direct	Local	Short Term	High	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Water Bodies	5.3.5	Water qaulity degredation	Negative	Without Mitigation	Direct	Local	Short Term	Medium	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Medium	Low
Soil	5.3.6	Soil quality degredation	Negative	Without Mitigation	Direct	Local	Long term	High	Medium	High	Medium-High
				With Mitigation	Direct	Local	Long term	Low	Low	Low	Low
Workers Health, Sanitation and Safety	5.3.7.1	Accident and Injury	Negative	Without Mitigation	Direct	Local	Long term	High	Medium	High	Medium-High
				With Mitigation	Direct	Local	Long term	Low	Low	Low	Low
	5.3.7.2	Health impact due to environmental condition	Negative	Without Mitigation	Direct	Local	Short term	Low	Low	Medium	Low
				With Mitigation	Direct	Local	Short term	Low	Low	Low	Very Low
Impact on Key point Installation	5.3.8	Environmental condition degradation in the KPI area	Negative	Without Mitigation	Direct	Local	Short Term	Low	Low	Medium	Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Solid waste disposal	5.3.9	Impact on air, water and ecosystem	Negative	Without Mitigation	Direct	Local	Short Term	Low	Low	Medium	Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Social Impact	5.3.10.1	Impact on local resources	Negative	Without Mitigation	Direct	Local	Short Term	Medium	Low	Medium	Low

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
	5.3.10.2	Impact on community health	Negative	Without Mitigation	Direct	Local	Long Term	Medium	Medium	Medium	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
	5.3.10.5	Employment Generation	Positive	Without Mitigation	Direct	Local	Medium Term	High	Low	High	Medium-Low
				With Mitigation	Direct	Local	Long Term	High	Medium	High	Medium High
Wastewater Disposal	5.3.11	Impact on soil, water and ecosystem	Negative	Without Mitigation	Direct	Local	Long Term	High	Medium	High	Medium-High
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Transportation of Raw Materials	5.3.12	Impact on water and ecosystem	Negative	Without Mitigation	Direct	Local	Short Term	Medium	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Ecology	5.3.13.1	Terrestrial Flora	Negative	Without Mitigation	Direct	Local	Short Term	Low	Medium	Low	Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
	5.3.13.2	Terrestrial Fauna	Negative	Without Mitigation	Direct	Local	Short Term	High	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
	5.3.13.3	Aquatic Ecosystem	Negative	Without Mitigation	Direct	Local	Long Term	High	Medium	High	Medium-High
				With Mitigation	Direct	Local	Short Term	Medium	Low	Medium	Low
Groundwater	5.3.14.1	Groundwater quality	Negative	Without Mitigation	Direct	Local	Long Term	Medium	Medium	Medium	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
	5.3.14.2	Groundwater availability	Negative	Without Mitigation	Direct	Local	Short Term	High	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low

Table 6-3: Impact Significance during Operation Phase

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
Natural Resources	5.4.1.1	Agricultural Resources	Negative	No impact expected on agricultural resources since project site only used for salt and shrimp cultivation. Rather it may increase crop production. Application of fly ash in agricultural land increases crop production. The operation of the coal-based power plant will lead to industrial development in the surrounding area that ultimately increases the stress on the surrounding agricultural land.							
	5.4.1.2	Impact on Livestock	Negative	Project site land only used for salt and shrimp cultivation. Since the project site has no contribution to livestock hence, the impact on livelihood can be accessed as insignificant.							
Collection of Local Resources	5.4.2	Stress on local resources and environment	Negative	Annually 1.47 million tons coal will be required for the operation of the power plant. Also, 500 KL/annum HFO and LDO will be required for the plant. All the required coal will be imported from Australia and Indonesia. Liquid fuel will also be imported from abroad. No major resource will be collected from locally. So, no impact has been predicted locally for collection of resources.							
Ambient Air Quality	5.4.3.3	Impact on ambient air due to operation of the plant	Negative	Without Mitigation	Direct	Local	Long Term	High	Medium	Medium	Medium-Low
				With Mitigation	Direct	Local	Long Term	Low	Low	Low	Low
Ambient Air Quality	5.4.3.4	Impact on ambient air due to operation of the plant and	Negative	Without Mitigation	Direct	Regional	Long Term	High	High	Definite	High
				With Mitigation	Direct	Regional	Long Term	Low	Low	Low	Low

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
		other power plants									
Green House Gas Emission	5.4.3.4	Impact on ambient air due to operation of the plant and other power plants	Negative	Without Mitigation	Direct	Regional	Long Term	Medium	Medium	Medium	Medium-Low
				With Mitigation	Direct	Regional	Long Term	Low	Low	Low	Low
Ambient Noise Level	5.4.5	Impact on resident and ecosystem	Negative	Without Mitigation	Direct	Local	Long Term	Medium	Medium	High	Medium-Low
				With Mitigation	Direct	Local	Long Term	Low	Low	Low	Low
Water Bodies	5.4.6.1	Surface water quantity	Negative	Without Mitigation	Direct	Local	Long Term	Insignificant	Low	Unlikely	Very Low
				With Mitigation	Direct	Local	Long Term	Insignificant	Low	Unlikely	Very Low
	5.4.6.2	Degradation of surface water quality	Negative	Without Mitigation	Direct	Local	Long Term	High	Medium	High	Medium High
				With Mitigation	Direct	Local	Long Term	Low	Low	Low	Low
	5.4.6.3	Impact due to discharge of hot water	Negative	Without Mitigation	Direct	Regional	Long Term	High	Medium	High	Medium High
				With Mitigation	Direct	Local	Long Term	Medium	Medium	Medium	Medium-Low
	5.4.7.1	Solid waste disposal	Negative	Without Mitigation	Direct	Local	Long term	Medium	Medium	Medium	Medium Low

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
Waste Generation and Disposal				With Mitigation	Direct	Local	Long term	Low	Low	Low	Low
Wastewater Generation and Disposal	5.4.7.2	Wastewater generation and disposal	Negative	Without Mitigation	Direct	Local	Long term	High	Medium	High	Medium High
				With Mitigation	Direct	Local	Long term	Low	Low	Low	Low
Soil and Agriculture	5.4.8	Soil quality degradation	Negative	Without Mitigation	Direct	Local	Long term	Medium	Medium	Low	Low
				With Mitigation	Direct	Local	Short term	Low	Low	Low	Very Low
Groundwater	5.4.9	Contamination of groundwater	Negative	Without Mitigation	Direct	Local	Long term	High	Medium	Medium	Medium Low
				With Mitigation	Direct	Local	Long term	Low	Low	Low	Low
Ash Disposal	5.4.10	Impact on Air, Soil and groundwater	Negative	Without Mitigation	Direct	Local	Long term	High	Medium	High	Medium High
				With Mitigation	Direct	Local	Long term	Low	Low	Low	Low
Ecology	5.4.11.1	Terrestrial Flora	Negative	Without Mitigation	Direct	Regional	Long Term	Medium	Low	Medium	Medium Low
				With Mitigation	Direct	Local	Long Term	Insignificant	Low	Low	Very Low
	5.4.11.2	Terrestrial Fauna	Negative	Without Mitigation	Direct	Regional	Long Term	Medium	Medium	Medium	Medium-Low
				With Mitigation	Direct	Regional	Long Term	Insignificant	Low	Low	Low

Env. Attribute	Section	Impact	Impact Category	Scenario	Impact Nature	Extent	Duration	Impact Intensity	Potential for irreplaceable loss	Probability	Significance
	5.4.11.3	Aquatic Ecosystem	Negative	Without Mitigation	Direct	Regional	Long Term	High	Medium	High	Medium High
				With Mitigation	Direct	Regional	Long Term	Medium	Low	Medium	Medium Low
Occupational Safety	5.4.12	Health impact to employee	Negative	Without Mitigation	Direct	Local	Long Term	High	Medium	High	Medium High
				With Mitigation	Direct	Local	Long Term	Low	Low	Low	Low
Public Health and Safety	5.4.13	Impact on community health	Negative	Without Mitigation	Direct	Local	Long Term	Medium	Medium	Medium	Medium Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Traffic Movement	5.4.14	Impact on air and community health	Negative	Without Mitigation	Direct	Local	Long Term	Low	Low	Low	Low
				With Mitigation	Direct	Local	Short Term	Low	Low	Low	Very Low
Social Impact	5.4.15.2	Employment Generation	Positive	Without Mitigation	Direct	Local	Long Term	High	Medium	High	Medium-High
				With Mitigation	Direct	Local	Long Term	High	High	High	High
	5.4.15.5	Loss of Livelihood	Positive	Without Mitigation	Direct	Local	Long Term	Medium	Medium	Medium	Medium-Low
				With Mitigation	Direct	Local	Long Term	Low	Low	Low	Low
Transportation of Primary Fuel	5.4.16	Impact on water and ecosystem	Negative	Without Mitigation	Direct	Regional	Long Term	Medium	Low	Medium	Medium Low
				With Mitigation	Direct	Local	Long Term	Low	Low	Low	Low

CHAPTER 7

Mitigation of Impacts

7 MITIGATION OF IMPACTS

Key environmental and social impacts of the proposed 635 MW coal-fired power plant project at Matarbari, Maheshkhali, Cox's Bazar have been identified and assessed in Chapter-6 in this EIA report. These analyses identify the scope of adopting mitigation measures or reconciliation of the project design with the objective of preventing environmental pollution in compliance with ECA, 1995 and subsequent amendment and Noise Pollution (Control) Rules, 2006 and Air Pollution (Control) Rules, 2022. The following section describes mitigation measure required for limiting the negative impacts of the proposed power plant project activities and contingency measures required for reducing risk of accidental hazard and enhancement measures for enhancing positive impacts with the aim of sustainable implementation and operation of the project ensuring environmental and community safety. Orion Power Unit-2 Dhaka Limited (OPDL-2) will be responsible for ensuring that the mitigation measures in the Environmental Management Plan are implemented throughout the lifespan of the proposed project.

7.1 Mitigation Measures for Pre-Construction Stage Impacts

7.1.1 Mitigation Measures of Impact on Landform

The following mitigation measures will be adopted to mitigate the landform change

- Land development will be confined within the project boundary, and special care needs to be taken as the earth filling material cannot move to the adjacent land;
- Avoidance of productive land and far from the nearest settlement area is preferable;
- Avoidance of encroachment of waterbodies is preferable;
- Trees/Vegetation clearance should be reduced as much as possible;
- Greenbelt development as early as possible after completion of the construction activities immediately;
- Complete the landfill and soil compaction as soon as possible before starting the construction activities for the power plant;
- Landfilling and site development activities can be continued during dry season only to avoid drainage congestion/waterlogging in the project site and its surrounding area;
- Adequate storm water drainage plan should be ensured by the project proponent during the pre-construction stage of the proposed project;
- Parking of vehicles and stockpiling of materials/excavated earth should be done in systematic way to avoid the damaging of aesthetics of the site; and
- Regular monitoring of the drainage condition and waterlogging situation in the project area.

7.1.2 Mitigation Measures of Impact due to Resource Collection

The following needs to be adopted to mitigate the impact due to collection of resources for land development

- The contractor must select the dredging site in such a way that the dredging activities will not impact on protected area, wildlife sanctuary, fish sanctuary, marine protected area, fishing zone, fish breeding site, vessels traffic route, hilsa, dolphins and turtle movement route;
- The contractor must be checked the quality of required dredge material/soil before starting the dredging activities;
- Necessary permission must be taken from the concern authorities like Deputy Commissionaire Office, Port Authority, DoE, Ministry of shipping before starting dredging activities, if required;
- Avoid the monsoon season for dredging activities;
- Regular maintenance of water vessels, vehicles in accordance with manufacturer's specifications;

- Identify potential hazards to workers, particularly those that may be life threatening and provide necessary preventive and protective measures;
- No disturbance of water vessels those who moves in the sea/river for accessing the nearest boat landing station must be ensured;
- Dredged soil shall be covered and confined to avoid their wind drifted during transportation;
- Switched off and park the dredgers and barges in a designated area when not in use;
- Instruct the workers to avoid disturbance of aquatic animals;
- Instruct the workers to protect water resources and no disposal of waste in the sea/river from the dredgers and material carrying barge;
- Provide adequate space for movement and safe passage of fishes and other aquatic animals;
- Schedule activities to avoid disturbance of fish and aquatic animal during critical periods of the day (e.g., night) or year (e.g., periods of breeding);
- Turn off all unnecessary lighting at night to avoid attracting and disturbance of fishes; and
- Regular monitoring the fish death and disturbance of fish and aquatic animals in the dredging site.

7.1.3 Mitigation Measures of Impact on Drainage Pattern

The following mitigation measures will be adopted to avoid drainage congestion

- Land development will be confined within the project boundary;
- Ensure the proper drainage in the project site;
- No waste dumping in the existing drainage around the project site;
- An alternate canal must be excavated by the project proponent before filling the existing canal;
- Ensure the water availability for salt/shrimp/agricultural activities to the southern side of the project boundary;
- Ensure the proper drainage network around the project site since the rainwater can drain out properly and settlement are free from waterlogging;
- Separate drainage network should be constructed to drain out the liquid waste from the project site;
- Monitor the surrounding drainage condition during the monsoon season to avoid the waterlogging.

7.1.4 Mitigation Measures of Impact on Ambient Air

The following mitigation measures will be adopted to minimize the impact on air quality

- Water sprinkling will be regularly carried in order to arrest the fugitive dust on landfill sites;
- Limit the speed of the vehicles (it shall be 20 km/hour) and cover the vehicles during the movement or transportation of soil for landfilling;
- Ensure that vessels should be covered during transportation of soil;
- Stored materials such as: excavated earth, dredged soil, gravel and sand shall be covered and confined to avoid their wind drifted;
- Stop unnecessary vehicle and engine operation in the project site when it is not in working mode;
- Vehicles, DG sets and machineries to be properly and timely maintained and serviced regularly to control the emission of air pollutants;
- Equipment causing excess pollution (e.g. visible smoke) will be banned from project sites immediately prior to usage;
- Use of good quality fuel and lubricants will be promoted. Moreover, low Sulphur content diesel shall be used as fuel for DG sets to control emission of SO_2;
- Periodic checking of vehicles and construction machinery to ensure compliance to emissions standard following the National Motor Vehicles Standard (Schedule- 2: Standards for emission from motor vehicles, Air Pollution Control Rules, 2022);

- Dust monitoring should be carried out every day by the contractor in the landfilling site; and
- The Ambient Air quality monitoring should be carried out by the contractor following the National Air Pollution Control Rules, 2022 (Schedule-1: Ambient Air Quality Standard).

7.1.5 Mitigation Measures of Impact on Ambient Noise Level

Following mitigation measures shall be maintained to mitigate the noise impact during pre-construction phase.

- Inform the local community before starting the landfilling activities;
- Trees/Vegetation clearance should be reduced as much as possible;
- Provide appropriate Personal Protective Equipment (PPE) among the workers those who will work within or near the high noise generation source;
- Avoiding unnecessary engine operations and horns (e.g. equipment's with intermitted use switched off when not working);
- Activities that take place near sensitive receptors to be carefully planned (restricted to daytime, taking into account weather conditions etc.) and use noise barrier (if required);
- Maintain vehicles and construction equipment in good working condition including regular servicing;
- Use muffler and silencer to reduce the noise level from the equipment and machineries;
- Periodic checking of vehicles to ensure compliance to sound standard following the National Motor Vehicles Standard (Schedule-2: Standards for sound originating from motor vehicles or mechanized vessels, Noise pollution control rules 2006); and
- Regular monitoring of noise pollutants concentrations following the National Sound Quality Standard (Noise Pollution (control) rules 2006).

7.1.6 Mitigation Measures of Impact on Waterbody

The following mitigation measures shall be maintained to mitigate the impact on waterbody during pre-construction phase.

- Avoidance of encroachment of waterbodies is preferable;
- Temporary drainage should be ensured by the contractor during landfilling and site development;
- Regular monitoring of the drainage condition and waterlogging situation in the project area;
- An alternate canal must be excavated and regulator needs to be set up by the project proponent before filling the existing canal;
- During the excavation of new canal and regulator, it must be considered the depth and width of the canal to drain water from the surrounding area;
- Site cleaning wastes should be dump primarily in a specific area in the project site and immediately remove to the approved site;
- Duration of stockpiling should be minimized as much as possible;
- Accidental spill management plan should be introduced in the site;
- Introduction of land/soil erosion and dust control practices in the project site; and
- Monitor the surface water and groundwater by testing in designated laboratory should be done by the Contractor following the National Water Quality Standard (Schedule-2: Standards for Water, ECR, 2023).

7.1.7 Mitigation Measures of Impact on Soil

Following mitigation measures shall be maintained to mitigate the impact on soil during pre-construction phase.

- Establishing the project boundary prior to sand filling;
- Land development should be restricted within the project boundary;
- Demarcating routes for the movement of heavy vehicles;
- Stripping and placing soils when dry, and not when wet;
- The Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks;
- A site-specific Emergency Response Plan will be prepared by the Contractor for soil clean-up and decontamination;
- Fuel tanks and chemical storage areas will be provided with locks and be sited on sealed areas;
- Use of spill or drip trays to contain spills and leaks;
- Use of spill control kits to contain and clean small spills and leaks;
- The storage areas of oil, fuel and chemicals will be surrounded by bunds or other containment device to prevent spilled oil, fuel and chemicals from reaching the receiving waters;
- The construction contractor will implement a training program to familiarise staff with emergency procedures and practices related to contamination events;
- Segregation of hazardous and non-hazardous waste and provision of appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimize odour nuisance);
- Storage of wastes in closed containers away from direct sunlight, wind and rain;
- Storage of waste systematically to allow inspection between containers to monitor leaks or spills;
- Ensuring that storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container; and
- Disposal of waste by licensed contractors/local municipality.

7.1.8 Mitigation Measures of Social Impact

7.1.8.1 Mitigation Measures of Land Loss

The following mitigation measures shall be adopted to minimize the impact on land loss

- The land acquired would be appropriately compensated;
- The land acquisition and compensation payment process would follow the national regulatory requirements and international practices;
- Avoidance of productive land is as much as possible;
- PAPs losing land shall be involved in project‘s job opportunity based on their qualification, if possible;

7.1.8.2 Mitigation Measures of Livelihood Loss

The possible mitigation measures to address the aforesaid impacts include:

- Preparation of livelihood restoration plan and eligibility for livelihood restoration measures;
- Enhancement of sustainable livelihood of the affected saltpan and shrimp workers through skill development for alternate employment;
- Unskilled labor during the project construction phase would be sourced from the local community;
- Training would be provided to the local people for their skill enhancement.

7.1.8.3 Mitigation Measures of Physical Displacement

The possible mitigation measures to address the aforesaid impacts include:

- Provide technical and financial assistance for the relocation of the affected households;
- Initiate CSR activities to enhance their livelihood;
- Involve the displaced person during the construction and operation phase of the power plant as per their skill.

7.1.8.4 Employment Generation

The following measures need to be taken for employment:

- Employing local people for site cleaning and development activities as per the expertise to the maximum extent possible;
- Equal employment opportunities for the local community and no discrimination based on race, religion, political influence etc.;
- No child and/or forced labour will be employed by the EPC contractor, it is strictly prohibited as per the Bangladesh labour law;
- Payment must be ensured by the contractor as per the present labour law in Bangladesh;
- No entrance of unauthorized person in the project site without the permission from the concern officer;
- Trained the workers by providing health and safety training on communicable diseases; and
- Working conditions and terms of employment will be fully compliant to the Bangladesh labour laws.

7.1.9 Mitigation Measures of Impact on Ecosystem and Biodiversity

7.1.9.1 Mitigation Measures of Impact on Terrestrial Flora

Following mitigation measures needs to be addressed during the pre-construction phase

- Trees/Vegetation clearance should be reduced as much as possible;
- Select coal conveyor routes in such a way as to avoid felling of Jhau trees;
- Regular monitoring and keeping records of tree removal from the project site;
- Tree felling, if unavoidable, shall be done only after compensatory plantation of at least three saplings for every tree cut is done;
- Dust mitigation measures i.e., water spraying, covering stockpiles during transportation, etc. should be followed;
- Greenbelt development around the project site and surrounding area as early as possible;
- Workers should be aware of the importance of natural resources and should not unnecessarily break branches, twigs, flowers, etc. of adjacent vegetation; and
- Diesel and other oils used for machineries should be stored carefully and use drip pans to avoid mixing with soil and water.

7.1.9.2 Mitigation Measures of Impact on Terrestrial Fauna

The following mitigation measures shall be adopted to minimize the impact on terrestrial fauna

- Dust mitigation measures i.e., regular watering and sprinkling should be followed;
- Machinery with lesser noise production should be used as far as practicable;
- Noisy equipment such as breakers and rollers should be located as far away from receptors;
- Directional lighting facility should be followed at project site to avoid disturbance of the movement of nocturnal wildlife species;
- Refrain from engaging in noisy tasks during nighttime;
- Workers should be aware of the importance of natural resources and should not do any harm or death to wildlife;

7.1.9.3 Mitigation Measures of Impact on Aquatic Ecosystem

Following mitigation measures needs to be addressed to mitigate the impact on aquatic ecosystem during the pre-construction phase

- Dredging should be done in designated place. Siltation control curtains should be used to minimize the dredging impacts.

- Oil leakage or spillage from land filling, levelling, and compacting associated machinery will be contained and cleaned up regularly;
- Waste oil will be collected and stored for recycling or disposal;
- Workers should be aware of the importance of natural resources and should not dispose anything into the waterbodies;
- No disturbance for aquatic animal and keep provision for the fish movement;
- Turn off all unnecessary lighting to avoid attracting and disturbance of fishes and wildlife; and
- Regular monitoring the fish death and disturbance of fish and aquatic animals in the dredging site.

7.1.10 Mitigation Measures of Impact on Occupational Health and Safety

The following mitigation measures shall be adopted to minimize the impact on occupational health and safety

- Brief the workers before starting the activities in the project site;
- Workers would be provided with appropriate and adequate personal protection equipment (PPE);
- Ensure effective use of the personal protection equipment (PPE);
- Provide health care and first aid facilities are readily available in the project site;
- Establishment of safety sign in the accident-prone area/source in the project site and dredging site;
- Restriction for unauthorized person in the project site;
- Controlled vehicles speed on the proposed project site, it shall be 20 km/hour;
- Provide adequate lighting in the landfilling area and along the roads in the project site;
- Identify potential hazards to workers, particularly those that may be life threatening and provide necessary preventive and protective measures;
- Stop unnecessary engine operation when it is not in work;
- Provision of clean drinking water in the construction camp in accordance with Schedule 2(b) of ECR, 2023;
- Trained the workers by providing health and safety training on communicable diseases;
- Educating project personnel, and area residents on risks, prevention, and available treatment for vector-borne diseases;
- No child and/or forced labour will be employed by the EPC contractor, it is strictly prohibited as per the Bangladesh labour law;
- The dredging work should be carried out in calm weather and sea condition and avoid work during bad weather;
- Provide proper navigational lighting and navigation aids for the vessels;
- Working conditions and terms of employment will be fully compliant to the Bangladesh labour laws; and
- The record of the accidents and incidents in the project site will be maintained using a register.

7.2 Mitigation Measures for Construction Stage Impacts

7.2.1 Mitigation Measures of Impact on Land Use

The following mitigation measures shall be adopted to minimize the impact on land use

- Prior to start the construction, project area should be bounded;
- The vertical clearance of the coal conveyor belt should be adjusted in such a way that the natural beauty of the Matarbari beach is maintained;
- Ensure water intake and outfall structures will not hamper beach access;
- Encroachment in the other areas should be restricted.

7.2.2 Mitigation Measures of Impact on Natural Resources

7.2.2.1 Mitigation Measures of Impact on Agricultural Resources

Following mitigation measures needs to be addressed during the construction phase

- Avoidance of productive land and far from the nearest settlement area is preferable;
- Avoidance of encroachment of surrounding land is preferable; and
- Greenbelt development as early as possible after completion of the construction activities immediately.

7.2.2.2 Mitigation Measures of Impact on Fisheries

Following mitigation measures needs to be addressed to mitigate the impact on fisheries during the construction phase

- Regular servicing and maintenance of vehicles and construction equipment's and only well-maintained equipment will be operated;
- Workers shall be instructed to protect fisheries resources and unauthorized capture are prohibited;
- No wastewater will be disposed into the aquatic environment;
- Schedule activities to avoid disturbance of fish and aquatic animal during critical periods of the day (e.g., night) or year (e.g., periods of breeding);
- Regular monitoring the fish death and disturbance of fish and aquatic animals during construction of jetty;
- Create noise barrier and avoid unnecessary machineries and equipment's operation;
- Restriction on fish capture in the river during the construction phase;
- Avoid major activities in the river during fish breeding time;
- Monitoring of ambient noise level as per the guidelines of the DoE (Noise Pollution Control Rules 2006);
- Ensure proper collection and disposal of solid wastes from construction camp;
- All sewage and liquid effluent will be treated properly as per the guidelines of DoE (Schedules 3 and 4 of the ECR, 2023);
- Careful handling of construction waste in the construction site;
- A brief instruction of all workers about the noise control measures and disturbance on ecosystems in the construction site; and
- Construction workers shall be instructed to protect natural resources, flora and fauna, including wild animals and aquatic life, hunting and unauthorized fishing are prohibited.

7.2.2.3 Mitigation Measures of Impact on Forest

There is no forest within the project boundary. However, the following mitigation measures shall be adopted to minimize the impact on terrestrial flora

- Trees/Vegetation clearance should be reduced as much as possible;
- Water spray to the dry earth/material stockpiles, access roads and bare soils as and when required to minimize the potential for environmental nuisance due to dust;
- Regular water sprinkling will minimize the ecological disturbance due to windblown dust in the project site;
- Create barrier around the project site;
- Stored materials such as: excavated earth, gravel and sand shall be covered and confined to avoid their wind drifted;
- Limit the speed of the vehicles (it shall be 20 km/hour) and cover the vehicles during the movement or transportation of soil for landfilling on the existing road network;
- The contractor in the project site should carry dust monitoring out every day.

7.2.3 Mitigation Measures of Impact on Ambient Air Quality

Following mitigation measures needs to be addressed to mitigate the impact on ambient air quality during the construction phase

- The EPC contractor should develop and implement a Construction Environment Management Plan (with reference to the management of air quality during the construction phase) once detailed information relating to the construction methodology and the schedule is available (prior to commencement);
- The EPC contractor will be compacted access roads and kept clean, free from mud and slurry and spray with water to minimize the dust generated from the vehicles and trucks;
- The EPC contractor should consider minimization of ground-works when high winds are present;
- The EPC contractor should undertake land grading, improvement or moving of materials during periods of low winds;
- Sand and other materials will be stored in specifically designated areas and will be properly stored at the site and will be water-sprayed or covered;
- Implementation of regular watering and sprinkling dust suppression regime, during the dry season;
- The concrete batching plant will be located within the protected site to keep it away from sensitive receptor/s;
- Stockpiles will be maintained at the site only, which is a fenced area. No stockpiles will be maintained outside, and the maximum possible distance between the stockpiles and receptors will be maintained;
- Material transport will be totally enclosed with impervious sheeting, and wheel washing will be carried out at the site;
- Waste from construction will not be burned;
- The movement of construction vehicles will be minimized, and a 20 km/hr speed limit will be enforced around the construction site;
- Exhaust vent of DG set will be kept at proper height to ensure quick dispersion of gaseous emissions;
- Equipment causing excess pollution (e.g. visible smoke) will be banned from project sites immediately prior to usage;
- Periodic checking of vehicles and construction machinery to ensure compliance to emissions standard following the National Motor Vehicles Standard (Schedule-2: Standards for emission from motor vehicles, APCR, 2022);
- The Ambient Air quality monitoring should be carried out by the contractor following the National Air Pollution Control Rules 2022 (Schedule-1: Standards for Ambient Air Quality).and
- Lorries and trucks engines should be turned off while waiting on site to minimise the exhaust emissions.

7.2.4 Mitigation Measures of Impact on Ambient Noise Level

The following mitigation measures shall be adopted to minimize the impact on ambient noise level

- Normal working hours of the contractor will be between 06:00 and 21:00 hours from Saturday to Thursday. If work needs to be undertaken outside these hours, it should be limited to activities that do not exceed the noise criteria at nearby noise sensitive receptors;
- Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from noise- sensitive receptors;
- The EPC contractor should ensure that all equipment and its mufflers are regularly serviced, and immediately serviced/replaced if damaged;
- Acoustic covers on all machine engines that generate excessive noise levels are to remain closed at all times;

- The EPC contractor should limit operation times of noisy equipment, vehicles and activities, where possible;
- Designation of a community liaison officer who will be able to deal with the concerns of residents and establishment of a noise complaint response program can enable the identification and resolution of any noise related concerns at an early stage;
- The EPC contractor should conduct regular inspection and spot checks of all noise generating equipment.
- Machinery and construction plant that may be in intermittent use (e.g. trucks) shall be shut down or throttled down during non-work periods;
- Low noise equipment shall be used as far as practicable;
- The number of equipment operating simultaneously shall be reduced as far as practicable;
- The contractor should consider the noise emission characteristics of equipment when selecting equipment for the project and select the least noisy machine available to perform the specific work (this is a requirement of OSHA 2007);
- Mobile noise sources such as cranes, earth moving equipment shall be routed in such a way that there is a minimum disturbance to receptors;
- Restrict the nighttime vehicle movement through the access road;
- Adopt the vehicle speed (20 km/hr) limit in the access road
- All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50m away from the site boundary;
- Temporary noise barriers shall be provided surrounding the high noise generating construction equipment;
- Stone breaking machine should be confined within a temporary shed so that noise pollution could be kept minimum;
- Instruction to the drivers to avoid unnecessary engine operation and horn in the project site approach road;
- The personnel involved in the high noise generating activities shall be provided with personal protective devices to minimize their exposure to high noise levels;
- Periodic checking of vehicles to ensure compliance to sound standard following the National Motor Vehicles Standard (Standards for sound originating from motor vehicles or mechanized vessels, Noise Pollution Control Rules, 2006); and
- The Noise level monitoring should be carried out by the contractor following the Noise Pollution (control) rules 2006).

7.2.5 Mitigation Measures of Impact on Water Bodies

The following mitigation measures shall be adopted to minimize the impact on water bodies

- Restrict the earthwork activities during monsoon season;
- Channelize all surface runoff from the construction site through a stormwater drainage system and provide adequate size double chambered sedimentation tank;
- Prevent & mitigate spill of paint/fuel within the construction site;
- Oil leakage or spillage will be contained and cleaned up immediately. Waste oil will be collected and stored for recycling or disposal;
- Adequate sanitary facilities, i.e. toilets and showers, will be provided for the construction workforce;
- Construction camp wastewater (both grey and black water) will be stored in soaking pits/ septic tanks;
- Labor camp should be constructed at a distance from the water bodies and 500 m away from the settlement area;
- No solid and liquid waste discharge is allowable into the water bodies from the construction camp;
- Instruct workers to maintain clean environment in the construction camp;

- The solid waste generation due to workers dwelling on the site will be segregated and will be transported and disposed of to waste disposal facility;
- Provide sufficient number of latrine and bin and aware the workers to use the bins and keep clean the latrine for better health management;
- Stockpiles will be protected by plastic sheets and suitably secured against the wind, at the end of each working day if rain is forecasted;
- The EPC contractor will train their employees including sub-contractors at the site to minimize water consumption for ablutions and to ensure an understanding of wastewater issues; and
- All liquids effluent will be treated to meet the standards specified in Schedules 3 and 4 of the ECR, 2023 prior to discharge to the River.

7.2.6 Mitigation Measures of Impact on Soil

The following mitigation measures will be adopted to minimize the soil pollution

- Establishing the project boundary prior to start construction;
- Demarcating routes for the movement of heavy vehicles;
- Stripping and placing soils when dry, and not when wet;
- Restricting the height of topsoil stockpiles to minimize erosion and compaction;
- The Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks;
- A site-specific Emergency Response Plan will be prepared by the Contractor for soil clean-up and decontamination;
- Fuel tanks and chemical storage areas will be provided with locks and be sited on sealed areas;
- Use of spill or drip trays to contain spills and leaks;
- Use of spill control kits to contain and clean small spills and leaks;
- The storage areas of oil, fuel and chemicals will be surrounded by bunds or other containment device to prevent spilled oil, fuel and chemicals from reaching the receiving waters and soil;
- The construction contractor will implement a training program to familiarise staff with emergency procedures and practices related to contamination events;
- Segregation of hazardous and non-hazardous waste and provision of appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimize odour nuisance);
- Storage of wastes in closed containers away from direct sunlight, wind and rain;
- Construction wastes including metal, packaging materials should be dump primarily in a specific area in the project site and immediately remove to the approved site and finally disposed by approved vendors;
- No direct disposal of waste into open environment from the construction camp, it is strictly prohibited;
- Storage of waste systematically to allow inspection between containers to monitor leaks or spills;
- Ensuring that storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container; and
- Disposal of waste by licensed contractors/local municipality

7.2.7 Mitigation Measures of Impact on Workers Health, Sanitation and Safety

7.2.7.1 Mitigation Measures of Impact due to Accidents and Injuries from General Construction Activities

The following mitigation measures shall be adopted to minimize the impact due to accidents and injuries from general construction activities

- Adequate health care and sanitation facilities for construction workers will be provided by the contractor at the construction campsite;
- Adequate first aid facilities in the construction site;
- The contractor must be ensured the good quality drinking water facility in the construction site as per the DoE standard;
- Proper H&S measures for the workers such as using of appropriate PPE (helmet, earplug, musk, safety shoes, hand gloves etc.) should be taken to avoid any accidents;
- Safety sign in the accident/hazard-prone area/source;
- Regular tool-box training shall be conducted prior to start work;
- Constructional and occupational safety measures to be adopted during construction phase of the project;
- The health of workers will be checked for general illness; first time upon employment and thereafter at periodic intervals, as per the local laws and regulations;
- The workers will be diagnosed for respiratory functions at periodic intervals and during specific complaints etc. Health center and ambulance facility will be provided to the worker;
- No entrance of unauthorized people in the construction site without the permission from the concern officer;
- Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis;
- Regular mosquito repellent spraying during monsoon periods; and
- The contractor will take documentation of the accidents and illness in the construction site.

7.2.7.2 Mitigation Measures due to Health Impact associated with Environmental Conditions

The following mitigation measures shall be adopted to minimize the impact associated with environmental conditions

- Water spraying in dust generation sites for reducing dust pollutions;
- Provide appropriate PPE among the workers those who will work within dust emission sites;
- Instruct the workers about the health and safety issues in the construction site before starting the construction activities and ensure secure working environment;
- Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis;
- Adequate facilities for the health of construction workers will be provided at the construction camp;
- Safety sign in the accident/hazard-prone area/source;
- Establishment of the waste management plan and hazardous material handling plan at the project construction site;
- Handling of hazardous liquid should be done carefully by the designated experienced person; and
- Proper monitoring should be done by the contractor.

7.2.8 Mitigation measures of impact on Key Point Installation

The following mitigation measures shall be adopted to minimize the impact on key point installation

- Make aware workers about the key point installation;
- Consult with respective KPI authority prior to start the construction work and possible impact which may happen due to the project construction;
- Install proper signage of KPI area;
- Make aware workers in terms of access to the restricted place;
- Management of entry and exit register and

- Training of security personnel.

7.2.9 Mitigation Measures of Impact due to Solid Waste Disposal

The following mitigation measures shall be adopted to minimize the impact due to solid waste disposal

- Establishment of the waste management plan at the project construction site;
- Construction wastes that will be generated during construction stage should be dump primarily in a specific area in the project site and immediately remove to the approved site;
- Ensure proper collection and disposal of solid wastes within the construction camps and construction site;
- Solid waste burning in the construction site is strictly prohibited;
- Insist waste separation by source; organic wastes in one container and inorganic wastes in another container at sources;
- The organic wastes should be always covered with a thin layer of sand so that flies, mosquitoes, dogs, cats, rats, etc. are not attracted;
- Dispose organic wastes in a designated safe place on daily basis;
- Indiscriminate dumping of waste would be avoided to ensure proper management and disposal of the waste generated using the waste management system;
- Maximum effort would be made to reuse and recycle the generated solid waste;
- Attempts will be made to keep the waste segregated into different heaps as far as possible so that further gradation and reuse is facilitated;
- Materials, which would be reused for purpose of construction, levelling, making roads/pavement will also be kept in separate heaps from those which are to be sold or landfilled; and
- Regular monitoring will be carried out by the contractor to record of generation and disposal of waste in daily basis.
- Hazardous solid waste should be sell to the authorized vendors.

7.2.10 Mitigation Measures of Social Impact

7.2.10.1 Impacts on Local Resources and Infrastructures

The following mitigation measures will be adopted for local resources and infrastructure

- All the facilities for the workers during construction period must be ensured by the contractor;
- Must ensure the good quality living condition in the construction camp for the workers;
- Local community workers can be engaged for the construction period;
- Contractor should be ensured the availability of water for the construction activities;
- Provision of clean drinking water in the construction camp in accordance with Schedule 2(b) of ECR, 2023;
- Adequate first aid facilities in the construction site;
- Trained the workers by providing health and safety training on communicable diseases;
- Educating project personnel, and area residents on risks, prevention, and available treatment for vector-borne diseases;
- Working conditions and terms of employment will be fully compliant to the Bangladesh labor laws.

7.2.10.2 Impact on Community Health and Safety

The following mitigation measures will be adopted for community health and safety

- Inform the local community before starting the construction activities;
- The contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for working methods, plant utilisation, construction sequence and safety arrangements;

- Barriers will be provided to prevent entrance of Persons into the construction site and also to protect public exposure to hazards associated with construction activities;
- Avoiding formation of stagnant water pools in and around the site;
- Implementation of a vector control programme in labour camps and surrounding areas;
- Educating area residents and workers on risks, prevention, and available treatment for vector-borne diseases;
- Regular water spying in the high dust generating area;
- Put the noise barrier/wall in the high noise generating area;
- Proper traffic monitoring should be done by the contractor and keep the record of accidents;
- Limit the speed of construction vehicles in the construction site and project approach road, it shall be 20 km/hour;
- Instruct the driver's to drive carefully in the project site and approach road;
- Use of mobile phone during driving is strictly prohibited in the construction site;
- Proper indication of accident-prone area, education and religious institutes in the project site;
- Proper Traffic Management Plan (TMP) should be prepared by the contractor during starting of construction & follow it strictly; and
- In this TMP, the road safety measures such as speed breakers, warning signs/lights, road safety signs, flagman etc. should be included to ensure uninterrupted traffic.

7.2.10.3 Impact on Demography

The following mitigation measures will be adopted for impact on demography

- The contractor should develop and implement a transparent recruitment process and communicate the same through the social welfare offices to manage expectations and opportunistic influxes;
- Priority for employment and other economic opportunities should be given to the local community to minimize in-migration;
- The contractor should develop and implement camp and workforce management protocols which are clearly communicated to the workforce and enforcement measures implemented;
- The contractor should customize the grievance mechanism developed in this EIA Study and implement it for the construction phase of the project;
- The Contractor and Developer should facilitate small and medium enterprise (SME) development in the local communities and the surrounding region;
- The Contractor and Developer should invest in infrastructure development that can provide long-term benefit to the communities;
- The developer should identify and facilitate training opportunities with vocational training institutions such as the local workforce to participate in other job sectors; and
- The developer should support sustainable development and implementation of new technologies in local agricultural production and fishing.

7.2.10.4 Employment Generation

The following mitigation measures will be adopted for employment generation:

- OPDL-2 and its contractors must endeavour to prioritize the local community in the allocation of job opportunities, prioritizing from the residents immediately neighbouring and/or displaced by the project;
- OPDL-2 should also ensure opportunities for capacity building are afforded to the local communities to enable them to benefit from the available employment opportunities. This includes training in skills set required during the construction phase of the project;
- Job advertisements should be made through mediums that are easily accessible to the local community;

- Where possible, expertise should be sourced locally then nationally before resorting to the engagement of international experts;
- The recruitment selection process should seek to promote gender equality and the employment of women where possible; and
- Management and enhancement measures for local employment should be included in the company's labour and human resources plan.

7.2.10.5 Economic Growth

The following mitigation measures will be adopted for economic growth

- Ensure that economic opportunities are available or are created for the local community and that proper capacity building is afforded to the local communities to enable them to benefit from the available economic opportunities;
- Communication and information programs should be used to manage expectations and target local service providers;
- OPDL-2 and its contractors should, to the extent possible, make deliberate efforts to source for all required supplies from local providers, prioritizing from locally to the rest of the Country, before resorting to importation; and
- Tender documents should include guidelines for the involvement of local entrepreneurs, businesses and SMEs from the local sector.

7.2.10.6 Capacity Building

The following mitigation measures will be adopted for capacity building

- The contractor should institute an elaborate structure to promote and enhance knowledge transfer between international experts employed by the project and the local employees;
- The contractor should ensure the effective capacity building is afforded to the local communities to enable them to benefit from the available economic opportunities. This includes training for the skills required during the construction operational phase of the project;
- The contractor should effectively communicate the skill requirements to the local community well in advance of the construction phase. This should be done through mediums that are easily accessible to the local community such as local newspaper, upazila & union noticeboards, local radio, etc.

7.2.11 Mitigation Measures of Wastewater Generation and Disposal

The following mitigation measures shall be adopted to minimize the impact due to waste generation and disposal

- Domestic sewage would be appropriately managed and disposed;
- Establishment of the waste management plan and hazardous material handling plan at the project construction site;
- Disposal of wastewater in open environment is strictly prohibited;
- Instruct the workers to avoid improper disposal;
- All waste oils and chemicals should be stored in drums or tanks in a bunded compound situated on an impermeable surface in order to prevent potential spillage;
- Channelize all surface runoff from the construction site through a stormwater drainage system and provide adequate size double chambered sedimentation tank;
- Prevent & mitigate spill of paint/fuel within the construction site;
- Oil leakage or spillage will be contained and cleaned up immediately. Waste oil will be collected and stored for recycling or disposal;
- Adequate sanitary facilities, i.e. toilets and showers, will be provided for the construction workforce;

- Construction camp wastewater (both grey and black water) will be stored in soaking pits/ septic tanks and treated in STP; and
- All liquids effluent will be treated to meet the standards specified in Schedules 3 and 4 of the ECR, 2023 prior to discharge.

7.2.12 Mitigation Measures for Impact due to Transportation of Raw Materials

The following mitigation measures shall be adopted to minimize the impact due to transportation of raw materials

- Proper Traffic Management Plan (TMP) should be prepared by the contractor during starting of construction & follow it strictly;
- In this TMP, the road safety measures such as speed breakers, warning signs/lights, road safety signs, flagman etc. should be included to ensure uninterrupted traffic;
- Movement especially at nearby the educational institute (schools, College, madrasha etc.), community infrastructure (mosques, graveyards, playground etc.), bazar and health complex should be careful and control the speed and avoid unnecessary horns;
- In addition, BRTA and BIWTA traffic rules and regulations should be strictly followed;
- Avoid disturbance and careful during construction vehicle and equipment movement in the project site and approach road;
- Use of low Sulphur content fuel for vehicles operation;
- Divert traffic to follow alternative routes to avoid traffic jams;
- Limit the speed of construction vehicles in the construction site and project approach road, it shall be 20 km/hour;
- Communicate with local fisherman and nearby KPI's authority prior to start the construction;
- Use of mobile phone during driving is strictly prohibited in the construction site and approach road;
- Maintain vehicles and construction equipment in good working condition including regular servicing;
- Instruct the driver's to drive carefully in the project site;
- Instruct the drivers to avoid unnecessary horns and engine operation in the construction site and approach road;
- Adequate lighting facilities in the construction site; and
- Proper indication of accident-prone area, education and religious institutes in the project site and along the approach road.

7.2.13 Mitigation Measures of Impact on Ecology

7.2.13.1 Mitigation Measures of Impact on Terrestrial Flora

Following mitigation measures shall be adopted to minimize the impact on terrestrial flora

- Suppression of fugitive dust emissions through spraying water in the construction area;
- Covering dust generating loose materials with tarpaulin sheets during transportation to the site;
- Restrict vehicle movement within site to a speed less than 20 km/hour at site to minimize potential for dust generation in the surroundings;
- Supply fuel to the worker for cooking and train them not to use wood as a fuel which will reduce the impacts on vegetation in the surrounding of the project site;
- Construction activities should be planned and undertaken in a phased manner;
- Greenbelt development around the project site and surrounding area as early as possible; and
- Plantation of local species for stabilization of the filled in material and plantation in surrounding areas.

7.2.13.2 Mitigation Measures of Impact on Terrestrial Flora

Following mitigation measures shall be adopted to minimize the impact on terrestrial fauna

- The construction activities should be scheduled in such a way that it minimizes noise and vibration;
- The noise generating activities should be scheduled during the daytime only;
- Provide acoustic enclosures and noise barriers in areas of high noise generating sources to avoid discomfort to local wildlife. The barriers should be erected in such a way that it does not interfere with the natural movement migratory and shorebird roosting, and foraging ground;
- Dust suppression measure should be implemented to minimize the dust pollution during construction work;
- Use low-intensity lighting, which reduces the brightness of the lights and helps to reduce the glare;
- Movement of construction and transport vehicles should be restricted to dedicated paths to minimize any harm to small mammals near to proposed site;
- Traffic management plans shall be developed to minimize the impact of construction traffic on wildlife, such as by limiting the speed of vehicles (20 km/hr) or the number of vehicles on site at any given time to avoid road kill;
- Construction activities should be planned and undertaken in a phased manner; and
- Strict prohibition will be implemented on trapping, hunting or injuring wildlife within the subcontractors and should bring a penalty clause under contractual agreements.

7.2.13.3 Mitigation Measures of Impact on Aquatic Ecosystem

Following mitigation measures shall be adopted to minimize the impact on aquatic ecosystem:

- Provision of barriers/control walls at construction material storage areas to avoid contamination by surface runoff
- Hazardous wastes and chemicals to be stored on paved surfaces with secondary containment to prevent potential contamination through surface runoff.
- Noise and vibration control measures, such as insulation or mufflers, can help reduce the noise and vibration generated from construction activities (at jetty construction site).
- Lighting on the construction site should be shielded to reduce the excessive light pollution caused by the construction activities. This will help to prevent the disorientation Wildlife (Herpetofauna, mammals, and migratory and shore birds).
- Avoidance of any leakage of fuels and other contaminants from barges/trawlers/hip to River;
- Trawlers/barges with valid requisite licenses and emergency handling capacity or tie-ups shall only be engaged;
- Standard codes and practices to be followed during the unloading of fuels and construction material;
- Proper maintenance for the avoidance of any leakage of fuels and other contaminants from barges/trawlers to River;
- Providing proper toilets and sanitary arrangement for construction camps;
- Restriction on construction workers for fishing in the River;
- Avoid the coal conveyer belt construction during turtle breeding season;
- Avoid night lighting on the shoreline during construction period;
- Restrict the waste dumping into the water body;
- A detailed Turtle survey should be conducted in the shoreline of Matarbari, Dhalghata sea beach to determine the Species Diversity, occurrence of turtle for nesting and laying eggs, and number of eggs laid during breeding months; and
- A Turtle Conservation Plan should be developed. This plan should include conservation initiatives to insure both in-situ and ex-situ conservation of marine turtles.

7.2.14 Mitigation Measures of Impact on Groundwater

7.2.14.1 Mitigation Measures of Impact on Ground Water Quality

The following measures will be implemented to mitigate potential ground water contamination:

- Ensure proper spill control and management at site;
- Ensure storage of hazardous material and waste in proper manner and disposed the waste in hazardous waste landfill site;
- Fuel should be kept on concrete floor with bund;
- Adequate sanitary facilities, i.e. toilets and showers, will be provided for the construction workforce;
- Workers will be trained in the use of designated areas/bins for waste disposal and encouraged to use toilets.
- Septic tanks/STP will be provided to treat sanitary wastewater; and
- The surface runoff or extracted ground water contaminated by silt and suspended solids will be collected by the on-site drainage system and discharged into storm drains after the removal of silt in silt removal facilities;

7.2.14.2 Mitigation Measures of Impact on Ground Water Availability

The following mitigation measures are suggested to minimize the impact on ground water availability:

- Periodic Monitor the ground withdrawal and depletion rate;
- Take the NoC from WARPO/Upazila/Union integrated water management committee for groundwater use and
- If the local community do not get water during the dry period OPDL-2 needs to be installed a deep tube well for the local people to serve the water.

7.3 Mitigation Measures for Operation Stage Impacts

7.3.1 Mitigation Measures of Impact on Air Quality

7.3.1.1 Mitigation Measures of Impact due to Coal Handling, Transportation and Storage/Coal Preparation

The following mitigation measures are suggested to minimize the impact due to coal handling, transportation and storage:

- One full covered arch type coal yard is designed, the front and back sides will be closed by wind barriers for dust suppression purpose;
- A cover will be installed for the conveyor for coal transportation to coal yard;
- Unloading of coal will be minimized (e.g., reduce the frequency of activity, etc.) during times of high-speed winds;
- For the control of fugitive dust emission within and around the Coal handling plant, dust extraction and suppression systems will be provided;
- Dust suppression system will be installed at all the transfer points in Coal Handling Plant and at Coal stockyard. Dust extraction system would be provided in crusher house, and at Coal stockyard;
- Further in order to arrest the coal dust generation, conveyers will be provided with enclosed galleries. The bottom portion of all the conveyors will be provided with seal plates within the power plant area and above roads;
- To control emissions of fugitive dust within and around the coal handling plant and coal stockyard, a water spray system shall be installed. Spraying water in coal yard to keep the surface wet and prevent wind from blowing coal and dust;

- Dust collection system with ventilation system having bag filters will be provided to evacuate dust and hazardous gases like Methane from the coalbunkers. Collected dust will be returned to coal bunker. The dust collector outlet emission will be restricted to 50 mg/Nm^3 to trap the dust in the bunkers;
- Storage of coal would be designed in such a way that the air content in the coal pile is minimized. Dimension of the coal stack, particularly the height, is a very important parameter for making storage of coal safe and adequate care would be taken while designing the same;
- Re-greening especially along boundary of plant site, surrounding coal yard with domestic plants;
- The coal pile area run off water during monsoon season will be led to a pond. Coal particles will settle down in the pond and clear water will be allowed to overflow to the central monitoring basin for treatment;
- Automatic dust detectors will be provided in the coal yard and in case the dust level exceeds beyond a threshold value, water sprinkling will be carried out;
- All transfer points shall be provided with a dry fog dust suppression system;
- The loading and unloading equipment shall be used with a minimized height of drop to the stockpile to reduce the generation of fugitive dust;
- Dust extraction and dust handling systems shall be installed to reduce fugitive dust emissions. The coal dust extraction system shall be designed to suck the dust-laden air from the confined areas such as screening and belt feeders and at transfer points;
- Coal stockpiles shall be mechanically compacted to minimise air ingress and the potential for autoignition and loss of volatiles;
- Use of water suppression for control of loose materials on paved or unpaved road surfaces; and
- Dust suppression and extraction system will be provided at each critical location to minimize the impact of coal dust that is known to cause irritation to the eyes and mucous membrane; and
- Limit the vehicle speed (20 km/hour) near the project site approach road.

7.3.1.2 Mitigation Measures of Impact due to Fuel Combustion

To ensure compliance with the air emission criteria for flue gas stacks, the following measures will be implemented during operations:

- The flue gas to be exhausted at 220m stack height;
- The OPDL-2 shall design and install an electrostatic precipitator (ESP) (efficiency of no lower than 99.72%) for the power plant. The ESP shall be installed upstream of the FGD/chimney and downstream of the air heaters in order to meet the environmental emission limits regulated by DoE, Bangladesh and IFC EHS Guidelines for Thermal Power Plants;
- The OPDL-2 shall install Limestone-Gypsum Wet Flue Gas Desulphurization (FGD) system (efficiency no lower than 93%) to remove sulfur dioxide from the flue gas before the flue gas is emitted to the environment;
- Low NOx burner is adopted for the boiler, which can effectively control the generation and emission of the NOx. The emission concentration of the NOx is $\leq$ 350mg/Nm^3 (as NO_2, Dry, O2=6%);
- Fugitive emissions from the coal power plant site during operation will be controlled by visual inspection and maintenance program;
- Ensuring the standard of Bangladesh (MoEFCC) where emission always should be lower due to nearly presence of any sensitive area;
- Maintain coal quality as stipulated in project description;
- The plant equipment must be performance tested during commissioning phase to ensure standard has been maintained;
- Continuous Emission Monitoring System (CEMS) will be installed to detect the emission of pollutants from the flue gas such as PM, SO_2, NOX, CO and CO_2, etc.

- Automatic monitoring process and presenting on the real-time Web Pages should be implemented;
- Stack monitoring data collected during commissioning and the subsequent operation period will be reported to the DoE, Cox's Bazar and also Head office at Dhaka on an quarterly basis as part of the statutory environmental audit and will be subject to inspection by external environmental auditors to verify the performance and compliance status;
- Ambient air quality monitoring stations to be installed within the project site to obtain such measurable parameters, while periodic air quality monitoring using high/low volume samplers to be conducted at other locations;
- Install instruments to record meteorological data such as wind speed, direction, solar radiation, relative humidity and temperature shall be established so that operating power plant can record these parameters on a regular interval;
- Regular maintenance and overwhelming as per design specification;
- Regular inspection and maintenance of boiler, pressure parts, FD and ID fans, ESP, FGD and ash separation and handling system, and other ancillaries;
- Regular maintenance of plant at the proposed facility will also be carried out in order to optimize and minimize emissions;
- Health impact assessment needs to be carried out before works commence to provide a baseline for monitoring health impacts and
- It is highly recommended to conduct a validation run after 1 to 3 months during operations stage using actual CEMS, stack testing, and ambient air monitoring results.

7.3.2 Mitigation Measures of Green House Gas Emission

The following mitigation measures are suggested to minimize the impact due to greenhouse gas emission:

The proposed plant is based on ultra-supercritical technology, which has high thermal efficiency, thereby reducing greenhouse gases emissions per unit of output. It is recognized that carbon capture readiness for a project is a proactive measure in the direction of contributing to minimize carbon footprint from the coal-based power plant. This would facilitate actions as soon as the reliable Carbon Dioxide separation technology and a suitable storage option become commercially viable.

OPDL-2 shall ensure sufficient space for installing carbon capture equipment. Provided the technology is commercially viable, the necessary electricity and steam supplies for the carbon capture system can be made available. The project shall install $C0_2$ monitor and analyse $C0_2$ equivalent emission from its power generating units once the Project achieves commercial operation date (COD).

Also, the following mitigation measures will minimise GHG emissions to ALARP levels:

- Continuous monitoring and recording of CO_2 emission from the stacks through CEMS;
- Ensure that all equipment and machinery is maintained in accordance with manufacturer's specifications;
- Higher efficiency steam turbine blade design; and
- Improved efficiency of auxiliary drives.

7.3.3 Mitigation Measures of Impact on Ambient Noise Level

The following mitigation measures will be adopted to minimize the impact due to noise generation:

- Each feed water pump sets shall be covered by a separate enclosure;
- Each coal crusher shall be covered by a separate hood;
- Small units like condensate and vacuum pumps, shall be designed so as to limit noise emission;

- Bypass valve, the de-super heater and the relevant piping shall be covered with acoustic insulation;
- To achieve the noise limitations in the control room, the control equipment such as computers and its accessories (such as printers) and the air conditioning system shall be designed so as to limit noise emission;
- During construction/operation/maintenance/inspection works, the personnel will wear personnel protection equipment, like ear plugs/ear mufflers etc;
- Steam vent pipes shall be fitted with silencers;
- The steam generator thermal insulation shall be designed to limit noise emission;
- The steam generator draught fans, the electrostatic precipitators and the air heaters shall be designed to limit noise emission;
- The main transformers shall be designed to limit noise emission;
- 220 m stack height and high velocity should be maintained;
- Discharge of emissions through stack must be directed vertically upward without any impedance or hindrance;
- Maintaining DoE standard of the acoustic environment with spatial and temporal basis;
- Use a sound-absorbing boundary wall that acts as noise damper;
- Noise insulation should be implemented surrounding the turbine and generator casing;
- Noise dumper/insulator must be installed around the casing of conveyor belt;
- Switch off / throttle down all vehicle and engine of the vessel when not in use;
- Construct high and thick boundary wall that could act as noise damper;
- Provision of sound-insulated control rooms with noise levels below 60 dBA;
- Workplace noise sampling including personal noise monitoring which identifies are at risk from hazardous levels of noise;
- Design of generators to meet applicable occupational noise levels;
- Identification and marking high noise areas and require that personal noise protecting gear is used all the time when working in such high noise areas (typically areas with noise levels >75 dBA);
- Avoiding continuous (more than 8 hours) exposure of workers to high noise areas in the plant operation site;
- Compulsory use of personal protective equipment (PPE) such as earplugs for the workers;
- Provision of insulating caps and aids at the exit of noise source on the machinery;
- Use of physical barriers and green belt development around the plant to restrict the noise from going outside the proposed plant boundary during operation;
- Provision of training and information that ensures the workers are aware of the hazard from excessive noise exposures and how to properly use the protective equipment that has been provided;
- The OPDL-2 should conduct regular inspection and spot checks of all noise generating equipment; and
- Regular monitoring of noise pollutants concentrations following the Noise Pollution (control) rules 2006.

7.3.4 Mitigation Measures of Impact on Water Bodies

7.3.4.1 Mitigation Measures of Impact on Surface Water Quantity

The following mitigation measures are suggested to minimize the impact on surface water quantity:

- Records will be maintained to monitor the quantity of water being used;
- Efforts shall be made to ensure that the reuse of process water is carried out to reduce the net water requirement; and
- Permission must be taken from respective authority as per water rules 2018.

7.3.4.2 Mitigation Measures of Impact on Surface Water Quality

The following mitigation measures will be adopted to minimize the impact on surface water quality:

- Appropriate treatment shall be provided to the process effluents and runoff prior to use in other uses;
- Domestic sewage, coaly wastewater, oily wastewater, industrial wastewater will be recycled after treatment;
- The quality of treated effluent shall be monitored regularly;
- There will be a central effluent monitoring basin collecting the treated effluent located in the sewage treatment station. The treated effluent will be recycled for coal handling washing water, coal yard spray/dust suppression water, water for green belt etc.;
- FGD wastewater will be treated by FGD wastewater treatment system and send to the ash yard;
- Treated sewage and wastewater shall comply with the ECR 2023 prescribed standards (Schedule 3: Standard for sewerage water and Schedule 4: Standard for wastewater);
- All the waste that would be produced during the power plant operation units and workers facilities must be treated in the ETP and STP plant;
- Offsite runoff entering the site from surrounding areas will be routed around the site area through the use of overland flow, open channel flow, and underground piping or a garland drain around the site;
- Regular maintenance of the rainwater harvesting process;
- Increase the efficiency of water reuse and recycling;
- Water conservation plan should be implemented on a broader scale;
- The oily sludge shall be reused or disposed offsite through authorized agency;
- Effluent treatment plant needs to proper work with the provision of additional load bearing capacity during accidental cases;
- Regular monitoring to the water quality at specified locations in the certain time interval;
- The vessel to be engaged shall have to comply with the international and national standard;
- Adopt enclose system for coal unloading and transportation (through conveyor belt);
- Maintain ECR 2023, IMO Conventions, MARPOL etc.;
- The practice of dust suppression should be to moisten the coal not to wet the coal
- Introduce speed limitation for vessels;
- Limiting dropping of coal and escapee during unloading; and
- Ensure no dumping of ballast water, no oil spillage, no discharge of wastewater, no waste dumping;

7.3.4.3 Mitigation Measures of Impact due to Discharge of Cooling Water

The following mitigation measures are suggested to minimize the impact on river water quality due to discharge of hot water:

- Discharge system shutdown in event that discharge temperature of cooling water exceeds standard (no more than 5°C of ambient water temperature as per Schedule 4-Standards for Waste from Industrial Environment Units or Project Waste of Environmental Conservation Rules

2023) and the applicable World Bank Group environmental requirements and World Bank/IFC guidelines);

- Monitor the water temperature at the discharge point daily and keep the record;
- Design the discharge outlet in a way that water temperature elevate as much as lower;
- Thermal discharge from the power plant needs to be controlled to ensure that the discharge water temperature does not result in thermal pollution;
- After circulating water and heat exchange, it can be return to the river;
- RO concentrated water and circulating cooling effluent water can be mixed before discharge;
- Treated water effluent shall be mixed with the cooling water to dilute the concentration of the treated effluents;
- During the initial testing at the plant and cooling water systems commissioning, it should be ensured the initial effluent and cooling water discharges fully comply with the DoE and/or IFC standards on thermal discharge;
- Over-chlorination of the condensed water will be prevented and should be achieved through process monitoring;
- The project proponent must ensure regular monitoring of surface water temperature near the discharge point;
- Monitoring of the phytoplankton, zooplankton and benthos near the intake and discharge point by the project proponent; and
- A detailed fish survey for baseline data on fish population (abundance and richness) and behavior in the Kutubdia channel and near shore of Bay of Bengal River must be conducted by the OPDL-2 during construction and operation phase.

7.3.5 Mitigation Measures of Impact due to Waste Generation and Disposal

7.3.5.1 Mitigation Measures of Impact due to Solid Waste Disposal

The following mitigation measures are suggested to minimize the impact due to solid waste disposal:

- The OPDL-2 will develop and implement a waste management plan for the operational phase of the power plant project;
- Employees should be trained in the proper handling and disposal of the fly ash, bottom ash and wet FGD gypsum to minimize their risk of exposure in accordance with the OPDL's occupational health and safety procedures;
- Provision of different waste bin with color for different waste (recyclable, reusable, biodegradable, hazardous etc.) in roadside, parking places, office and other official and public places in the plant site;
- Employees should be provided with appropriate PPE for handling the ash;
- Proper handling and disposal by employees would minimize exposure or health related issues to the public;
- A drainage system should be provided in the ash field to discharge excess rainwater;
- Based on the specific situation(s) at the time, the OPDL-2 should take suitable measures to prevent erosion of the ash pile during the monsoon season or a failure of part of the ash pile;
- The standard practice of kitchen waste collection and disposal should be implemented. Some temporary bins with a colour marking indicating degradable and non-degradable waste might be installed in the staff colony and workplaces to prevent scattered throwing of wastes.
- There should be a designated site or scientific landfill area for kitchen waste disposal for controlling bad odour and leachate having a susceptibility to contaminate water. Moreover, it

should be protected from the scavenging by birds and animals, washing out by rainfall runoff, etc. Furthermore, a site should be designated for biodegradable kitchen waste disposal; and

- Proper handling and disposal by employees would minimize exposure or health related issues to the public; and
- Regular monitoring of the ash yard will be ensured by the OPDL-2.

7.3.5.2 Mitigation Measures of Impact of Wastewater Generation and Disposal

OPDL-2 will follow the mitigation measures that have been presented in section 7.3.4.2 as well as following mitigation measures:

- The Operations and Maintenance (O&M) company should ensure that all hazardous materials and wastes on site are properly stored in closed systems in bunded areas;
- Process wastewater (e.g. oil-contaminated wastewater) will be treated separately from non-process run-off. Oil separator(s) will be utilized to provide primary treatment of oily wastewater. Used oil removed from the wastewater will be stored in drums and sell to the DoE approved vendor;
- Wastewater containing chemicals resulting from various streams (e.g. chemical storage, boiler blow-down water, chemical cleaning effluents) will be pre-treated by neutralization and/or detoxification prior to being collected and treated at the wastewater treatment plant on site. This will ensure the treatment process will function properly and the effluent discharges comply with the discharge limits stipulated under ECR 2023 and IFC guideline;
- All wastewater is envisaged to be treated in the wastewater collection systems/treatment facilities will when in compliance with effluent discharge parameters, be re-used in the coal ash yard for dust suppression purposes.
- It is recommended to construct and commission a central sewerage treatment plant (STP) for treating sanitary waste as a large number of the employees will be residing inside the power plant complex. The sewerage treatment plant might be of a biological type or in combination with physical, chemical and biological type. Generally, a STP consists of screening devices, aeration, active sludge treatment, sedimentation, clarification and separation/recirculation of sewage sludge. Membrane bioreaction is a good alternative;
- The sludge from STP should be disposed of in compliance with the IFC standard and ECR 2023.
- The dry cake of sludge should be managed properly so as to avoid leaching of heavy metals in the rainfall runoff. A dry cake that would be mostly iron sludge has market potential in steel rolling mill. However, the EPC contractor should consider this issue and propose a sustainable management plan for sludge handling.

7.3.6 Mitigation Measures of Impact on Soil and Agriculture

The following mitigation measures will be adopted to minimize the impact on soil and agriculture:

- Wastes will be stored in a manner that will prevent contact between incompatible wastes, i.e. post compatibility checks,
- Proper labelling of hazardous wastes;
- Waste oil will be collected in MS drum and stored on paved platforms with proper labelling. the waste will be sold to DoE approved vendors;
- The spent ion exchange material will be sent for landfilling;
- Special care will be taken in the storage areas to prevent any spillage of hazardous wastes and restrict access (except for trained staff) to such areas;
- Periodic audits will be carried out for such areas and containers; also on the segregation and collection systems and the findings will be documented and appropriate action taken against irregularities;

- A spill response plan and emergency plan will be prepared to address accidental spillages or release of hazardous wastes;
- A proper manifest record will be maintained of waste travelling/ removed from the site;
- Proper training to the farmer on using fly ash in the agricultural field;
- Awareness growing to use the by-product of the power plant efficiently;
- Monitoring not only inside but also outside the land areas free from any kind of waste disposal or potentially to be polluted lands;
- Use of bio-indicator for pollution measurement;
- Increase the facilities of ash marketing through infrastructure development, creating awareness and formulating policies; and
- The hazardous waste such as spent oil as well as non-hazardous wastes shall be disposed of off to DoE authorised vendors only.

7.3.7 Mitigation Measures of Impact on Ground Water

The following mitigation measures will be adopted to minimize the impact on groundwater pollution:

- Wastewater Management philosophy should be based on "Zero Discharge Approach";
- The underflow sludge from the raw water treatment will be sent to a settling pond;
- The clear overflow from the pond will be utilized for green belt development and dust suppression;
- Groundwater must be free from any harmful effluents and wastes leakage from oil and chemical tank or storage through seepage;
- Regular monitoring the level and quality of groundwater in the power plant;
- Provide training and awareness building programs to the labours and professionals while monitoring the sources of groundwater contamination;
- Sealed or paved the coal, ash and waste silo/storage/disposal site to blocked the communication between hazardous materials/leachate and groundwater;
- Effluent from coal handling plant (CHP) primarily consisting of coal dust-laden water from various dust extraction points as well as dust suppression system and run-off water from coal-pile will also be led to a guard pond. Effluent from oil unloading area will be taken to an oil removal system; where clear oil will be taken to a storage tank, and the water led to the guard pond. Skimming tank is provided separately to remove contaminated oil etc.;
- The run-off from the coal handling area will flow into the drains which will be suitably provided at various places in the coal yard. The run-off collected in this manner will be led to a common sump for further treatment to reduce the suspended solids;
- It is proposed to dispose the sewage from the various buildings in the power plant through a combined sewage treatment tank. The effluents from the sewage treatment plant will be disposed of suitably;
- Use of water efficient plumbing fixtures (ultra flow toilets and urinals, low flow sinks, water-efficient dishwashers and washing machines). Water efficient plumbing fixtures use less water without any reduction in quality and service; and
- To promote reuse and development of a closed-loop system for water, segregation of wastewater will be done in two ways - Harvested stormwater will be utilized for artificial recharge of groundwater sources and wastewater will be reused on site after treatment.

7.3.8 Mitigation Measures of Impact due to Ash Disposal

OPDL-2 will follow the mitigation measures that have been presented in section 7.3.5.1 as well as following mitigation measures:

- An advanced technique like ESP, ash silo and ash pond have to be maintained regularly for ash management;
- Fly ash (dry form) generated from the plant should be separated after burning of coal through ESP and commercially utilized to the maximum extent possible;
- Fly ash evacuated from ESP/Economizer/Air Preheater collecting hoppers is transported in closed pipe lines by pneumatic means;
- At the time of unloading fly ash into the silos, some ash laden air would get vented out. In order to restrict the fly ash dust particles to the limits of 50 mg/Nm^3, a vent filter will be installed on top of each of the fly ash silos;
- It is proposed to use closed trucks for fly ash transportation in order to avoid dust nuisance. To reduce the dust nuisance while loading the ash from fly ash silos, the fly ash is conditioned with water spray;
- Water sprinkling system will be commissioned in the ash disposal area to restrain flying of fine ash to wind;
- It is also proposed to dispose un-utilized fly ash to ash dyke;
- The dust nuisance in the ash disposal area will be contained by ensuring that the ash is always kept wet;
- The ash pond will be developed with dykes all round constructed with earth. The ash bund shall be designed to be suitable under all conditions to which they may be subjected to, including self-weight, vertical loads, lateral loads, water pressure, seepage and draw down, seismic effects etc for the ultimate stage of raising of the bund;
- The bunds shall be of homogenous earthen construction. The design of bund shall ensure that the phreatic (seepage) line shall not meet downstream face of the embankment. To ensure this, adequate internal drainage arrangement shall be provided. The embankment shall be safe against failure due to "piping".
- Average Finished Bed level shall be maintained as even as possible. Leakage from the bottom of the ash pond will be prevented by using an impermeable layer, such as high-density polyethylene (HDPE) sheet or silt layer;
- Water recovered from ash pond will be collected into recovery water sump near Ash Pond and will be pumped back to the clarifier (located in the plant) with the help of centrifugal pumps. Necessary Chemical dosing at the inlet of clarifier will be provided to enable settling down of the particles. Clear water will flow by gravity into clear water sump;
- Wastewater will be managed and treated appropriately by neutralization and sedimentation to comply with water quality of Bangladesh regulations;
- To avoid the contamination of nearby fields, toe drain is provided all around the periphery of outer dyke which will collect the seepage water from storage lagoon. This water is pumped back for recirculation in ash recovery pump house;
- Periodic inspection by cross functional team will enable the plant management staff to monitor and plan safe disposal;
- Awareness of the safety of dyke shall be part of monitoring system;
- Watering in ash pond as required for the dry season;
- Re-greening especially along the boundary of the plant site, surrounding ash pond with domestic plants according to local climate conditions;
- As the ash pond is filled, discarded portions of the pond will be managed to minimize the risk of air pollution due to fugitive dust emissions. Throughout the total life cycle, the ash pond will be in constant monitoring, inspection and maintenance.
- Bottom ash should be collected in wet form and should be stored in the ash dyke until suitable users are identified;

- Increase the facilities of ash marketing through infrastructure development, creating awareness and formulating policies;
- Fly ash shall be sold to the cement industries as much as possible;
- Sprinkling system is provided for required sprinkling, to guarantee over 8% of moisture contents on ash surface and increase cohesion between ash particles;
- Spreading and rolling operations within the ash yard should use mobile machinery to reduce interference with the ash surface. Measures should be taken to prevent people and animals or vehicles from interfering with ash;
- Ash transportation road has hardened pavement and has to be regularly sprayed and cleaned to avoid impact on air quality by fugitive dust from vehicle traffic;
- A leachate collection system should be incorporated in the ash yard design and provided at the lowest point(s) of the ash yard. The leachate and runoff should be collected from the coal ash pile and diverted it into a leachate storage or treatment system;
- A groundwater monitoring system made up of wells should be installed and operated around the ash yard capable of verifying whether coal ash or leachate has penetrated the pad;
- Stormwater canals will be constructed along the perimeter of the ash dump. The leachate from the canals will be collected and treated in the ash treatment pool with the treated water used in the ash yard through a sprinkler system for dust suppression;
- The O&M Company will develop and implement a waste management plan for the operational phase of the project;
- Employees should be trained in the proper handling and disposal of the fly ash, bottom ash and wet FGD gypsum to minimize their risk of exposure in accordance with the O&M Company's operational health and safety procedures; and
- Employees should be provided with appropriate personal protective equipment (PPE) for handling the ash. Proper handling and disposal by employees would minimize exposure or health-related issues to the public.

7.3.9 Mitigation Measures of Impact on Ecology

7.3.9.1 Mitigation Measures of Impact on Terrestrial Flora

The following mitigation measures are suggested to minimize the impact on terrestrial flora:

- Ensure the proper functioning of Electrostatic Precipitators (ESP) to achieve maximum efficiency to keep the particulate matter emission less than 40mg/Nm^3;
- Coal dust suppression should be done by water sprinkling at the coal transfer points;
- Dust extraction and dust handling systems to be installed at the coal handling plant, and ash handling units to reduce fugitive dust emissions;
- A plantation plan should be implemented for greenbelt development with appropriate indigenous species. Extensive plantation of pollutant-resistant trees in and around the project area will serve as pollution sink and noise barrier;
- Fly ash should be efficiently managed to control the emission of heavy metals in the environment;
- The leaf surface acts as reaction centers for removing atmospheric pollutants. So, the plant has left of large surface areas are suggested for development of green belt; and
- Plant health monitoring should be conducted regularly.

7.3.9.2 Mitigation Measures of Impact on Terrestrial Fauna

The following mitigation measures are suggested to minimize the impact on terrestrial fauna:

- Project related activities should be avoided during the nighttime;

- The contractor should install equipment that meets the environmental noise limits stipulated by DoE, Bangladesh environmental noise regulations;
- The installed equipment should comply with the requirements of the occupational noise limits specified in the occupational noise regulations;
- Provide acoustic barriers in areas of high noise generating sources to avoid discomfort to terrestrial fauna adjacent to project site;
- All coal transfer points should be provided with dry fog dust suppression system;
- Disturbance, harassment, killing or possession of any wildlife species by project workers while working should be prohibited;
- A traffic management system should be prepared and implement by the project proponent;
- Control the speed of the vehicles (20 km/hour) in the approach road, paved and unpaved road and bare surface in the power plant;
- Instruct the workers and awareness creation not to disturb the terrestrial ecology;
- Avoid unnecessary lighting in the project site at night time; and
- Rescue, rehabilitation, and relocation should be done for injured or affected terrestrial fauna when necessary.

7.3.9.3 Mitigation Measures of Impact on Aquatic Flora and Fauna

The following mitigation measures shall be adopted to minimize the impact on aquatic ecosystem:

- Monitoring of temperature at the discharge point at a frequency of everyday;
- Discharge system shutdown in event that discharge temperature of effluent exceeds standard (maximum 5°C more than ambient water temperature as per Environmental Conservation Rule 2023, Schedule 4-Standards for Waste from Industrial Environment Units or Project Waste) and the applicable World Bank Group environmental requirements and World Bank/IFC guidelines);
- A log of all dangerous chemicals be kept, how to be used, transported stored and disposed of;
- Keep all dangerous chemicals, oils, greases, solvents, and residues in a secure room;
- Have a standard operating procedure on how to deal with spills;
- Have a spill response team readily available to respond;
- Train worker on spills and how to deal with them;
- Restrict the night lighting along the coast line/coal conveyer belt area;
- Have a containment and disposal plan for all hazardous material (where to dispose);
- Collect and separate the spilled water from runoff water then store and treat separately;
- All oils and hazardous materials to be disposed of after proper treatment satisfying Environmental Conservation Rules 2023;
- The water supply pipeline intake point should be provided with sufficient screening to filter out larger aquatic organisms (e.g., fish, frogs, and toads) and foreign matter, preventing this material from being drawn into the pumps;
- Drum screens need to adopt in order to limit the entrainment of fish in the cooling water system, and intake velocities should be as low as possible;
- The intakes for the water pumps in the main pump-house will meet the IFC guidelines, including recommended intake velocity less than 0.30 m/s and a mesh size of 9.5 mm;
- The channel can be built for water channelization rather than a direct abstraction from the river;
- Monitoring should continue to ensure that the deterrents are working effectively;
- On-site wastewater should be treated to achieve maximum reuse and recycling rather than ultimate disposal to the river;

- Regular consultation, training and stakeholder meeting should be arranged with the local bodies and project personnel;
- Use of bio-indicator for pollution measurements like benthic community, plankton or sensitive organisms;
- Spot-check of shipping and barging activities by relevant agencies;
- The coal carrying ship has to follow the less biodiverse route and must avoid the Hilsha spawning zone;
- Enforcement of fishing ban during the breeding/nursing period;
- Discharge the concentrated saline water with the non-saline cooling water in the sea;
- Enforce the relevant law of restricting ballast water and haul water dumping in the River;
- Zero discharge from coal carrying vessel should be adopted;
- Follow standard practice for shipping and barging operation;
- Introduce speed limitation for the vessel;
- Avoid the area where the dolphin and other aquatic wildlife in abundant
- Awareness building activities should be carried out continuously;
- No trapping and killing of Dolphin; and
- A Turtle Conservation Plan should be developed. This plan should include conservation initiatives to insure both in-situ and ex-situ conservation of marine turtles.

7.3.10 Mitigation Measures of Impact on Occupational Health and Safety

Following mitigation measures have been suggested for minimizing work-related health and safety impacts on workers:

- Identification of potential exposure levels in the workplace during working activities;
- Use of personal protective equipment (PPE) in the workplaces;
- Regular checking, monitoring and careful operations with the standard procedure;
- Precautions have to be ensured during handling the hazardous chemicals;
- Ensure the hospital facilities emergency after any kind of accidental event;
- Auto signalling system should be installed as a safety plan;
- Regular practicing or showdown by the rescue team for the mock accident;
- Compliance monitoring to the charged professionals and monitoring devices;
- Regular consultation meeting should be introduced between locals and project personnel to exchange knowledge;
- Introducing health insurance for the employees;
- Regular inspection and maintenance of pressure vessels and piping shall be carried out;
- Adequate ventilation shall be provided in work areas to reduce heat and humidity;
- The time required for work in elevated temperature environments will be reduced, and access to drinking water will be ensured;
- Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc. shall be done;
- Warning signs near high-temperature surfaces and personal protective equipment (PPE) as appropriate, including insulated gloves and shoes, shall be provided;
- Provision of sound-insulated control rooms with noise levels below 60 dB;
- Identifying and designating high noise areas to ensure that personal noise protecting gear is used by workers all the time when working in such high noise areas (typically areas with noise levels >85 dBA);

- Provision of specialized electrical safety training to those workers working with or around exposed components of electric circuits. This training should include, but not be limited to, training in basic electrical theory, proper safe work procedures, hazard awareness and identification, proper use of PPE, proper lockout/tag out procedures, first aid including CPR and proper rescue procedures. Provisions should be made for periodic refresher training as necessary;
- Use of automated combustion and safety controls and proper maintenance of boiler safety controls;
- Implementation of startup and shutdown procedures to minimize the risk of suspending hot coal particles (e.g., in the pulverizer, mill, and cyclone) during startup;
- Regular cleaning of the facility to prevent accumulation of coal dust (e.g., on floors, ledges, beams, and equipment);
- Appropriate education of workers on handling and management of chemicals in accordance to MSDS;
- Removal of hot spots from the coal stockpile (caused by spontaneous combustion) and spread until cooled and ensure that loading of hot coal into the pulverized fuel system is not carried out;
- Use of automated systems such as temperature gauges or carbon monoxide sensors to survey solid fuel storage areas to detect fires caused by self-ignition and to identify risk points;
- The O&M should ensure there is an effective and efficient firefighting system together with an adequately trained Emergency Response Team;
- Based on the health and safety risk assessment findings, OPDL-2 shall develop & implement a formal OHS Management System compliant with the applicable requirements of the OHSAS and IFC General EHS Guidelines ;
- Adequate first aid facilities in the power plant premises; and
- Dust extraction and dust handling systems shall be installed to reduce fugitive dust emissions.

7.3.11 Mitigation Measures of Impact on Public Health and Safety

Following mitigation measures have been suggested for minimizing public health and safety:

- Update technology and emission controlling equipment should be ensured by the OPDL-2;
- Regular maintenance, replacement and performance should be tested as per manufacturer guidelines;
- All the waste from the power plant and workers facilities should be collected properly disposed as per best practices and followed the guidelines of the DoE, Bangladesh;
- All the wastewater must be treated in the STP and ETP;
- Solid waste should be collected and disposed properly;
- The OPDL-2 should ensure good quality drinking water supply in the plant premises as per the ECR, 2023;
- Safety training should be given for the drivers;
- Ban the faulty equipment's, machineries and vessels in connection with the power plant project;
- Training on sanitation and hygiene, sexually transmitted diseases (STD)/HIV, education and communication should be incorporated by the OPDL-2 into new employee orientation programs;
- Proper drainage system should be ensured in the project premises and surrounding area;
- Instruct the workers about the waste generation and management;
- Regular monitoring should be ensured by the OPDL-2 EHS department;
- Greenbelt development in and around the power plant as early as possible after finishing the construction activity.

- O&M company should form a grievance redress team to solve the social issue due to the project operation;
- Proper waste management will be implemented as the surrounding people will not be affected;
- Keep harmony with the surrounding community and
- Prepare a CSR plan and implement accordingly for the local people;

7.3.12 Mitigation Measures of Impact due to Traffic Movement

Following mitigation measures have been suggested for minimizing due to traffic movement:

- The OPDL-2 should develop a Traffic management plan for the operational phase;
- Regularly inspect the access roads conditions and, whenever necessary, repair damages related to traffic movement;
- Dust suppression measures must be implemented by the project proponent near the project site and dust generation site on a regular basis;
- Establishment of safety sign, warning light post, speed breaker should be ensured by the project authority and all signs should be written in local language;
- Limit the vehicle speed near the narrow approach road, school, bazar, mosque and settlement area etc.;
- Instruct the driver to avoid unnecessary engine operation and horns in the approach road;
- Use of mobile phone during driving is strictly prohibited;

7.3.13 Mitigation Measures of Social Impact

7.3.13.1 Mitigation Measures of Creation of Direct, Indirect and Induced Employment

The following mitigation measures are suggested to enhance the employment opportunity of the local people:

- OPDL-2 must endeavour to provide the local community for any job opportunities, prioritizing from the residents immediately neighbouring and/or displaced by the project;
- The OPDL-2 should ensure opportunities for capacity building is afforded to the local communities to enable them to benefit from the available employment opportunities. This includes training in skills set required during the operational phase of the project;
- Expertise should be sourced locally then nationally before resorting to engagement of international experts;
- Job advertisements should be made through mediums that are easily accessible to the local community such as local newspaper and radios, etc;
- The recruitment selection process should seek to promote gender equality and the employment of women where possible.
- Management and enhancement measures for local employment should be included in the company's labour and human resources plan;
- Promotion and prioritization of employment opportunities for the local community; and
- OPDL-2 should make a conscious effort to promote local business people in the procurement of goods and services to assist in providing more economic and employment opportunities for the local community

7.3.13.2 Mitigation Measures of Economic Growth

OPDL-2 will follow the following enhancement measures to promote the economic growth of the local as well as national level:

- Ensure that economic opportunities are available or are created for the local community and that proper capacity building is afforded to the local communities to enable them to benefit from the available economic opportunities;
- Communication and information programs should be used to manage expectations and target local service providers;
- Establish youth and women empowerment training centre and introducing diverse income generating activities training;
- Extension of social safety nets for affected people and people underexposure of plant possessed risk;
- The OPDL-2 should make deliberate efforts to source for all required supplies from the local provider to the extent possible,;
- Tender documents should include guidelines for the involvement of local entrepreneurs, businesses and SMEs from the local sector; and
- OPDL-2 should promote and support economic empowerment initiatives for the local community through its CSR programme.

7.3.14 Mitigation Measures of Impact due to Transportation of Primary Fuels

The following mitigation measures shall be adopted to minimize the impact due to transportation of primary fuels:

- Adoption of a dust suppression system;
- The ship to be engaged shall have to comply with the international and national standard;
- Adopt enclose system for coal unloading and transportation;
- Coal conveyor should be fully covered so that windblown dust can not generate from the coal transfer process;
- Maintain ECR 2023, IMO Conventions, MARPOL etc.;
- The practice of dust suppression should be to moisten the coal not to wet the coal;
- Use of personal protective equipment (PPE);
- Regular checking, monitoring and carefully handing with safety procedure;
- Spraying water like mist in order to reduce the risk of ignition;
- Precautions have to be ensured while handling the coal;
- Switch off / throttle down of all equipment and machinery when not in use;
- Introduce speed limitation for ship;
- Limiting dropping of coal and escape during unloading;
- Ensure no dumping of ballast water, no oil spillage, no discharge of wastewater, no waste dumping from ship; and
- Monitoring activities of the foreign ships during coal transportation.

CHAPTER 8

Analysis of Alternatives

8 ANALYSIS OF ALTERNATIVES

8.1 Introduction

This chapter discusses the alternative considerations that have been studied before finally proposing the present project. The alternatives can be considered for the following major issues.

a. The requirement of the proposed project to meet the power demand.
b. Selection of the proposed site
c. Selection of the project configurations and technology

8.2 No build Scenario

Bangladesh has an anticipated power requirement of 14,500 MW for the year 2020-21 as compared to 13,300 MW for the previous year. Presently, the power demand growth rate is 9.02%, but it has been expected to be increased at a greater rate in the upcoming years. The power sector in the country comprises of 3 segments viz.

- Public sector- it comprises of BPDB, ASPCL, NWPGCL, EGCB and RPCL and
- Private sector- it is constituted by Independent Power Producers (IPP)/Supporting IPP, Rental Power Plants and Rural Electrification Board (REB)

Bangladesh Economic Review shows the total grid based installed capacity was 22,031 MW in FY 2020-21 including 10,146 MW in public sector (56%), 9,481 MW in private sector (40%) and 1244 MW in joint venture and 1160 MW (4%) from cross-border.

The gap between installed capacity and maximum generation of electricity in Bangladesh is increasing over the years, creating pressure on the supply of electricity. The peak demand and generation figures (Refer to **Table 8-1**) indicate an increase of 25.97% in power deficit. Electricity generation is not reliable and the peak demands are also not met. Moreover, power prices are increasing with the increments of government subsidy.

Table 8-1: Comparison between Peak Demand and Peak Generation

Parameter	FY 2020-21	FY 2021-22	% Change in parameter
Peak Demand (MW)	14,500	15.800	8.97
Peak Generation (MW)	13,792	14,782	7.18
Deficit (MW)	708	1018	43.8

Source: BPDB Annual Report 2020-21

As per Bangladesh Economic Review 2022, 100% of the country's population has access to electricity, and the per capita generation is 560 kWh. The government of Bangladesh has assigned top priority to the development of power sector realizing its importance in economy, industry and social development of the country. In this regard, the government has set the vision to provide access to affordable and reliable electricity to all. The government is further focusing into its vision targeting the upcoming years up to 2030 and prepared the Power System Master Plan (PSMP) in 2016. According to the PSMP, under a long-term plan, there are targets of achieving electricity generation capacity of 40,000 MW again demand of 33,000 MW by 2030 and 60,000 MW against a demand of 52,000 MW by 2041. **Table 8-2** shows power sector development and future plan of the Government.

Table 8-2: Power Sector Development and Future Plan

Sl.#	Description	Year 2022 (Feb'22)	Year 2030	Year 2040
1.	Installed capacity (MW)	25,284*	40,000	60,000

Sl.#	Description	Year 2022 (Feb'22)	Year 2030	Year 2040
2.	Electricity Demand (MW)	15,500	33,000	52,000
3.	Transmission Line (Ckt. Km)	13,017	27,300	34,850
4.	Grid Substation Capacity (MVA)	55,307	1,20,000	2,61,000
5.	Distribution Line (Km)	619,000	660,000	783,000
6.	Per Capita Power Generation (KWh)	560	815	1,475
7.	Access to Electricity (%)	100	100	100

Source: Power Division* Including Captive and RE

In order to secure the fuel supply, government has taken plan for fuel diversification. Electricity generation from gas/LNG, Liquid fuel, coal, nuclear, hydro, renewable energy and import from neighboring countries has also included in this plan. As per this plan, coal, nuclear, gas/LNG based combined cycle power plant will be used as base load power plants. On the other hand, liquid fuel and LNG/gas will be used for peak load power plants.

Bangladesh still depends on natural gas for power generation. Now a days due to the immense fuel crisis power generation get interrupted. The price of LNG has increased drastically making it out of buying range. Consequently, load shedding has to be done. The GoB government has canceled 10 coal-fired power plants due to no physical progress as well as GHG emission issues. Considering the present fuel crisis, OPDL's 635 MW coal-fired power plant has been prioritized by BPDB to set up in the Matarbari, Maheshkhali area on already acquired land. The plant will play a crucial role in supplementing the future power demand of the country. Power from Orion Power Unit-2 Dhaka Ltd. will be evacuated by 400kv double circuit transmission line connecting to Maheshkhali 400kv switchyard. The transmission line already been under construction.

It will facilitate local and regional development by supplying electricity. It will coherence with the national goal through assisting electricity to residents of the country, increasing job opportunity, enhancing industrial and port facilities, sustaining irrigation system etc. Also, it will generate electricity with alternative fuel that will impede load shedding. However, the facilities of this added amount of electricity would not be acquired if the "No Project Scenario" alternative is chosen.

8.3 Analysis of Alternative Site for Location of Power Plant

The project proponent selected two (2) candidate sites for the establishment of the proposed power plant. The following **Figure 8-1** shows the selected two potential sites. The sites are located:

Site-1: Matarbari Union of Maheshkahli Upazila in Cox's Bazar District; and

Site-2: Hossaindi Union of Gazaria Upazila in Munshiganj District.

After the primary selection, the project proponent conducted different types of survey in different perspectives (Technical, Economical, Environmental and Social) and discussions with the government departments for the finalization of location for the proposed power plant.

Figure 8-1: Potential Sites for Proposed Project

Source: OPDL-2

8.3.1 Site Selection Criteria

Many factors came into play during selecting a proper site for a thermal power plant based on its sustainability and land availability. Previously the Site-2 was also selected as a suitable site to set up a coal based thermal power plant. Now, BPDB has suggested to shift the location to Matabari which is more suitable. Following **Table 8-3** shows the comparison between two sites.

Table 8-3: Site Selection Criteria

Criteria	Project site-1 (Matarbari)	Project Site-2 (Gazaria)	Comparative Analysis
Location	Located at Matarbari union on the left bank of Kutubdia channel. The site is only 4.7 km from the Matarbari deep seaport	Located near Kajjar Gao on an island along the western bank of Meghna River. The site is at an approximate distance of 200 nautical miles from the deep-sea anchorage point at Chittagong.	The site -1 has advantage due to the nearby deep seaport

Criteria	Project site-1 (Matarbari)	Project Site-2 (Gazaria)	Comparative Analysis
Topography and land use	The topography of the site is flat with salt and shrimp cultivation are the main activities. The land is low lying and will require earth filling.	The topography is flat with shrimp farming being the main activity. The land is low lying and will require filling up.	Topography is similar with no distinct advantage
Land Acquisition	No land acquisition is required since land already acquired	Land already purchased	Advantage is similar for both sites
Need for Resettlement	There are no houses on the proposed project site	There are no houses on the proposed project site	Advantage is similar for both sites
Connectivity /access	The site is accessible through both road and river ways	The site is situated on an island hence river navigation is the only mode of transportation.	Site-1 is better connected
Transmission Line	Approximately 13 km transmission line will be required to connected with Maheshkhali 400kv switchyard. Then power will be evacuated through Maheshkhali-Madunaghat-Vulta 400 kv transmission line	The power generated will be evacuated through 230 kV transmission lines to the Meghnaghat substation located at a distance of about 3.5 km from site. Meghna River crossing will be required	Site-1 is suitable since there is no large river crossing
Coal Transportation	Coal will be imported from abroad through 60000-70000 dwt ship to the Matarbari deep seaport. Coal will be transfer from port coal unloading jetty coal yard through 4.7 km conveyer belt.	Mother vessel cannot be accessed to the site directly. It will come at Chattogram which is 240km approximately in southeast direction from the site. Coal will be transported from Chattogram to site by barge	Site- 1 is suitable as no inland transportation is required as well as no transshipment
Availability of water resources	Water is available in the Kutubdia channel/sea round the year at site 1	Water availability is comparatively less than site 1	Site-1 is more suitable in terms of water availability
Navigation depth	The navigation depth is higher comparing the site 2.	The navigation depth in the less compared to site 1	Site-1 is more suitable
Dredging requirement	No dredging will be required by OPDL-2	Maintenance dredging will be required by own cost	Site-1 is more suitable

Criteria	Project site-1 (Matarbari)	Project Site-2 (Gazaria)	Comparative Analysis
Environmentally sensitive area	There is no environmental sensitive area within 10 km from the project	There is no environmental sensitive area within 10 km from the project	Advantage is similar for both sites

8.3.2 Selection of the Site

After evaluation, site-1 (Maheshkhali upazila in Cox's Bazar district), having major favorable features along with good environmental features has been identified for the proposed project. The site-1 site has the following advantages:

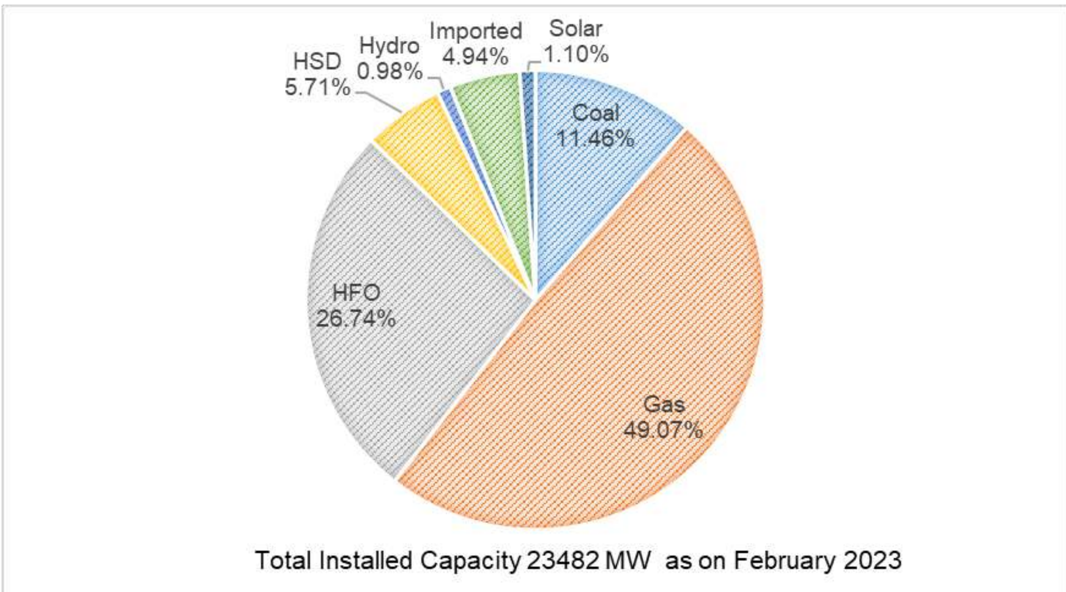
- Availability of required plain land.
- No Resettlement required.
- Close to the Matarbari deep seaport.
- The proposed project site is located on the bank of the Kutubdia Channel.
- Directly can transport 60,000-70,000 dwt coal carrying ship to the Matarbari port hence, no transshipment is required.
- Availability of surface water,
- Availability of navigation depth and no dredging required.
- No forest land within the project site and
- No National Parks, Wildlife sanctuaries within 10 km radius.

8.4 Alternative Fuel

Coal is still the most cost-effective fuel for generating electricity. For large scale energy production, one of the conventional modes of power generation has to be adopted, even though coal has higher pollution potential than some of the other fuel such as natural gas, oil and nuclear. Renewable energy is location specific and not in a position to supply large power on a continuous basis to act as baseload plants.

Bangladesh heavily relies on natural gas for power generation. As on February 2023 (**Figure 8-2**), natural gas-fired power plants contribute the largest share of 11,522 MW (49.07%) to the total installed capacity (23482 MW) whereas furnace oil was the second largest contributor with 6278 MW (26.74%). Diesel fired power plants (1341 MW) accounted for 5.71% of the capacity whereas hydro (230 MW) and coal power plants (2692 MW) contributes 0.98% and 11.46% respectively. Power import and Renewable energy contributes 1160 MW (4.94%) and 259 MW (1.10%).

Figure 8-2: Power Generation by Fuel Type



Source: Bangladesh Power Development Board, 2023

The availability of gas in Bangladesh is on the decline. Non-availability and un-affordability of fuel such as natural gas or oil is an important factor to consider in Bangladesh. To transport natural gas, a large investment in infrastructure is also required. In addition, there is a significant demand existing for gas from other industrial consumers and transportation making it a commercially unviable option furthermore.

According to the revisiting Power System Master Plan (PSMP) 2016, fuel wise forecasted generation capacity may be 79,507 MW which will require for meeting up demand of 72,379 MW in 2041. Out of this generation capacity, Gas/LNG based capacity will be higher compared to other fuels like coal, power import etc. in 2041. Coal based capacity will be second highest (32.2%) of total net power generation capacity in 2041. To meet the future demand, 2% power will be required from liquid fuel-based power plants and 15% from imported power of total net generation capacity in 2041. Considering demand forecast and issues mentioned above, year-wise fuel mix in power generation plan is shown in **Table 8-4**.

Table 8-4: Year-wise Fuel Mix in Power Generation Plan-Low Case Studies

Fuel	Year wise Composition MW (%)			
	2025	2030	2035	2041
Coal	9,913 (24.8%)	17969 (33.7%)	23,940 (37.0%)	25,596 (32.2%)
Gas/LNG	18,960 (47.4%)	23,744 (44.6%)	28,292 (43.5%)	34165 (43.0%)
Liquid Fuel	6,778 (16.9%)	5,591 (10.5%)	1,636 (2.5%)	1,840 (2.3%)
Import	2996 (7.5%)	3,496 (6.6%)	7,496 (11.5%)	11,996 (15.1%)
Nuclear	1,116 (2.8%)	2,232 (4.2%)	3,348 (5.0%)	5,580 (7.0%)
Hydro	230 (0.6%)	230 (0.4%)	330 (0.5%)	330 (0.4%)
Total	39,993 (100%)	53,262 (100%)	65,042 (100%)	79,507 (100%)

Source: Revisiting Power System Master Plan (PSMP), 2016

Presently the power generation capacity from coal-based power plant is 2692 MW which is far beyond the future plan. Therefore, government of Bangladesh has taken initiative to install coal-based power plant for reaching the future power generation capacity as per the PSMP 2016. GoB approved total 18 coal-based power plants. But in 2021 Government of Bangladesh dropped 10 coal-based power plant due to fail to come into generation within their stipulated timeframe as well as GHG emission issues. As the natural gas crisis is significant in Bangladesh therefore, recently several LNG based power plants are in pipeline. In recent fuel crisis becomes acute problem due to Russia-Ukraine war and It is unknown when the situation will return to normal. As a result, LNG price goes highest. Now, BPDB has permitted to OPDL-2 to set up the 635 MW coal based thermal power plant in Matarbari which was previously supposed to set up in Gazaria, Munshiganj. Considering present fuel crisis, still coal is the preferred choice given its shorter gestation period, lower costs and relative safety.

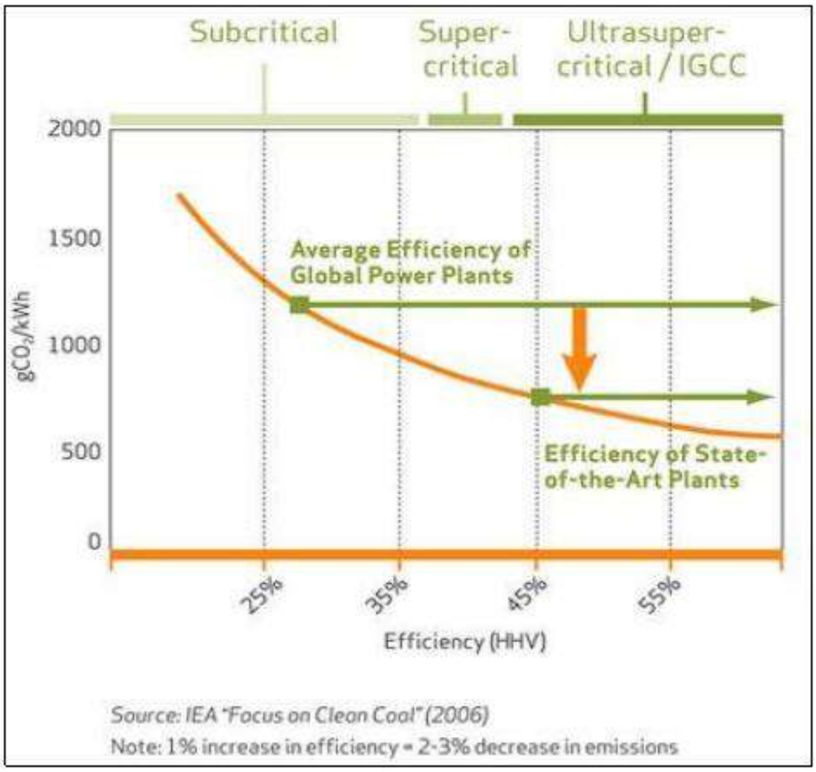
8.5 Analysis Boiler Technology

The technology options for large, pulverized coal-fired power plants are subcritical, super-critical and ultra-super critical. Ultra-supercritical plants operate at steam pressure above 22.1 megapascals (about 3,200 pounds per square inch) and use once-through boilers. In the ultra-supercritical stage, water becomes gas. Subcritical plants operate at steam pressure below 19 megapascals and use drum-type boilers. In the subcritical stage, the steam is a mix of liquid and gas. The ultra-super critical plants are a class above ultra-supercritical and operate at ~2-3% higher efficiency than ultra-supercritical ones. It operates with steam pressure and temperature range of 25.4 MPa g and 571ºC.

Currently, the ultra-supercritical technology is fast becoming standard practice in the power industry for large coal-fired power plants for its efficiencies of 42% or higher, compared with the subcritical technology efficiency of 35–38%. Higher efficiency means better utilization of coal, hence cutting down emissions. (Refer **Figure 8-3**) The lifecycle costs of ultra-supercritical coal-fired power plants are lower than those of subcritical plants. Current designs of ultra-supercritical plants have installation costs that are only 3-5% higher than those of subcritical plants. Fuel costs are considerably lower with an increased efficiency and operating costs are either lower or the same as compared to subcritical plants. More than 400 ultra-supercritical plants are operating in the US, Europe, Russia and Japan.

The concerns of carbon footprint demand further increase in efficiency whist burning coal and Ultra Super Critical (USC) technology offers even higher efficiency and therefore lower emission than any other technology class. USC based power plants are constructed in recent times in Europe, USA and Japan, based on high quality coal available in the western countries, however, no such units are being built with low quality coal as yet. The affordable electricity is the key for development in the developing economies like Bangladesh. The high capital cost resulting in unaffordable tariff to the customer, reliability issues of this technology on available coal and lack of indigenization are proving to be the bottleneck to make this a viable option right now for adoption.

Figure 8-3: Emission Reduction with Increase in Efficiency



Source: www.worldcoal.org

Advantages of Ultra Supercritical Power Plant

- Higher Efficiency

Ultra-Supercritical steam conditions improve the turbine cycle heat rate significantly over subcritical or supercritical steam conditions. The extent of improvement depends on the main steam and reheat steam temperature for the given supercritical pressure. A typical supercritical cycle will improve the station heat rate by more than 5% which results in fuel savings to the extent of 5%. Overall ultra-supercritical power plant efficiency of 42%- 43% is achievable with current ultra-supercritical parameters.

- Emissions

Improved heat rate results in a 5% reduction in fuel consumption and hence a 5% reduction in CO2 emissions per MWh energy output. Typically for a 660 MW Ultra-supercritical unit, the annual reduction in CO2 emission will be about 600,000 tons of CO2 with respect to baseline emission established by CEA for 2008 – 2009.

Ultra-Supercritical technology-based thermal power project is a potential candidate to avail the benefits under Clean Development Mechanism (CDM) established by United Nations Framework Convention on Climate Change (UNFCCC).

- Operational Flexibility

Ultra-Supercritical technology units also offer the flexibility of plant operation such as:

- Shorter start-up times
- Faster load change flexibility and better temperature control
- Better efficiency even at part load due to variable pressure operation
- High reliability and availability of power plant

CHAPTER 9

Environmental Management Plan

9 ENVIRONMENTAL MANAGEMENT PLAN

The main purpose of the Environmental Management Plan (EMP) is to identify project specific actions that will be undertaken by the project authority for mitigation of the specific impacts identified in the proposed project. These actions will be incorporated into project management system and integrated into the implementation at various stages of project development. The EMP describes both generic good practice measures and site-specific measures, the implementation of which is aimed at mitigating potential impact associated with the project activity.

Objectives of the Environmental Management Plan

The main objective of EMP is to warrant that the industrial development in an identified particular study area needs to be entangled with judicious utilization of non-renewable resources and to ensure that the stress/load on the ecosystem is within its permissible assimilative capacity i.e., it's carrying capacity. In above context assimilative capacity refers to the maximum amount of pollution load that can be discharged into the environment without affecting the designated use of various environmental attributes and is governed by dilution, dispersion and removal due to physico-chemical and biological process. An effective EMP ensures that these environmental requirements and objectives are satisfied during all phases of project. The long-term objectives of the EMP for all the environmental attributes are as under:

- To comply with all the regulations/applicable laws stipulated by DoE, Bangladesh;
- To create good working conditions for employees;
- To encourage and achieve highest performance and response from individual employees and contractors;
- To plan out the complete strategy to take care of stakeholder engagement;
- Budgeting and allocation of funds for environment management;
- Continuous development and search for innovative technologies for a cleaner and better future environment; and
- To contribute significantly to sustainable development.

9.1 EMP during Pre-construction Stage

The boundary of the proposed project site shall be clearly identified on site before starting the land filling, leveling and compaction.

9.1.1 Land Development

The proposed project is going to be established within the premises of the leased land from the Coal Power Generation Company Bangladesh Limited (CPGCBL). The land requirement for the proposed project is about 225 acres of which 201.64 acres for power plant, 1.73 acres for access road and 18.63 acres for coal corridor. In the power plant site, there is no titled settlement. Only nine squatters are living beside the embankment within the project site. Also, 12 squatters are living within the 20 meters coal conveyer belt area. Hence, total 21 squatters need to be relocated from the project site. During the pre-construction and development stage, only site preparation and land filling work will be done. The current land elevation of the power plant site is +1.25 m which needs to be raised +10 meters. So, a significant amount of land filling material will be required. According to the OPDL-2, the required filling material will be sourced from an authorized third party. Generally, the sands are sourced from river or sea area. A separate EIA study for the dredging activities in the Bay of Bengal or river will be required prior to start the dredging activities. The quality of the dredged soil will be confirmed by the contractor before starting landfilling activities. During land development, surface soil, drainage pattern, water quality and terrestrial ecology will be impacted. Any accidental spillage of fuels and lubricants and improper management of the solid and liquid waste from the dredgers will impact on the aquatic ecosystem. To mitigate the impacts during land development stage following management plan should be considered by the project proponent:

- Quality of the dredge soil shall be ensured by the EPC contractor before starting the dredging and landfilling activities;
- All topsoil will be retained and reused where possible;
- Scheduling activities (as far as possible) to avoid extreme weather events, such as heavy rainfall and high winds;
- Minimizing the amount of soil handled;
- Stabilizing exposed areas;
- Covering or spraying water on stockpiles of excavated material;
- Provision of channels, earth bunds or sandbag barriers on site to direct stormwater to silt removal facilities;
- Collection of surface runoff or extracted groundwater contaminated by silt and suspended solids by the on-site drainage system and removal of silt in silt removal facilities prior to discharge into storm drains;
- Protection of stockpiles by plastic sheeting to ensure that they are suitably secured against the wind at the end of each working day if rain is forecasted;
- Provision of surface protection and drainage works. Earthworks to form the final surfaces will be followed up with surface protection, and drainage works to prevent erosion caused by rainstorms;
- Appropriate surface drainage will be designed and provided where necessary;
- Temporary trafficked areas and the access road will be protected by coarse stone ballast or equivalent. These measures will be designed to prevent soil erosion caused by rainstorms. Temporary or permanent roadside drains shall be provided for the access road;
- Drainage systems, erosion control and silt removal facilities will be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit will be removed regularly;
- Any temporarily diverted drainage will be reinstated to its original condition when the construction work has finished or when the temporary diversion is no longer required;
- Measures will be taken to reduce the ingress of site drainage into excavations. If trenches have to be excavated during the wet season, they will be excavated and backfilled in short sections wherever practicable. Water pumped out from trenches or foundation excavations will be discharged into storm drains via silt removal facilities;
- The necessary precautions for seasonal wet periods and for when a rainstorm is imminent or forecasted will be clearly identified;
- Temporary and permanent drainage pipes and culverts will be provided to facilitate runoff discharge. These will be designed for the controlled release of storm flows; and
- Contractor must obtain necessary approval from concerned authority.

9.1.2 Location and Source of Soil and Other Material for Development

According to the OPDL-2, the dredge materials or soil for the proposed power plant project land development will be collected from the Sea (Bay of Bengal) or river by dredging. OPDL-2 intends to collect the dredged soil by an authorized 3rd party. The location of dredging not yet confirmed. However, dredging activities will be impacted on the surface water by increasing turbidity, aquatic life, migration of fish, disturbance of river traffic etc. Before starting the dredging activities, the EPC contractor and project authority must ensure the following things:

- Before selection of the dredging site in the Bay of Bengal or river, the project proponent and contractor must ensure the avoidance of the Protected Area, Wildlife Sanctuary, Fish Sanctuary, Fishing Zone, Fish Breeding and Spawning ground;

- Avoid sensitive areas;
- Avoid the migration route of Hilsha, Turtle and Dolphins and others aquatic animals;
- Avoid the Turtle breeding season and fishing zone;
- Selection of the best available technique dredging methods;
- Best equipment and barge used in the operation;
- Consider the formation time of cyclone disaster (April-May and October-November) and prefer the winter season for dredging;
- No disturbance of existing boat traffic near the dredging site and project adjacent river or channel;
- Necessary approval or permission from the Deputy Commissionaire (DC) office, Water Resources Planning Organisation (WARPO), Bangladesh Inland Water Transport Authority (BIWTA), Department of Environment (DoE), Department of Fisheries (DoF), Ministry of Shipping etc.

9.1.3 Transport of Soil and other Material

The dredge material or soil will be transported from dredging site to the project site. There will be almost 100 numbers of equipment including dredger(s), bulldozers, dump trucks and loaders for dredger operation and land filling. About 250 operators and labors will be dispatched in the project site in order to quickly finish the dredging activities and for the landfilling materials transportation. Dust generation and number of traffic volume will be the main concern. Following should be considered:

- Proper planning and scheduling on the dredging and disposal to avoid strong wind, current and tides that will further add to widen the effect of spreading of sediments;
- Best equipment and barge used in the operation;
- Use of low Sulphur content of oil or natural gas for the transportation vehicles;
- Cover the transportation vessels using tarpaulin so that dust cannot blown;
- Any accidental oil and hazardous chemicals leakage and spillage will be contained and cleaned immediately; and
- Proper collection of oil and hazardous chemicals and stored for recycling or disposal.

9.1.4 Method and Equipment for Collection of Soil and Other Material

Dredging activities in the sea or river will be done by the dredgers. The dredgers are classified into the following categories. The types of the dredgers below mainly differ in method of dislodging the soil.

- Mechanical dredgers- Grab dredger, Dipper dredger, Bucket dredger, Back-hoe dredger, Rock breaker
- Hydraulic dredgers- Plain suction dredger, Cutter suction dredger, Trailer suction dredger, water injection dredger
- Pneumatic dredgers
- Special dredging equipment's

The following factors govern the selection of a dredger for a particular work:

- Site characteristics and conditions
- Nature of soil/rock to be excavated
- The nature of dredged material to be transported
- Environmental factors

In Bangladesh, at present BIWTA mostly uses cutter suction dredgers of the sizes 18 and 20 inches for their inland dredging. The dredging technique not yet finalized for the project. The EPC contractor will determine the dredging methods and details equipment's requirement after getting the work order from the project proponent. Dredging activities will be preferred during the dry (winter) season.

9.1.5 Closing of Sites of Sources of Soil and Other Material

The Bay of Bengal or river will be the possible dredging source and transportation of dredge soil as the landfilling materials for the proposed project site. The dredging site or source of material not yet confirmed. However, the third party or who will supply the soil material will be responsible to close the sites of sources of soil material.

9.1.6 Dredging Activities Management Plan

In dredging works, proper dredging and spoil management should be followed in the following procedure to mitigate the temporary and localized turbidity and sedimentation in River.

- Equipment should be kept in good order with skilled operators. Disposal must be made in confinement chamber;
- Cutter head speed will always be kept to the minimum level that yields an acceptable production rate;
- Dredging activities should be avoided sensitive locations (Hilsha breeding ground, sanctuary) and
- Dredging activities should be planned to avoid surfacing and swimming time of Juvenile Dolphins (i.e. dawn and evening).

There are some impacts during the pre-construction stage on environment (air, noise, water, and ecology). Subsequent mitigation measures for pre-construction stage have been suggested in section 7.1. The management plant during the pre-construction stage is presented in **Table 9-1**.

Table 9-1: Management Plan for Pre-construction Phase

Issues/ Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
Landform Changes	- Landform and land use of the project site will be changed; - Existing canal and low-lying area needs to be fill up; - Natural/artificial drainage will be impacted	• Land development will be confined within the project boundary; • Avoidance of encroachment of waterbodies is preferable; • Trees/Vegetation clearance should be reduced as much as possible; • Greenbelt development as early as possible after completion of the construction activities immediately; • Landfilling and site development activities can be continued during dry season; • Adequate storm water drainage plan should be ensured; • Parking of vehicles and stockpiling of materials/excavated earth should be done in systematic way to avoid the damaging of aesthetics of the site; and • Regular monitoring of the drainage condition and waterlogging situation in the project area.	**Implementation:** Contractor **Supervision:** OPDL-2
Dredged Material collection for land development	- Increase noise, turbidity and increase number of vessels movement, which may impact on aquatic ecosystem & disturbance the river traffic temporarily; - Accidental spillage of fuels, lubricants and improper management of the solid and liquid waste from the dredgers will impact on the aquatic ecosystem.	• The contractor must be select the dredging site avoiding protected and ecological sensitive area; • The contractor must be checked the quality of required dredge material/soil before starting the dredging activities; • Necessary permission must be taken from the concern authorities; • Avoid the monsoon season for dredging activities; • Regular maintenance of water vessels, vehicles; • Switched off and park the dredgers and barges when not in use; • Instruct the workers to protect water resources and no disposal of waste in the sea/river from the dredgers and material carrying barge; • Provide adequate space for movement and safe passage of fishes and other aquatic animals; • Schedule activities to avoid disturbance of fish and aquatic animal during critical periods of the day (e.g., night) or year (e.g., periods of breeding); • Turn off all unnecessary lighting at night to avoid attracting and disturbance of fishes; and • Regular monitoring the fish death and disturbance of fish and aquatic animals in the dredging site.	**Implementation:** Contractor **Supervision:** OPDL-2/DoE/Local administration
Drainage Pattern	- Existing canal and low-lying area needs to be fill up;	• Land development will be confined within the project boundary; • Ensure the proper drainage in the project site; • No waste dumping in the existing drainage around the project site;	**Implementation:** Contractor

Issues/ Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
	- Natural/artificial drainage will be impacted; - Surrounding area might be inundated	• An alternate canal must be excavated by the project proponent before filling the existing canal; • Ensure the water availability for salt/shrimp/agricultural activities to the southern side of the project boundary; and • Monitor the surrounding drainage condition during the monsoon season to avoid the waterlogging.	**Supervision:** OPDL-2
Ambient Air	- Dust pollution from vehicles movement; - Gaseous emission from the operation of machineries, equipment's, vessels and vehicles will be impacted the ambient air quality.	• Water sprinkling will be regularly carried in order to arrest the fugitive dust; • Limit the speed of the vehicles (it shall be 20 km/hour) and cover the vehicles during the movement or transportation of soil for landfilling; • Ensure that vessels should be covered during transportation of soil; • Stop unnecessary vehicle and engine operation when not in use; • Vehicles, DG sets and machineries to be properly maintained and serviced regularly to control the emission of air pollutants; • Equipment causing excess pollution (e.g. visible smoke) will be banned from project sites immediately prior to usage; • Use of good quality fuel and lubricants will be promoted; • Dust monitoring should be carried out every day; and • The Ambient Air quality monitoring should be carried out by the contractor following the National Air Pollution Control Rules, 2022 (Schedule-1: Ambient Air Quality Standard).	**Implementation:** Contractor **Supervision:** OPDL-2/DoE
Ambient Noise	- Noise level will increase due to dredging activities, soil transportation, landfilling, levelling, compaction of soil, traffic movements, operation of vehicles and machinery, removal of trees/vegetation. - Impact on terrestrial fauna, aquatic fauna, occupational and community health and safety.	• Inform the local community before starting the landfilling activities; • Provide Personal Protective Equipment (PPE) among the workers; • Avoiding unnecessary engine operations and horns; • Activities that take place near sensitive receptors to be carefully planned (restricted to daytime, taking into account weather conditions etc.) and use noise barrier (if required); • Maintain vehicles and construction equipment in good working condition including regular servicing; • Use muffler and silencer to reduce the noise level from the equipment and machineries; • Periodic checking of vehicles to ensure compliance to sound standard following the National Motor Vehicles Standard (Schedule-2: Standards for sound originating from motor vehicles or mechanized vessels, Noise Pollution Control Rules, 2006); and	**Implementation:** Contractor **Supervision:** OPDL-2/DoE

Issues/ Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• Regular monitoring of noise pollutants concentrations following the National Sound Quality Standard (Noise Pollution (control) rules 2006).	
Waterbodies	- Impact on existing drainage system in the proposed project site and its surroundings; - Waterlogging problems; - Impact on aquatic environment due to accidental spillage of fuels and lubricant	• Avoidance of encroachment of waterbodies is preferable; • Temporary drainage should be ensured by the contractor during landfilling and site development; • An alternate canal must be excavated and regulator needs to be set up by the project proponent before filling the existing canal; • During the excavation of new canal and regulator, it must be considered the depth and width of the canal to drain water from the surrounding area; • Site cleaning wastes should be dump primarily in a specific area in the project site and immediately remove to the approved site; and • Accidental spill management plan should be introduced in the site.	**Implementation:** Contractor **Supervision:** OPDL-2/DoE
Soil Quality	- Loss of top soil - Soil contamination due to accidental spillage - Soil compaction	• Establishing the project boundary prior to sand filling; • Land development should be restricted within the project boundary; • Demarcating routes for the movement of heavy vehicles; • Stripping and placing soils when dry, and not when wet; • The Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks; • A site-specific Emergency Response Plan will be prepared by the Contractor for soil clean-up and decontamination; • Fuel tanks and chemical storage areas will be provided with locks and be sited on sealed areas; • Segregation of hazardous and non-hazardous waste and provision of appropriate containers for the type of waste type; and • Disposal of waste by licensed contractors/local municipality.	**Implementation:** Contractor **Supervision:** OPDL-2
Land Loss	- Total 225 acres land loss. - Total 166.25 acres land is private land, and 58.75 acres land is government khas land.	• The land acquired would be appropriately compensated; • The land acquisition and compensation payment process would follow the national regulatory requirements and international practices; and • PAPs losing land shall be involved in project's job opportunity based on their qualification, if possible.	**Implementation:** NGO/CPGCBL **Supervision:** DC office
Livelihood Loss	- Approximately 204 saltpan workers will lose their livelihood due to the	• Preparation of livelihood restoration plan and eligibility for livelihood restoration measures; • Enhancement of sustainable livelihood of the affected saltpan and shrimp workers through skill development for alternate employment;	**Implementation:** NGO/ OPDL-2 **Supervision:**

Issues/ Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
	intervention of proposed project. - Approximately, 20 shrimp cultivator will lose their livelihood	• Unskilled labor during the project construction phase would be sourced from the local community; and • Training would be provided to the local people for their skill enhancement.	OPDL-2
Physical displacement	- Total 21 squatters will be displaced	• Provide technical and financial assistance for the relocation of the affected households; • Initiate CSR activities to enhance their livelihood; • Involve the displaced person during the construction and operation phase of the power plant as per their skill.	**Implementation:** NGO/ OPDL-2 **Supervision:** OPDL-2
Employment Generation (Positive Impact)	- Approximately 250 workers including operator and laborers will be required during pre-construction phase	• Employing local people for site cleaning and development activities as per the expertise to the maximum extent possible; • Equal employment opportunities for the local community and no discrimination based on race, religion, political influence etc.; • No child and/or forced labour will be employed by the EPC contractor; • Trained the workers by providing health and safety training on communicable diseases; and • Working conditions and terms of employment will be fully compliant to the Bangladesh labour laws.	**Implementation:** Contractor **Supervision:** OPDL-2
Terrestrial Flora	- Loss of vegetation resulting from land clearing and leveling, which would destroy original vegetation; - Impact on terrestrial flora due to dust generation	• Trees/Vegetation clearance should be reduced as much as possible; • Select coal conveyor routes in such a way as to avoid felling of Jhau trees; • Regular monitoring and keeping records of tree removal from the project site; • Tree felling, if unavoidable, shall be done only after compensatory plantation of at least three saplings for every tree cut is done; • Dust mitigation measures i.e., water spraying, covering stockpiles during transportation, etc. should be followed; • Greenbelt development around the project site and surrounding area as early as possible; and • Workers should be aware of the importance of natural resources and should not unnecessarily break branches, twigs, flowers, etc. of adjacent vegetation	**Implementation:** Contractor **Supervision:** OPDL-2
Terrestrial Fauna	- Disturbance of terrestrial common birds;	• Dust mitigation measures i.e., regular watering and sprinkling should be followed; • Machinery with lesser noise production should be used as far as practicable;	**Implementation:** Contractor **Supervision:** OPDL-2

Issues/ Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
	- Noise from movement of construction machinery will impact on terrestrial fauna;	• Directional lighting facility should be followed at project site to avoid disturbance of the movement of nocturnal wildlife species; and • Refrain from engaging in noisy tasks during nighttime;	
Aquatic Ecosystem	- Dredging activities will be impacted fish and aquatic life; - Accidental spillage may contaminate surface water; - Sedimentation load may decrease the DO level	• Dredging should be done in designated place. Siltation control curtains should be used to minimize the dredging impacts. • Oil leakage or spillage from land filling, levelling, and compacting associated machinery will be contained and cleaned up regularly; • Waste oil will be collected and stored for recycling or disposal; • No disturbance for aquatic animal and keep provision for the fish movement; • Regular monitoring the fish death and disturbance of fish and aquatic animals in the dredging site.	**Implementation:** Contractor **Supervision:** OPDL-2
Occupational Health and Safety	- Dust, fumes and noise that could lead to possible respiratory problems, hearing loss and other health-related problems; - Use of power tools and accessories, falling gadgets, cuts from sharp objects could cause potential injuries and harm to health of workers. - Improper management of the labor camp will also impacts on workers' health, sanitation and safety.	• Brief the workers before starting the activities in the project site; • Ensure effective use of the personal protection equipment (PPE); • Provide health care and first aid facilities are available in the project site; • Establishment of safety sign in the accident-prone area; • Controlled vehicles speed on the proposed project site, it shall be 20 km/hour; • Provide adequate lighting in the landfilling area and along the roads in the project site; • Contractor should be ensured the availability of water for the workers camp; • Trained the workers by providing health and safety training; • No child and/or forced labour will be employed by the EPC contractor; • Provide proper navigational lighting and navigation aids for the vessels; • Working conditions and terms of employment will be fully compliant to the Bangladesh labour laws; and • The record of the accidents and incidents in the project site will be maintained using a register.	**Implementation:** Contractor **Supervision:** OPDL-2

9.2 EMP during Construction Phase

The boundaries of the construction site shall be clearly identified on site during the construction process. The method of identification shall be either permanent fencing, temporary fencing or construction/safety barricades or high visibility tape. Where existing or new permanent fencing is used to identify construction boundaries high visibility warning tape should be interwoven in the fence. All works and storage of materials and equipment shall be restricted to this area during the construction phase.

9.2.1 Site Preparation

9.2.1.1 Site Development and Backfilling

It is proposed that site development for power plant project will be developed sequentially one after another. The proposed project site is a salt pan area. The major land development activities will be done during the pre-construction phase. The land development will be done using dredging spoil or soil from the sea or river. So far, any part of site development, it is required to encompass the site development demarcated and well-compacted earthen ring dyke initially. So that, no loose earthen materials can move to the river by runoff water. Before dumping of dredging materials, base stripping of topsoil has to be made proper bonding, and stripped materials have to be kept in a safe place for reuse it after completion of site development. Backfilling has to be made layer by layer ensuring proper compaction and water spraying so that no dust can emit in the air causing air pollution.

9.2.1.2 Construction Site Management Plan

The construction camp and the site should be managed in such a way that would cause minimum degradation or damage to the surrounding environment. The contractor must take responsibility for the construction site to confirm contractual aspects and applicable environmental standards of Bangladesh. Adequate numbers of bins, sanitary toilet, water supply system, drainage system, firefighting system etc. should be provided in the site. However, good housekeeping is necessary for preventing environmental damage. All the construction materials and stockpiles should be maintained within the project area provided with rain and wind protection. Environment, Health and Safety department of OPDL-2 should be employed with responsibility of monitoring the activities, which causes any environmental effects, and ensuring enforcement of EMP during construction activities.

9.2.1.3 Construction Waste Management Plan

Construction waste should be managed properly. The rate of waste generation should be reduced by adopting efficient technique and limiting waste generating activities. The measures for controlling construction waste may include limiting site clearance activities, plan stocking and gathering of construction materials and equipment, fencing around the construction yard, maintaining existing right of way to carry construction materials, adopting proper sanitation system for employees, banning of waste burning, and quality housekeeping. A waste dumping place should be provided with efficient waste collection and disposal techniques. No waste should be dumped to the surrounding waterbodies. Burning of solid waste in the construction site is strictly prohibited.

Appropriate measures will be provided with run-on and run-off system might be constructed from controlling run off from construction yard and liquid waste. Initiatives must be taken to reuse and recycle of waste materials. Hazardous material including fuel and other combustible materials shall have to be stored with highest care and safety. Spillage, accidental release must be controlled adopting Hazardous material handling guideline.

9.2.2 Infrastructure Services

The Contractor shall follow the following management plan during construction stage of the proposed power plant project:

- The location of the construction camp should be in an acceptable location based on environmental, cultural or social point of view;
- Construction camp should be away from the local community to avoid social conflict and avoid adverse impacts on the community;
- Use of alcohol and drug is strictly prohibited in the construction site and use of local people for collection and transportation;
- Sufficient and good quality accommodation for the construction workers;
- The proposed project site is a cyclone prone area so before establishing the construction camp it should be considered;
- Ensure adequate supply of good quality ground water as per the national water quality standard of DoE, Bangladesh;
- Adequate hygienic sanitary facilities and sewerage system. The minimum number of toilet facilities required is one toilet for every ten persons;
- Provide in-house community/common entertainment facilities. Dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible;
- Ensure proper collection and disposal of solid wastes within the construction camp and treatment facilities for sewerage of toilet and domestic wastes;
- Insist waste separation by source; organic wastes in one pot and inorganic wastes in another pot at household level;
- Provide adequate health care facilities within construction sites;
- Provide first aid facility round the clock. Maintain stock of medicines in the facility and appoint fulltime designated first aider or nurse and ambulance facilities;
- Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work;
- Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis;
- Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellant sprays during monsoon; and
- Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. Place display boards at strategic locations within the camps containing messages on best hygienic practices.

9.2.3 Construction Equipment

During the construction stage of the proposed power plant project, heavy machinery will be used which causes noise, vibration and air pollution. The following measures should be taken by the contractor during the construction stage:

- Regularly maintain all diesel-powered equipment and reduce idling time to avoid emissions of NO_2, $PM_{2.5}$, PM_{10} and SO_2;
- Minimize movement of construction vehicles and enforce a speed limit (20 to 30 km/hour) around the construction site;
- Where available use low Sulphur diesel and diesel-powered equipment in collaboration with best management practices;
- Implement best practice procedures to control vehicle/equipment air emissions (such as turning off equipment when not in use);
- Only well-maintained equipment should be operated on-site;
- Vehicle/equipment exhausts observed to be emitting significant black smoke from their exhausts should be serviced/ replaced;

- Regular maintenance of equipment including lubricating moving parts, tightening loose parts and replacing worn out components should be conducted;
- Noise barriers should be installed around the construction site to reduce the noise pollution impacts on nearest sensitive receptors;
- Concrete mixing plant or high noise generation machineries should be kept as far as possible from the nearest receptors; and
- Normal working hours of the contractor will be between 09:00 AM to 06:00 PM. If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of the noise criteria as per the DoE guideline.

9.2.4 Safety Measures

Occupational health and safety are essential to ensuring a suitable working environment on construction sites. A good working environment encourages the workers to increase the capability. During the construction phase of the proposed power plant, the contractor should take the following health and safety measures.

- The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for working methods, plant utilisation, construction sequence and safety arrangements;
- Measures will be implemented to reduce the likelihood and consequence of the following hazards:
  - ✓ falling from a height;
  - ✓ falling into water;
  - ✓ entanglement with machinery;
  - ✓ tripping over permanent obstacles or temporary obstructions;
  - ✓ slipping on greasy or icy walkways;
  - ✓ falling objects;
  - ✓ asphyxiation;
  - ✓ explosion;
  - ✓ contact with dangerous substances;
  - ✓ electric shock;
  - ✓ mistakes in operation;
  - ✓ variable weather conditions;
  - ✓ lifting excessive weights; and
  - ✓ traffic operations.
- A Permit to entering system will be established to ensure that only authorised persons to gain entry to the site;
- Competent and adequately resources sub-contractors will be used where construction activities are to be sub-contracted;
- All persons working on site will be provided information about risks on Site and arrangement will be made for workers to discuss health and safety with the Contractor;
- The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for working methods, plant utilisation, construction sequence and safety arrangements;
- All workers will be properly informed, consulted and trained on health and safety issues;
- Personal Protective Equipment (PPE) shall be worn at all times on the Site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips;
- Women in the region generally wear "sarees", which is not appropriate while working in hazard-prone construction areas. If women will be working in the hazard-prone areas, then the contractor needs to ensure proper outfit and PPEs;

- Before starting work all the appropriate safety equipment and the first-aid kit will be assembled and checked as being in working order. Breathing apparatus will be tested at regular intervals in the manner specified by the manufacturer;
- All lifting equipment and cranes will be tested and inspected regularly. All hoistways will be guarded;
- All scaffolding will be erected and inspected in conformity with the Factories Act and the appropriate records maintained by the Contractor;
- Safety hoops or cages will be provided for ladders with a height in excess of two meters;
- When there is a risk of drowning lifebelts shall be provided, and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding;
- All breathing apparatus, safety harnesses, life-lines, reviving apparatus and any other equipment provided for use in, or in connection with, entry into Confined Spaces, and for use in emergencies, will be properly maintained and thoroughly examined at least once a month, and after every occasion on which it has been used;
- Where sound levels cannot be reduced at the source, suitable hearing protection will be provided when noise levels indicate a Leq of more than 85 dB (A). When hearing protection is used, arrangements will be made to ensure the wearers can be warned of other hazards; and
- The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations when the work is in progress.

9.2.5 Air Quality Management Plan

Construction activities generate large volumes of particulate matter and sometime significant volume of greenhouse gases. However, with the project activities like land filling, levelling, cutting etc., a large amount of particulate matter might be generated. Hence, an efficient air quality management plan has to be adopted. The mitigation plan includes limiting particulate matter generating activities, adopting dust suppression system, limiting vegetation clearance activities, avoiding earthen road for traffic movement, covering stockpiles, traffic management, etc. The monitoring of air quality in the construction site should be monitored and ensured by the contractor following the monitoring plan as guided in the report.

9.2.6 Noise Level Management Plan

In the construction site, noise to be generated from different mechanical equipment's, machineries and vehicles used in construction activities and transportation shall have to be managed to ensure ECR, 2023 and Noise Pollution (Control) Rules, 2006 defined standard. Adopting the necessary mitigation measures might reduce the generation of noise from construction activities. The monitoring of noise level in the construction site should be monitored and ensured by the contractor following the monitoring plan as guided in the report.

9.2.7 Water Resources Management Plan

According to the project proponent, water required during the construction phase of the proposed project only surface water will be used. Waste from the construction camp should be monitored and ensured the proper disposal to avoid surface water pollution. Construction wastewater management would control the discharge of waste into the Kutubdia Channel and adjacent Kohelia-Matamuhuri river. The contractor will instruct and provide proper training to the monitoring professionals during construction work.

During construction stage there will be different impacts on environmental components. The management plan for construction stage is presented in **Table 9-2**.

Table 9-2: Management Plan for Construction Stage

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
Land Use	- change the existing landform and land use of the project site	• Prior to start the construction, project area should be bounded; • The vertical clearance of the coal conveyor belt should be adjusted in such a way that the natural beauty of the Matarbari beach is maintained; • Ensure water intake and outfall structures will not hamper beach access; • Encroachment to the other areas should be restricted.	**Implementation:** Contractor **Supervision:** OPDL-2
Agricultural resources	- Surrounding area might be impacted	• Avoidance of productive land and far from the nearest settlement area is preferable; and • Greenbelt development as early as possible after completion of the construction activities immediately.	**Implementation:** Contractor **Supervision:** OPDL-2
Fish Resources	- Fisheries resources will be impacted by the increase of vessels movement, accidental spillage of oil and lubricants, blast water, oil mixed water, solid waste disposal; - Jetty construction activities will be created noise, vibration and increase the turbidity in the river. - Restriction on fishing activity and reduction of fish production; - Improper management of waste and disposal from construction camp	• Workers shall be instructed to protect fisheries resources and unauthorized capture are prohibited; • No wastewater will be disposed into the aquatic environment; • Schedule activities to avoid disturbance of fish and aquatic animal during critical periods of the day (e.g., night) or year (e.g., periods of breeding); • Regular monitoring the fish death and disturbance of fish and aquatic animals during construction of jetty; • Create noise barrier and avoid unnecessary machineries and equipment's operation; • Avoid major activities in the river during fish breeding time; • Ensure proper collection and disposal of solid wastes from construction camp; • All sewage and liquid effluent will be treated properly as per the guidelines of DoE (Schedules 3 and 4 of the ECR, 2023);	**Implementation:** Contractor **Supervision:** MoF/OPDL-2
Forest Resources	- Few Jhau trees need to be cut down for coal conveyer belt construction	• Trees/Vegetation clearance should be reduced as much as possible; • Water spray to the dry earth/material stockpiles, access roads and bare soils as and when required to minimize dust; • Stored materials such as: excavated earth, gravel and sand shall be covered and confined to avoid their wind drifted; • Limit the speed of the vehicles (it shall be 20 km/hour) and cover the vehicles during the movement or transportation;	**Implementation:** Contractor **Supervision:** DoE/Forest department

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• The contractor in the project site should carry dust monitoring out every day.	
Ambient Air Quality	- Fugitive dust generation from the earthworks, operation of construction machinery, movement of vehicles, civil construction, handling and stocking of construction material; - Exhaust emissions from combustion of the petroleum products in project related vehicles, machinery, generators and vessels etc	• The EPC contractor should develop and implement a Construction Environment Management Plan; • The EPC contractor will compact access roads and kept clean, free from mud and slurry and spray with water; • The EPC contractor should consider minimization of ground-works when high winds are present; • Sand and other materials will be stored in specifically designated areas; • Implementation of regular watering and sprinkling dust suppression regime, during the dry season; • The concrete batching plant will be located within the protected site to keep it away from sensitive receptor/s; • Material transport will be totally enclosed with impervious sheeting, and wheel washing will be carried out at the site; • Waste from construction will not be burned; • The movement of construction vehicles will be minimized, and a 20 km/hr speed limit will be enforced around the construction site; • Exhaust vent of DG set will be kept at proper height to ensure quick dispersion of gaseous emissions; • Periodic checking of vehicles and construction machinery; • The Ambient Air quality monitoring should be carried out by the contractor periodically.	**Implementation:** Contractor **Supervision:** OPDL-2/DoE
Ambient Noise	- Noise level will increase due to the construction activities and movement of vehicles and equipment; - Impact on workers, settlement and terrestrial fauna.	• The EPC contractor should ensure that all equipment and its mufflers are regularly serviced, and immediately serviced/replaced if damaged; • The EPC contractor should limit operation times of noisy equipment, vehicles and activities, where possible; • The EPC contractor should conduct regular inspection and spot checks of all noise generating equipment. • Low noise equipment shall be used as far as practicable; • The number of equipment operating simultaneously shall be reduced as far as practicable; • Restrict the nighttime vehicle movement through the access road; • Adopt the vehicle speed (20 km/hr) limit in the access road	**Implementation:** Contractor **Supervision:** OPDL-2/DoE

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• Temporary noise barriers shall be provided surrounding the high noise generating construction equipment; • Stone breaking machine should be confined within a temporary shed so that noise pollution could be kept minimum; • Instruction to the drivers to avoid unnecessary engine operation and horn in the project site approach road; • Periodic checking of vehicles to ensure compliance to sound standard following the National Motor Vehicles Standard; and • The Noise level monitoring should be carried out by the contractor following the Noise Pollution (control) rules 2006).	
Waterbodies	- Improper management of waste from construction camp and construction site can deteriorate the surface water quality; - Oil spillage from the workshop, rainwater runoff, water vessel may contaminate surface water; - Increase the TSS in the surface water	• Restrict the earthwork activities during monsoon season; • Channelize all surface runoff from the construction site through a stormwater drainage system and provide adequate size double chambered sedimentation tank; • Prevent & mitigate spill of paint/fuel within the construction site; • Oil leakage or spillage will be contained and cleaned up immediately; • Adequate sanitary facilities, i.e. toilets and showers, will be provided for the construction workforce; • Construction camp wastewater (both grey and black water) will be stored in soaking pits/ septic tanks; • Labor camp should be constructed at a distance from the water bodies and 500 m away from the settlement area; • No solid and liquid waste discharge is allowable into the water bodies from the construction camp; • Instruct workers to maintain clean environment in the construction camp; • The solid waste generation in the site will be segregated and will be transported and disposed of to waste disposal facility; • The EPC contractor will train their employees including sub-contractors at the site to minimize water consumption; and • All liquids effluent will be treated to meet the standards specified in Schedules 3 and 4 of the ECR, 2023 prior to discharge to the River.	**Implementation:** Contractor **Supervision:** OPDL-2

<table>
<tr><th>Issues/Components</th><th>Potential Impacts</th><th>Mitigation/Enhancement Measures</th><th>Responsibility</th></tr>
<tr><td>Soil Resources</td><td>- Loose of topsoil due to excavation, leads to reduction of fertility;
- Construction wastes, such as metal cutting, debris, packaging materials, which may contaminate soil;
- Soil pollution from liquid and solid wastes from the construction labor camp facilities;
- Accidental spillage or inappropriate management of fuels, engine oil and hazardous chemicals.</td><td>• Establishing the project boundary prior to start construction;
• Demarcating routes for the movement of heavy vehicles;
• Restricting the height of topsoil stockpiles to minimize erosion and compaction;
• A site-specific Emergency Response Plan will be prepared by the Contractor for soil clean-up and decontamination;
• Fuel tanks and chemical storage areas will be provided with locks and be sited on sealed areas;
• The storage areas of oil, fuel and chemicals will be surrounded by bunds or other containment device to prevent spilled oil, fuel and chemicals from reaching the receiving waters;
• Segregation of hazardous and non-hazardous waste and provision of appropriate containers for the type of waste type;
• Storage of wastes in closed containers away from direct sunlight, wind and rain;
• No direct disposal of waste into open environment from the construction camp, it is strictly prohibited; and
• Disposal of waste by licensed contractors/local municipality</td><td>Implementation: Contractor
Supervision: OPDL-2</td></tr>
<tr><td>Accidents and Injuries from general construction activities</td><td>- Injuries and illnesses, accidents in the construction site</td><td>• Adequate health care and sanitation facilities for construction workers will be provided by the contractor;
• Adequate first aid facilities in the construction site;
• The contractor must be ensured the good quality drinking water facility in the construction site as per the DoE standard;
• Ensure proper PPE to the workers;
• Safety sign in the accident/hazard-prone area/source;
• The health of workers will be checked for general illness; first time upon employment and thereafter at periodic intervals, as per the local laws and regulations;
• Provide HIV awareness programming, including STI (sexually transmitted infections) to all workers on regular basis;
• Regular mosquito repellent spraying during monsoon periods; and
• The contractor will take documentation of the accidents and illness in the construction site.</td><td>Implementation: Contractor
Supervision: OPDL-2</td></tr>
<tr><td>Health Impact associated with</td><td>- Potential health impact due to changes in the environmental</td><td>• Water spraying in dust generation sites for reducing dust;
• Provide appropriate PPE among the workers those who will work within dust emission sites;</td><td>Implementation: Contractor
Supervision:</td></tr>
</table>

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
environmental conditions	quality of air, surface water, groundwater and soil quality; - Increased dust and noise during the construction period has the potential to lead to health impacts associated with eye irritation and general disturbance to daily activities	• Instruct the workers about the health and safety issues in the construction site before starting the construction activities and ensure secure working environment; • Establishment of the waste management plan and hazardous material handling plan at the project construction site; • Handling of hazardous liquid should be done carefully by the designated experienced person; and • Proper monitoring should be done by the contractor.	OPDL-2
Key point installation	- Project construction may impact on nearby key point installation	• Make aware workers about the key point installation; • Consult with respective KPI authority prior to start the construction work and possible impact which may happen due to the project construction; • Install proper signage of KPI area; • Make aware workers in terms of access to the restricted place; • Management of entry and exit register and • Training of security personnel.	**Implementation:** Contractor **Supervision:** OPDL-2
Solid Waste Disposal	- Solid waste generation from packaging materials like cartons, wooden cases and pallets and domestic activities including food wrappers and leftovers; - Waste from domestic activities in labour camp.	• Establishment of the waste management plan at the project construction site; • Ensure proper collection and disposal of solid wastes within the construction camps and construction site; • Solid waste burning in the construction site is strictly prohibited; • Insist waste separation by source; organic wastes in one container and inorganic wastes in another container at sources; • Dispose organic wastes in a designated safe place on daily basis; • Maximum effort would be made to reuse and recycle the generated solid waste; and • Regular monitoring will be carried out by the contractor to record of generation and disposal of waste in daily basis.	**Implementation:** Contractor **Supervision:** OPDL-2
Local Resources and Infrastructure	- Local resources demand will be increased - Local infrastructure will be developed	• All the facilities for the workers during construction period must be ensured by the contractor; • Must ensure the good quality living condition in the construction camp for the workers; • Local community workers can be engaged for the construction period;	**Implementation:** Contractor **Supervision:** Local government and administration/OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• Contractor should be ensured the availability of water for the construction activities; • Working conditions and terms of employment will be fully compliant to the Bangladesh labor laws.	
Community Health and Safety	- Increased Air and noise pollution will impact on community health; - Waterlogging in mud pockets leading to breeding of mosquito and related health impacts; - Risk of road accidents; - Risk of violence, alcoholism, and sexually transmissible diseases (HIV/AIDS, syphilis among others), injuries and loss of life or properties.	• Inform the local community before starting the construction activities; • The contractor will prepare and implement a Health and Safety Plan prior to commencing work; • Avoiding formation of stagnant water pools in and around the site; • Implementation of a vector control programme in labour camps and surrounding areas; • Regular water spying in the high dust generating area; • Put the noise barrier/wall in the high noise generating area; • Proper traffic monitoring should be done by the contractor and keep the record of accidents; • Limit the speed of construction vehicles in the construction site and project approach road, it shall be 20 km/hour; • Instruct the driver's to drive carefully in the project site and approach road; • Use of mobile phone during driving is strictly prohibited in the construction site; • Proper indication of accident-prone area, education and religious institutes in the project site; and • Proper Traffic Management Plan (TMP) should be prepared by the contractor during starting of construction & follow it strictly.	**Implementation:** Contractor **Supervision:** OPDL-2/Upazila health complex
Demography	- Local demography will be changed	• The contractor should develop and implement a transparent recruitment process; • Priority for employment and other economic opportunities should be given to the local community to minimize in-migration; • The contractor should customize the grievance mechanism developed in this EIA Study and implement it for the construction phase of the project; • The Contractor and Developer should facilitate small and medium enterprise (SME) development in the local communities and the surrounding region;	**Implementation:** Contractor and OPDL-2 **Supervision:** OPDL-2/ Local government and administration

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• The developer should identify and facilitate training opportunities with vocational training institutions such as the local workforce to participate in other job sectors; and • The developer should support sustainable development and implementation of new technologies in local agricultural production and fishing	
Employment Generation	- Local people will get direct, indirect and induced employment during construction	• OPDL-2 and its contractors must prioritize the local community in the allocation of job opportunities; • OPDL-2 should also ensure opportunities for capacity building are afforded to the local communities to enable them to benefit from the available employment opportunities; • Job advertisements should be made through mediums that are easily accessible to the local community; • Where possible, expertise should be sourced locally then nationally before resorting to the engagement of international experts; • The recruitment selection process should seek to promote gender equality and the employment of women where possible; and • Management and enhancement measures for local employment should be included in the company's labour and human resources plan.	**Implementation:** Contractor and OPDL-2 **Supervision:** MoLE/ MoSW, OPDL-2/ local government and administration
Economic Growth	- Local economy will be boost up	• Ensure that economic opportunities are available or are created for the local community and that proper capacity building is afforded to the local communities to enable them to benefit from the available economic opportunities; • Communication and information programs should be used to manage expectations and target local service providers; • OPDL-2 and its contractors should, to the extent possible, make deliberate efforts to source for all required supplies from local providers, prioritizing from locally to the rest of the Country, before resorting to importation.	**Implementation:** Contractor **Supervision:** OPDL-2/ Local government and administration
Capacity Building	- Capacity building of the local worker will be developed	• The contractor should institute an elaborate structure to promote and enhance knowledge transfer between international experts employed by the project and the local employees; • The contractor should ensure effective capacity building is afforded to the local communities to enable them to benefit from the available economic opportunities.	**Implementation:** Contractor **Supervision:** OPDL-2/ Local government and administration

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• The contractor should effectively communicate the skill requirements to the local community well in advance of the construction phase.	
Impacts due to wastewater generation and disposal	- Improper management and disposal of wastewater into the open environment will impacts on soil quality, sediment quality, surface water quality, groundwater quality and aquatic environment	• Domestic sewage would be appropriately managed and disposed; • Establishment of the waste management plan and hazardous material handling plan at the project construction site; • Instruct the workers to avoid improper disposal; • All waste oils and chemicals should be stored in drums or tanks in a bunded compound situated on an impermeable surface in order to prevent potential spillage; • Sufficient numbers of bin will be ensured by the contractor; • Insist waste separation by source; organic wastes in one container and inorganic wastes in another container at sources; • Channelize all surface runoff from the construction site through a stormwater drainage system and provide adequate size double chambered sedimentation tank; • Oil leakage or spillage will be contained and cleaned up immediately. Waste oil will be collected and stored for recycling or disposal; • Construction camp wastewater (both grey and black water) will be stored in soaking pits/ septic tanks; and • All liquids effluent will be treated to meet the standards specified in Schedules 3 and 4 of the ECR, 2023 prior to discharge.	**Implementation:** Contractor **Supervision:** OPDL-2
Impacts due to Transportation of Raw Materials	- Construction materials and equipment's will be transported by waterway as a result river traffic will be increased; - Heavy-duty vehicles and trucks carrying construction and building materials, personnel and equipment's to and from the project site during construction may affect traffic flow and could even cause accidents on existing access roads;	• Proper Traffic Management Plan (TMP) should be prepared by the contractor during starting of construction & follow it strictly; • Movement especially at nearby the educational institute, community infrastructure, bazar and health complex should be careful and control the speed and avoid unnecessary horns; • In addition, BRTA and BIWTA traffic rules and regulations should be strictly followed; • Avoid disturbance and careful during construction vehicle and equipment movement in the project site and approach road; • Divert traffic to follow alternative routes to avoid traffic jams; • Limit the speed of construction vehicles in the construction site and project approach road, it shall be 20 km/hour;	**Implementation:** Contractor **Supervision:** OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
	- Dust and exhaust emission from the traffic movement; - Increase noise level and disturb the terrestrial fauna.	• Communicate with local fisherman and nearby KPI's authority prior to start the construction; and • Instruct the driver's to drive carefully in the project site and access road;	
Terrestrial Flora	- Hampering plant growth and causing diseases	• Suppression of fugitive dust emissions through spraying water in the construction area; • Covering dust generating loose materials with tarpaulin sheets during transportation to the site; • Restrict vehicle movement within site to a speed less than 20 km/hour at site to minimize potential for dust generation in the surroundings; • Supply fuel to the worker for cooking and train them not to use wood as a fuel; • Construction activities should be planned and undertaken in a phased manner; and • Greenbelt development around the project site and surrounding area as early as possible;	**Implementation:** Contractor **Supervision:** DoF/OPDL-2
Terrestrial Fauna	- Impact on health and behavior of terrestrial fauna through dust, noise, and vibration - Impacts on movement and reproduction of wildlife species	• The construction activities should be scheduled in such a way that it minimizes noise and vibration; • The noise generating activities should be scheduled during the daytime only; • Provide acoustic enclosures and noise barriers in areas of high noise generating sources to avoid discomfort to local wildlife. • Dust suppression measure should be implemented to minimize the dust pollution during construction work; • Use low-intensity lighting, which reduces the brightness of the lights and helps to reduce the glare; • Movement of construction and transport vehicles should be restricted to dedicated paths to minimize any harm to small mammals near to proposed site; • Limiting the speed of vehicles (20 km/hr) or the number of vehicles on site at any given time to avoid road kill; and • Strict prohibition will be implemented on trapping, hunting or injuring wildlife within the subcontractors and should bring a penalty clause under contractual agreements.	**Implementation:** Contractor **Supervision:** DoF/DoE/OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
Aquatic Ecosystem	- Increased contamination and turbidity of adjacent waterbodies by dredging, wastewater runoff etc. - Degradation of habitats for aquatic resources - Impact on movement, growth, and reproduction of aquatic flora and fauna.	• Provision of barriers/control walls at construction material storage areas to avoid contamination by surface runoff; • Noise and vibration control measures, such as insulation or mufflers, can help reduce the noise and vibration generated from construction activities (at jetty construction site). • Lighting on the construction site should be shielded to reduce the excessive light pollution caused by the construction activities. This will help to prevent the disorientation of Wildlife (Herpetofauna, mammals, and migratory and shore birds). • Avoidance of any leakage of fuels and other contaminants from barges/trawlers/hip to River; • Trawlers/barges with valid requisite licenses and emergency handling capacity or tie-ups shall only be engaged; • Providing proper toilets and sanitary arrangement for construction camps; • Restriction on construction workers for fishing in the River; • Avoid the coal conveyer belt construction during turtle breeding season; • Avoid night lighting on the shoreline during construction period; • Restrict the waste dumping into the water body; • A detailed Turtle survey should be conducted in the shoreline of Matarbari, Dhalghata sea beach; and • A Turtle Conservation Plan should be developed.	**Implementation:** Contractor **Supervision:** Department of Fisheries/DoE/OPDL-2
Groundwater	- Spillage and seepage of chemical, oil and lubricants from the storage area, waste handling area and generation of domestic waste/wastewater from construction labour camp may impact on groundwater quality - Excessive withdraw of groundwater may depletion of groundwater level	• Ensure proper spill control and management at site; • Ensure storage of hazardous material and waste in proper manner and disposed the waste in hazardous waste landfill site; • Fuel should be kept on concrete floor with bund; • Adequate sanitary facilities, i.e. toilets and showers, will be provided for the construction workforce; • Septic tanks will be provided to treat sanitary wastewater; and • Periodic Monitor the ground withdrawal and depletion rate; • Take the NoC from WARPO/Upazila/Union integrated water management committee for groundwater use; and • If the local community does not get water during the dry period OPDL-2 needs to be installed a deep tube well for the local people to serve the water.	**Implementation:** Contractor and OPDL-2 **Supervision:** WARPO/OPDL-2

9.3 EMP during Operation Phase

9.3.1 Air Pollution Management

The major pollutants envisaged from the proposed 635 MW coal fired power plant at Matarbari, Cox's Bazar are particulate matter, sulfur dioxide, oxides of nitrogen and fugitive dust from the power plant operation. Dust will be generated during coal handling, ash handling and storage.

9.3.1.1 Transportation and Handling of Raw Materials

The proposed coal-fired power plant project site is located on the bank of Kutubdia Channel. During the construction phase of the project, a coal-handling jetty will be constructed in the Matarbari deep seaport. For the operation of the power plant approximately 1.47 million tons coal will be required, and it will be imported from the foreign countries (Indonesia and Australia). The required coal will be transported from coal source to the coal unloading jetty using 60,000-70,000 dwt ship since the port has sufficient draft. Coal will be transported from unloading jetty to coal yard through 4.7 km conveyer belt.

The vessel to be used for coal transportation shall have to satisfy all national laws and IMO conventions signed by GOB. Bangladesh is a signatory 25 IMO Conventions and Maritime Protocols to protect marine and terrestrial environment of the country. All these conventions and protocols have been discussed in Chapter-2. Therefore, all activities relating to shipment of coal through the port shall have to be done strictly in compliance with the standards set by the IMO, particularly the conventions, protocols and agreements. Shipping, barging and transferring should be regularly monitored by the relevant authorities (e.g., Chairman) Shipping, Port Authority, WARPO and BIWTA to ensure enforcement of these conventions and protocols. The Coast guard might be given responsibility for inspecting whether the vessels are adopting mitigation measures, complying national and international rules of safety and environmental conservation. Besides, an Environment Manager shall be given responsibility of monitoring transportation activities and of auditing environmental efficiency of the transportation system.

Proper dust suppression and self-combustion mitigation system must be adopted. Practice to moisten the coal but not wet them should be followed. However, water treatment plants should be planned and constructed for management of runoff and wash off water from coal stockpile and unloading system. The unloading system and conveyor system should be enclosed typed that would reduce generation of fugitive dust particles from coal.

9.3.1.2 Operation Stage

Operation and maintenance of boiler, stacks, ESP, FGD, pipelines and storage tanks facilities must be carried out regularly as per the instruction given in the manufacturer's maintenance manual. At the same time, the quality of the imported coal must be maintained as per design of the boiler and to comply with APCR, 2022. The low sulfur content coal should be imported and used in the proposed project. The potential dust generation source like ash handling system must be monitored and tested to evaluate the performance as per the standard. Regular inspection of boiler, FD and ID fans, separation and handling system and other ancillaries shall also be inspected and tested regularly whether this level remains lower than the allowable limit. Emission level of SO_2, NO_2 and particulate matter etc. will be monitored in the project site and surrounding area. The concern unit (Environment, Health and Safety) of the power plant will be responsible for the monitoring of emission level, mitigation measures and regular reporting of the inspection. The monitoring and inspection report shall have to be submitted to DoE, Bangladesh for renewing Environmental Clearance Certificate. The following mitigative measures will be employed to reduce the impacts on air quality:

- Electrostatic Precipitator (ESP) with dust collection efficiency of not lower than 99.72% will be adopted; in order to assure smoke dust concentration at chimney outlet lower than 40 mg/Nm^3;
- Flue Gas Desulfurization (FGD) system will be constructed for this project. Limestone-gypsum wet type desulfurization will be adopted with desulfurization efficiency of not lower than 93%.

The sulfur dioxide concentration at chimney outlet will be lower than 200 mg/Nm^3, which can satisfy the requirement of World Bank IFC EHS standard;

- The boiler adopts low NO_x burner and staged air distribution combustions to assure NO_x emission concentration at boiler outlet lower than 350 mg/Nm^3, which satisfies the requirement of limit value required by standards;
- In this project, one 220 m high chimney will be constructed. High chimney emission is conducive to pollutants diffusion;
- Continuous online monitoring system will be installed to monitor Particulate matter, SO_2, NO_2 and other pollutants; and
- All the internal roads will be of concrete/asphalt to reduce the fugitive dust generated due to the vehicular movement

9.3.2 Wastewater Management

The wastewater of this project will be treated in the centralized treatment plant and the treated water will be reused. Domestic sewage treatment system will be mainly used to collect domestic sewage water of the whole power plant. Domestic sewage water mainly includes staff shower drains and flush water drains, toilet drains, canteen drains etc. The domestic sewage in the plant area will be discharged into domestic sewage treatment plant through underground pipeline. The treated water will be reused for landscaping of the whole power plant.

Production wastewater mainly includes acid and alkaline wastewater from boiler water treatment system, wastewater from condensate polishing system, drains from air pre-heater flushing, etc. The wastewater will be collected, pressurized and discharged to industrial wastewater central treatment plant. The treated wastewater will be discharged to recycling water system for dry ash humidification, coal handling system flushing, etc.

This project will be arranged coal slime water treatment room for flush water drains from coal handling system. The coal slime water treatment adopts flocculating, settling and dosing methods. The treated water will be reused for coal yard sprinkling, etc.

After separate treatment, desulfurization wastewater will be reused for ash yard sprinkling. This project will be arranged with oily wastewater treatment system. The oily wastewater will be discharged to oil water separation pond and then pumped and delivered to oil-water separator to remove oil. After treating the oil mixed water in the Oily Waste Treatment Station, it will be sent to the ETP for further treatment and reuse in the plant.

Effluent quality shall have to be monitored at different stages of discharge and intake. Before discharging the treated effluent to the Kutubdia Channel the effluent standard shall have to be complied with ECR, 2023 defined standard for effluent (schedule 4: wastewater discharge standard for industry or project).

9.3.2.1 Storm Water Management

Based on the rainfall intensity of the proposed area, storm water drainage system will be designed and connected to final drains. The storm water drainage system will consist of well-designed network of open surface drains so that storm water will be efficiently drained off without any water logging in the project premises.

9.3.3 Noise Management

The noise of the power plant will be mainly from equipment vibration and friction. Major noise sources include turbine-generator set, exciter, various pumps and fans and coal pulverizer. To become public nuisance, the noise shall have three indispensable elements, i.e., noise source, route of transmission and receiver. Therefore, the power plant noise can be effectively controlled in three aspects, i.e., reducing noise of sound source, controlling route of transmission and strengthening personnel protection. For noise control at sound source, energy saving & low noise products shall be selected in design; during equipment tendering, requirements on noise level of equipment shall be specified; associated acoustic enclosure and silencer shall be provided for the equipment. The Noise level should be monitored and different locations inside of the power plant and nearest sensitive receptors (settlement, school, mosque etc.). EHS department of OPDL-2 shall be responsible for monitoring efficiency of the management plan and regular monitoring of noise level. Generally, following measures shall be taken:

- Silencer shall be installed at boiler exhaust vent and fan inlet;
- Acoustic enclosure shall be installed for turbine-generator set;
- Turbine-generator set shall adopt rigid coupling;
- Low noise exciter shall be selected;
- All equipment and mechanical machineries shall have to be maintained in good working order;
- Noise from other line sources like project vehicle, conveyer belt, vessel, etc. shall be controlled;
- Central control building will be sealed by 250 mm thick aerated concrete blocks. The central control room will be arranged in the middle of the central control building, surrounded by corridors or auxiliary rooms, which will be isolated from the external sound sources; and
- Workers at high noise areas shall wear noise-protecting earplug.

9.3.4 Solid Waste Management

9.3.4.1 Fly Ash Utilization

The peak generation of ash due to use of coal in the proposed 635 MW power plant is estimated to be about 363.8 tons per day whereas 0.133 million tons per annum. The dry ash will be taken in dry form to storage silo near plant boundary for utilization. There are 76 cement industries in Bangladesh, and it is planned to tie up with the cement plants for sale of fly ash. 100 % utilisation of fly ash has been considered. The ash will be loaded to trucks/barge through gravity flow for transport of fly ash to cement plants. Purging with hot air will be done for dry dust free environment. In case the cement plant is located beyond 5-7 km of the plant boundary; the fly ash will be transported in covered barges. The ash will be loaded to the barge using an inclined chute with hot air.

The options for utilisation of residue ash such as use in brick manufacturing, clinker industries, cement industries, compaction purposes are also being explored. However, land development and ash dyke have been planned in case of non-utilization of ash.

9.3.4.2 Fly Ash and Bottom Ash Management

Fly ash and bottom ash handling system have been described under section 3.7.8.1 and 3.7.8.2.

9.3.4.3 Boiler Slag Management

The Coal-fired power plant would generate significant solid waste in the form of coal ash residues from the coal fuel during the operational processes. The waste includes fly ash, bottom ash and boiler slag. The bottom ash including slag is coarser and heavier. Bottom ash and boiler slag are coarser than fly ash and the size of the particles can range from fine sand to fine gravel, or about 100 to 10,000 μm in diameter (EPA, 1988). Measures to prevent, minimize, and control the volume of solid wastes from thermal power plants recycling of coal combustion wastes in uses such as cement and other concrete products, construction fills (including structural fill, flowable fill, and road base). The coarse ash and slag may also be grounded into fine ash by the grinding system or be made into light-weight aerated concrete blocks according to the demand of the market.

According to the project proponent, ash and boiler slag shall be stacked separately, for the ease of comprehensive utilization in the future. When stacking, the ash will be spread, rolled and compacted from bottom to top layer by layer, with stacking elevation at least 1.0 m lower than ash dam, meeting limits of safety rules requirements in ash storage area. The ash will be rolled with principle of normal operating of machines. The operation slope may be 1:20~1:30. When ash yard will be expected to reach full capacity, the ash surface will be afforested or converted into cultivated land.

9.3.4.4 Ash Yard Management

The major solid waste generation from the coal-fired power plant is ash in form of fly ash and bottom ash. Maximum ash generation from the proposed power plant will be from the coal. The stream generating units will be the main sources of the solid waste where the coal will be burnt.

The proposed project will adopt positive-pressure dense-phase pneumatic ash handling system for fly ash and are cooled mechanical handling system for boiler bottom ash. The fly ash and bottom ash will be collected for comprehensive utilization. Otherwise, they will be transported to ash yard for stacking. The ash shall be stacked in blocks in ash yard, so as to minimize the working face of ash stockpiling.

There shall be an ash disposal area for the storage of humidified bottom ash and fly ash, pyrites and gypsum. The storage shall be equipped with water spray system for dust suppression. There shall be pumping station to removed excess rainwater to water treatment system. Size of the Ash Pond will be approx. 500 M x 300 M and 12 m of height. This storage will be sized for 1.5 years production of bottom ash and fly ash, pyrites and gypsum. The ash disposal area shall be divided into 2 cells, one cell for bottom ash, fly ash and pyrites, one cell for gypsum. Dams will be laid around the ash yard area. A 5-meter windbreak forest belt will set around the ash pond.

Anti-seepage of Ash Yard:

In order to avoid underground water contamination caused by wet fly ash and bottom ash in rainy days, anti-seepage geo-membrane will be laid at the bottom of ash silo and the side slope of ash dam to isolate pulverized fuel ash from outside.

Ash surface sprinkling and soil covering:

Truck sprinkling is adopted during operation phase of ash yard, so as to provide water for humidifying and rolling compaction as well as ash surface sprinkling in ash yard. During strong wind season, the exposed ash surface shall be regularly sprinkled. If necessary, the ash pile shall be covered with soil, so as to avoid fly ash pollution. In order to prevent dust from polluting surrounding area, growing trees at exterior area of ash yard to form 5 m width Green belt in order to reduce wind speed and minimize flying dust.

Others solid waste to be generated from different point sources like office, labour camp, living facilities, maintenance workshop, process unit etc. shall be efficiently collected, disposed and managed. Waste shall be collected and managed separately as per type. Initiatives might be taken for recycling and re-use of waste. On site, waste disposal system should be constructed and their performance should be monitored.

9.3.4.5 Dust Suppression System (DSS)

Dust suppression systems have to be installed at coal receiving terminal and plant site. The system functions (dust suppression) replenishing the evaporated moisture. An integrated system has to be installed to control dust at ship's hold, ship unloader, loaders, stackers, reclaimers, a conveyor system (including each transfer point), and stockyard. An automated system may be adopted to suppress the dust maintaining the moisture level of coal surface not below 7%– 8%. Sprinklers have to be set up in a way that will spray maximum water inform of the mist so that no surplus water will be generated. However, water collecting and recycling system also need to be installed in line with dust suppression system.

Furthermore, the conveyor system might be covered typed so that coal dust from wind action can be controlled. At transfer points, water sprinkler should be installed.

In case of ship's holds, water sprinkler jets should be provided at the bottom of the boom of the unloaders so that the operator will be able to operate the sprinkler as and when required. In such a case, no need to install an automated sensor.

The major source of dust generation is stockyard. The entire stockyard should be covered with water sprinkler provided with an automated moisture sensor. Sprinkler system provided with electrically operated valves and pumps are standard. The entire system, i.e. sensor, valves, pumps should be connected with computerized monitoring and control system.

9.3.4.6 Ash Management Plan

Ash is the prime coal combustion products that release as fly ash and bottom ash during the operation of power plant. In order to avoid airborne dust about 99% fly ash has been captured in the ESP and temporary storage at ash silo. Fly ash will be sold to the cement factory and other usable industries. In case of emergency, this ash will be transported through ash conditioner for disposal to ash disposal pond by truck. Ash carries out to the ash pond mixing with water. Closed cycle water system should be implemented during ash transfer process. The following measures should be taken for proper management of ash.

- Engineering control measures should be considered to maintain the ash dust concentration as low as is reasonably practicable.
- The capacity of ash pond should be higher
- Additional ash disposal facilities should be the plan as for contingencies
- Proper design is necessary for local and national marketing of the ash
- Regular monitoring the ash disposal facilities
- Avoid prolonged skin contact especially where the product is dampened
- Wear protective clothing; good working practices, as well as high standards of housekeeping and personal hygiene, should be maintained

9.3.5 House Keeping

Good housekeeping is one of the prime steps of safety. Good housekeeping of mechanical parts, rotator parts, electrical equipment, plant site, green belt, ESP, stack, etc. will ensure workplace safety and efficient functioning of the system. This good housekeeping has to be made at regular intervals and as per need. The following practices can be done for good housekeeping in the project site.

- Regular cleaning of internal roads of the power plant to avoid accumulation of dust;
- Proper placement of adequate number of containers for collection of solid wastes and garbage at each office, plant units and workers and officers' residence;
- Maintaining proper storage and disposal of wastes materials;
- Maintaining hygienic conditions in canteens, drinking water source and sanitation; and
- Developing a positive outlook among employees for keeping their workplace clean.

9.3.6 Safety and Occupational Health

Occupational safety and health are very closely related to productivity and good employer-employee relationship. The main factors that affect the occupational health in the project site are flue gas emissions and noise. To avoid any effects on the health of workers due to emissions and noise, sufficient measures have been proposed which include:

- Working conditions and terms of employment will be fully compliant to the Bangladesh labor laws and acts;
- Ensure appropriate PPE for the workers and officers inside of the power plant;
- Effective de-dusting system at loading, unloading, and transportation;
- Adequate and availability of first aid facilities in the power plant area;
- Awareness on safety and ensure using personal protective equipment;

- Introduction of compulsory audiometric testing for all employees exposed to excessive noise in the workplace (i.e., 85 dB or above);
- The plant will be equipped with high-output energy-efficient light fixtures that are properly shielded to reduce glare;
- During working hours, temperatures inside the buildings may be considered as reasonable, ranging in some areas between 16° and 25°C;
- Offices would be equipped with air conditioners, which would be serviced regularly by contracted technicians;
- Portable fans and heat extractors would be used in the production area to achieve an adequate air flow at specific work areas to keep operators cool;
- Imparting basic and refresher training to new and old employees respectively;
- Ensure that everyone, from management to production workers, understands sanitation and hygiene issues;
- No child and/or forced labor is allowable;
- No entrance of unauthorized people inside of the power plant without approval from the authority;
- Regular health checkup of the power plant workers and appropriate treatment facilities;
- Comply with GoB/DoE/OPDL-2 acts, regulations, codes and other statutory requirements that are currently in force including the amendments and new regulations that may come in future;
- The proposed project will comply with the emission and effluent standards of national regulations.

9.3.6.1 Measures to Prevent Occupational Diseases

The Occupational Health Survey of the employees in the proposed power plant shall be carried out at regular intervals.

- Regular monitoring of working environment and implementation of safety and control measures to prevent hazards and risks; and
- Use of protective equipment, clothing, helmets, dust mask, shoes, etc.

9.3.7 Community Health and Safety

The community health risks and insecurity resulting from project implementation and subsequent increased community population and attendant demand on community health and educational facilities would be addressed as following:

- Improved community health facilities and management;
- Increased community health education and sensitization on potential health risks including emotional stress and sexually transmitted diseases (STD);
- Traffic and transportation management plan;
- Controlled community access to construction sites and restricted areas;
- Public security management plan involving improvement of the Police camp and operations;
- Institution of grievance mechanism to address emerging concerns; and
- Community Health and Safety Management Plan; and
- Implementation of CSR activities and regular monitoring.

During the operation stage, there are several environmental and social impacts. A comprehensive management plan for operation stage is presented in the following **Table 9-4**.

Table 9-3: Management Plan for Operation Stage

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
Air Quality	- Dust generation due to Coal Handling, Transportation and Storage/Coal Preparation/Ash Handling and Storage -	• Wet control dust suppression will be provided for the coal unloading area to reduce the fugitive dust emissions; • Automatic dust detectors will be provided in the coal yard and in case the dust level exceeds beyond a threshold value, water sprinkling will be carried out; • All transfer points shall be provided with a dry fog dust suppression system; • The coal dust extraction system shall be designed to suck the dust-laden air from the confined areas such as screening and belt feeders and at transfer points; • There shall be an independent dust extraction system for each unit; • Coal stockpiles shall be mechanically compacted to minimise air ingress and the potential for autoignition and loss of volatiles; • Use of water suppression for control of loose materials on paved or unpaved road surfaces; and • Fugitive dust will be further controlled by developing a green belt along the periphery of the proposed power plant; • Coal stockyard should be covered so that wind cannot disperse storage coal; • Coal conveyor belt should be covered to avoid wind; • Greenbelt development in and around the project site; and • Limit the vehicle speed (20 km/hour) near the project site approach road	**Implementation:** EHS team of power plant operation unit **Supervision:** DoE/OPDL-2
Air Quality	- Air pollution from combustion of coal in the boiler and fuel oil as start-up or emergency purposes; - SO_2, NO_2 and particulate matter released from boilers, generators; - Fugitive emissions from materials handling and transfer,	• The flue gas to be exhausted at 220m stack height; • The OPDL-2 shall design and install an electrostatic precipitator (ESP) (efficiency of no lower than 99.72%) for the power plant. • The OPDL-2 shall install Limestone-Gypsum Wet Flue Gas Desulphurization (FGD) system (efficiency no lower than 93%) to remove sulfur dioxide from the flue gas before the flue gas is emitted to the environment; • Low NOx burner is adopted for the boiler, which can effectively control the generation and emission of the NOx;	**Implementation:** EHS team of power plant operation unit **Supervision:** DoE/OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
	heavy-duty vehicles, stockpile loading and unloading, wind erosion, paved roads and unpaved roads	• Ensuring the standard of Bangladesh (MoEFCC) where emission always should be lower due to nearly presence of any sensitive area; • Maintain coal quality as stipulated in project description; • The plant equipment must be performance tested during commissioning phase to ensure standard has been maintained; • Continuous Emission Monitoring System (CEMS) will be installed to detect the emission of pollutants from the flue gas such as PM, SO_2, NOX, CO and CO_2, etc. • Automatic monitoring process and presenting on the real-time Web Pages should be implemented; • Stack monitoring data collected during commissioning and the subsequent operation period will be reported to the DoE, Cox's Bazar and also Head office at Dhaka on a quarterly basis as part; • Ambient air quality monitoring stations to be installed within the project site to obtain such measurable parameters, while periodic air quality monitoring using high/low volume samplers to be conducted at other locations; • Regular maintenance and overwhelming as per design specification; • Regular maintenance of plant at the proposed facility will also be carried out in order to optimize and minimize emissions.	
Impact due to Greenhouse Gas Emission	- About 2,693,388 tones/year GHG emission due to coal combustion during boiler operation in the proposed project.	• Ensure good quality coal during import from the source country; • Installation of continuous stack emission (SO_2, NO_2, CO and particulate matters) monitoring; • Continuous monitoring and recording of CO_2 emission from the stacks through CEMS; • Ensure that all equipment and machinery is maintained in accordance with manufacturer's specifications; • Higher efficiency steam turbine blade design; and • Improved efficiency of auxiliary drives. • The height of the chimney should be 220 m as per the DoE guideline; • Greenbelt development in and around the project site; and	**Implementation:** OPDL-2 **Supervision:** DoE

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• The power plant equipment must be performance tested during commissioning phase to ensure that standard has been maintained.	
Impacts on Ambient Noise	- Noise generation from different process unit in the power plant, operation of vehicles and physical presence of workers; - Impacts on occupational health, community health, birds and others terrestrial fauna	• Each feed water pump sets shall be covered by a separate enclosure; • Each coal crusher shall be covered by a separate hood; • Small units like condensate and vacuum pumps, shall be designed so as to limit noise emission; • Bypass valve, the de-super heater and the relevant piping shall be covered with acoustic insulation; • Steam vent pipes shall be fitted with silencers; • The steam generator thermal insulation shall be designed to limit noise emission; • The steam generator draught fans, the electrostatic precipitators and the air heaters shall be designed to limit noise emission; • The main transformers shall be designed to limit noise emission; • Use a sound-absorbing boundary wall that acts as noise damper; • Noise insulation should be implemented surrounding the turbine and generator casing; • Switch off / throttle down all vehicle and engine of the vessel when not in use; • Construct high and thick boundary wall that could act as noise damper; • Workplace noise sampling including personal noise monitoring which identifies are at risk from hazardous levels of noise; • Design of generators to meet applicable occupational noise levels; • Avoiding continuous (more than 8 hours) exposure of workers to high noise areas in the plant operation site; • Compulsory use of personal protective equipment (PPE) such as earplugs for the workers; • Use of physical barriers and green belt development around the plant to restrict the noise from going outside; • The OPDL-2 should conduct regular inspection and spot checks of all noise generating equipment; and	**Implementation:** EHS team of power plant operation unit **Supervision:** DoE/OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• Regular monitoring of noise pollutants concentrations following the Noise Pollution (control) rules 2006.	
Surface water quantity	- Surface water withdrawal may impact on water availability	• Records will be maintained to monitor the quantity of water being used; • Efforts shall be made to ensure that the reuse of process water is carried out to reduce the net water requirement; and • Permission must be taken from respective authority as per water rules 2018	**Implementation:** OPDL-2 **Supervision:** WARPO
Impacts on Surface Water Quality	- Increase the surface water temperature from cooling water discharge; - High salinity water discharge from desalinization plant; - Pollution from ETP, STP and accidental spillage of oil and hydrocarbons	• Appropriate treatment shall be provided to the process effluents and runoff prior to use in other uses; • Domestic sewage, coaly wastewater, oily wastewater, industrial wastewater will be recycled after treatment; • The quality of treated effluent shall be monitored regularly; • FGD wastewater will be treated by FGD wastewater treatment system and send to the ash yard; • Treated sewage shall comply with the ECR 2023 prescribed standards (Schedule 4: Standard for wastewater); • All the waste that would be produced during the power plant operation units and workers facilities must be treated in the ETP and STP plant; • Increase the efficiency of water reuse and recycling; • Water conservation plan should be implemented on a broader scale; • The oily sludge shall be reused or disposed offsite through authorized agency; • Regular monitoring to the water quality at specified locations in the certain time interval; • The vessel to be engaged shall have to comply with the international and national standard; • Maintain ECR 2023, IMO Conventions, MARPOL etc.; • The practice of dust suppression should be to moisten the coal not to wet the coal • Introduce speed limitation for vessels; • Limiting dropping of coal and escapee during unloading; and	**Implementation:** EHS team of power plant operation unit **Supervision:** DoE/OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• Ensure no dumping of ballast water, no oil spillage, no discharge of wastewater, no waste dumping.	
Impacts due to discharge of once through Cooling Water	- Change to the temperature regime of the water column; - Reduction in the dissolved oxygen saturation; - Increased productivity of microbial communities in particular; - Changes in the distribution and composition of communities of organisms comprising sites; - Changes in shorebird distributions usually in response to increased macroinvertebrate of fish food supplies close to thermal discharges.	• Discharge system shutdown in event that discharge temperature of effluent exceeds standard (maximum 5°C more than ambient water temperature as per Environmental Conservation Rule 2023, Schedule 4-Standards for Waste from Industrial Environment Units or Project Waste); • Thermal discharge from the power plant needs to be controlled to ensure that the discharge water temperature does not result in thermal pollution; • Monitor the water temperature at the discharge point daily and keep the record; • Design the outlet structure in a way that elevate water temperature as much as lower; • After circulating water and heat exchange, it can be return to the river; • RO concentrated water and circulating cooling effluent water can be mixed before discharge; • Over-chlorination of the condensed water will be prevented and should be achieved through process monitoring; • Monitoring of the phytoplankton, zooplankton and benthos near the intake and discharge point should be tested by the project proponent; and • A detailed fish survey for baseline data on fish population and behavior in the Kutubdia channel and near shore of Bay of Bengal River must be conducted by the OPDL-2 during construction and operation phase.	**Implementation:** EHS team of power plant operation unit **Supervision:** DoE/OPDL-2
Impacts due to Solid Waste Generation and Disposal	- Approximately 363.8 tons/day fly ash and 72.8 tons/day will be generation and disposal; - Fugitive fly ash may cause pollution to the surrounding; - Risk of heavy metal pollution;	• The OPDL-2 will develop and implement a waste management plan for the operational phase of the power plant project; • Employees should be trained in the proper handling and disposal of the fly ash, bottom ash and wet FGD gypsum to minimize their risk of exposure; • Provision of different waste bin with color for different waste (recyclable, reusable, biodegradable, hazardous etc.);	**Implementation:** EHS team of power plant operation unit & OPDL-2 **Supervision:** OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
	- Others solid waste generation from the canteen, office, workers facilities etc	• Employees should be provided with appropriate PPE for handling the ash; • Proper handling and disposal by employees would minimize exposure or health related issues to the public; • A drainage system should be provided in the ash field to discharge excess rainwater; • The standard practice of kitchen waste collection and disposal should be implemented; • Proper handling and disposal by employees would minimize exposure or health related issues to the public; and • Regular monitoring of the ash yard will be ensured by the OPDL-2.	
Impacts due to wastewater generation and disposal	- Wastewater generation from domestic sources and industrial process (sewage, oil contaminated and/or chemical containing wastewater and stormwater run-off) storage, treatment and disposal; - Approximately 27 m^3 per day sewage effluent will be generated	• Follow the mitigation measures for surface water quality; • The Operations and Maintenance (O&M) company should ensure that all hazardous materials and wastes on site are properly stored in closed systems in bunded areas; • Process wastewater (e.g. oil-contaminated wastewater) will be treated separately from non-process run-off. Oil separator(s) will be utilized to provide primary treatment of the oily wastewater. Used oil removed from the wastewater will be stored in drums and sell to the DoE approved vendor; • Wastewater treatment process will function properly and the effluent discharges comply with the discharge limits stipulated under ECR 2023; • All wastewater is envisaged to be treated in the wastewater collection systems/treatment facilities will when in compliance with effluent discharge parameters, be re-used in the coal ash yard for dust suppression purposes. • It is recommended to construct and commission a central sewerage treatment plant (STP) for treating sanitary waste as a large number of the employee will be residing inside the power plant complex; • The sludge from STP should be disposed of in compliance with the ECR 2023; and • The dry cake of sludge should be managed properly so as to avoid leaching of heavy metals in the rainfall runoff.	**Implementation:** EHS team of power plant operation unit & OPDL-2 **Supervision:** OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
Impact on soil and agriculture	- Soil contamination by mixing of heavy metals from coal storage, coal ash storage and wastewater, chemical and hazardous waste management; - Solid wastes, oil leakage and waste oils will impact on soil; - Petroleum, oil leakage and waste oils may spill on the ground and ultimately into the soil; - Dust can accumulate on crops and impact on growth and production.	• Wastes will be stored in a manner that will prevent contact between incompatible wastes, i.e. post compatibility checks, • Proper labelling of hazardous wastes; • Waste oil will be collected in MS drum and stored on paved platforms with proper labelling. the waste will be sold to DoE approved vendors; • The spent ion exchange material will be sent for landfilling; • Special care will be taken in the storage areas to prevent any spillage of hazardous wastes and restrict access (except for trained staff) to such areas; • Periodic audits will be carried out for such areas and containers; also on the segregation and collection systems and the findings will be documented and appropriate action taken against irregularities; • A spill response plan and emergency plan will be prepared to address accidental spillages or release of hazardous wastes; • A proper manifest record will be maintained of waste travelling/ removed from the site; • Proper training to the farmer on using fly ash in the agricultural field; • Awareness growing to use the by-product of the power plant efficiently; • Monitoring not only inside but also outside the land areas free from any kind of waste disposal or potentially to be polluted lands; • Use of bio-indicator for pollution measurement; • Increase the facilities of ash marketing through infrastructure development, creating awareness and formulating policies; and • The hazardous waste such as spent oil as well as non-hazardous wastes shall be disposed of off to DoE authorised vendors only.	**Implementation:** EHS team of power plant operation unit & OPDL-2 **Supervision:** OPDL-2/ Agriculture Department
Impacts on Groundwater	- Groundwater pollution due to improper design and management of ash yard; - Contamination of groundwater by leakage or spillage of petroleum hydrocarbons from	• Wastewater Management philosophy should be based on "Zero Discharge Approach"; • The underflow sludge from the raw water treatment will be sent to a settling pond; • The clear overflow from the pond will be utilized for green belt development and dust suppression;	**Implementation & Supervision:** OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
	heavy vehicles and sewage and industrial wastewater; - Impacts on hydrology	• Groundwater must be free from any harmful effluents and wastes leakage from oil and chemical tank or storage through seepage; • Regular monitoring the level and quality of groundwater in the power plant; • Sealed or paved the coal, ash and waste silo/storage/disposal site to block the communication between hazardous materials/leachate and groundwater; • It is proposed to dispose the sewage from the various buildings in the power plant through a combined sewage treatment tank. The effluents from the sewage treatment plant will be disposed of suitably; and • To promote reuse and development of a closed-loop system for water, segregation of wastewater will be done in two ways - Harvested stormwater will be utilized for artificial recharge of groundwater sources and wastewater will be reused on site after treatment.	
Impact due to Ash Disposal	- Ash containing heavy metals will impacts on groundwater, soil, sediment, surface water, fish and food chain.	• Follow the mitigation measures of solid waste disposal; • An advanced technique like ESP, ash silo and ash pond have to be maintained regularly for ash management; • Fly ash (dry form) generated from the plant should be separated after burning of coal through ESP and commercially utilized to the maximum extent possible; • In case of emergency, this ash will be transported through ash conditioner for disposal to ash disposal pond by truck; • Bottom ash should be collected in wet form and should be stored in the ash dyke until suitable users are identified; • Increase the facilities of ash marketing through infrastructure development, creating awareness and formulating policies; • Sprinkling system is provided for required sprinkling, to guarantee over 8% of moisture contents on ash surface and increase cohesion between ash particles; • Ash after transportation to ash to ash yard, ash should be spread and compacted regularly;	**Implementation:** EHS team of power plant operation unit & OPDL-2 **Supervision:** OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• Ash yard is divided into sections and areas for planned ash spreading and piling. Upon reaching the final elevation, two layers of soil is covered (barrier layer and cover layer) and the yard is landscaped according to the closure requirement; • Ash transportation road has hardened pavement and has to be regularly sprayed and cleaned to avoid impact on air quality by fugitive dust from vehicle traffic; • A leachate collection system should be incorporated in the ash yard design and provided at the lowest point(s) of the ash yard. The leachate and runoff should be collected from the coal ash pile and diverted it into a leachate storage or treatment system; • A groundwater monitoring system made up of wells should be installed and operated around the ash yard capable of verifying whether coal ash or leachate has penetrated the pad; • The O&M Company will develop and implement a waste management plan for the operational phase of the project; and • Employees should be provided with appropriate personal protective equipment (PPE) for handling the ash. Proper handling and disposal by employees would minimize exposure or health-related issues to the public.	
Terrestrial Flora	- Hampering plant growth and causing diseases from flue gas emission	• Coal dust suppression should be done by water sprinkling at the coal transfer points; • Dust extraction and dust handling systems to be installed at the coal handling plant, and ash handling units to reduce fugitive dust emissions; • A plantation plan should be implemented for greenbelt development with appropriate indigenous species. Extensive plantation of pollutant-resistant trees in and around the project area will serve as pollution sink and noise barrier; • Fly ash should be efficiently managed to control the emission of heavy metals in the environment; • The leaf surface acts as reaction centers for removing atmospheric pollutants. So, the plant has left of large surface areas are suggested for development of green belt; and	**Implementation:** EHS team of power plant operation unit **Supervision:** OPDL-2/Forest Department

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• Plant health monitoring should be conducted regularly.	
Terrestrial Fauna	- Disturbance to avifauna due to fugitive dust emission from coal handling plants, fly ash and noise. - Impact on health, behavior, and reproduction of terrestrial fauna - Impact on the biogeochemical cycles	• Project related activities should be avoided during the nighttime; • The contractor should install equipment that meets the environmental noise limits stipulated by DoE, Bangladesh environmental noise regulations; • The installed equipment should comply with the requirements of the occupational noise limits specified in the occupational noise regulations; • Provide acoustic barriers in areas of high noise generating sources to avoid discomfort to terrestrial fauna adjacent to project site; • All coal transfer points should be provided with dry fog dust suppression system; • Disturbance, harassment, killing or possession of any wildlife species by project workers while working should be prohibited; • A traffic management system should be prepared and implement by the project proponent; • Control the speed of the vehicles (20 km/hour) in the approach road, paved and unpaved road and bare surface in the power plant; • Instruct the workers and awareness creation not to disturb the terrestrial ecology; • Avoid unnecessary lighting in the project site at nighttime; and • Rescue, rehabilitation, and relocation should be done for injured or affected terrestrial fauna when necessary.	**Implementation:** EHS team of power plant operation unit **Supervision:** OPDL-2/Forest Department
Impact on aquatic ecosystem	- Disruption of benthic ecology due to hot water discharge - Degradation of habitats for aquatic resources for hot water discharge - Direct impact on fish diversity and may lead to bring permanent change to fish diversity and composition;	• Follow the mitigation measures presented in section 7.3.4.2 and 7.3.4.3 • Monitoring of temperature at the discharge point at a frequency of everyday; • Discharge system shutdown in event that discharge temperature of effluent exceeds standard (maximum 5°C more than ambient water temperature as per Environmental Conservation Rule 2023, Schedule 4-Standards for Waste from Industrial Environment Units or Project Waste);	**Implementation:** EHS team of power plant operation unit & OPDL-2 **Supervision:** OPDL-2/Forest Department/

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
	- Lighting and noise in the jetty will create disturbance for the fish community; - Improper management of solid waste and disposal of untreated wastewater and liquid waste will impacts on local ecosystem.	• The temperature of the condenser cooling water will be strictly maintained up to 3°C at the boundary of mixing zone; • A log of all dangerous chemicals be kept, how to be used, transported stored and disposed of; • Keep all dangerous chemicals, oils, greases, solvents, and residues in a secure room; • Have a standard operating procedure on how to deal with spills; • Restrict the night lighting along the coastline/coal conveyer belt area; • Have a containment and disposal plan for all hazardous material (where to dispose); • All oils and hazardous materials to be disposed of after proper treatment satisfying Environmental Conservation Rules 2023; • The water supply pipeline intake point should be provided with sufficient screening to filter out larger aquatic organisms (e.g., fish, frogs, and toads) and foreign matter, preventing this material from being drawn into the pumps; • The intakes for the water pumps in the main pump-house will meet the IFC guidelines, including recommended intake velocity less than 0.30 m/s and a mesh size of 9.5 mm; • The channel can be built for water channelization rather than a direct abstraction from the river; • On-site wastewater should be treated to achieve maximum reuse and recycling rather than ultimate disposal to the river; • Regular consultation, training and stakeholder meeting should be arranged with the local bodies and project personnel; • Use of bio-indicator for pollution measurements like benthic community, plankton or sensitive organisms; • Spot-check of shipping and barging activities by relevant agencies; • The coal carrying ship has to follow the less biodiverse route and must avoid the Hilsha spawning zone; • Enforcement of fishing ban during the breeding/nursing period; • Discharge the concentrated saline water with the non-saline cooling water in the sea;	Fisheries department

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• Enforce the relevant law of restricting ballast water and haul water dumping in the River; • Zero discharge from coal carrying vessel should be adopted; • Awareness building activities should be carried out continuously; and • A Turtle Conservation Plan should be developed.	
Impact on Occupational Health and Safety	- Accidents, injuries, illness and death of the workers due to the operational activities of the proposed power plant	• Identification of potential exposure levels in the workplace during working activities; • Use of personal protective equipment (PPE) in the workplaces; • Regular checking, monitoring and careful operations with the standard procedure; • Precautions have to be ensured during handling the hazardous chemicals; • Ensure the hospital facilities emergency after any kind of accidental event; • Auto signalling system should be installed as a safety plan; • Regular practising or showdown by the rescue team for the mock accident; • Compliance monitoring to the charged professionals and monitoring devices; • Introducing health insurance for the employees; • Regular inspection and maintenance of pressure vessels and piping shall be carried out; • Adequate ventilation shall be provided in work areas to reduce heat and humidity; • Provision of sound-insulated control rooms with noise levels below 60 dB; • Implementation of startup and shutdown procedures to minimize the risk of suspending hot coal particles (e.g., in the pulverizer, mill, and cyclone) during startup; • Regular cleaning of the facility to prevent accumulation of coal dust (e.g., on floors, ledges, beams, and equipment); • Appropriate education of workers on handling and management of chemicals in accordance to MSDS;	**Implementation:** EHS team of power plant operation unit **Supervision:** OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
		• The O&M should ensure there is an effective and efficient firefighting system together with an adequately trained Emergency Response Team; and • Based on the health and safety risk assessment findings, OPDL-2 shall develop & implement a formal OHS Management System compliant with the applicable requirements of the OHSAS and IFC General EHS Guidelines ; •	
Impact on Public Health and Safety	- Risk from air emission, noise nuisance, radiation, dust emission, waste (solid, liquid, hazardous), improper drainage, accidents and injuries associated; - Risk of upsurge of sex workers and health hazards including HIV AIDS; - Pressure on existing infrastructure like health and educational facilities	• Update technology and emission controlling equipment should be ensured by the OPDL-2; • Regular maintenance, replacement and performance should be tested as per manufacturer guidelines; • All the waste from the power plant and workers facilities should be collected properly disposed as per best practices and followed the guidelines of the DoE, Bangladesh; • All the wastewater must be treated in the STP and ETP; • Solid waste should be collected and disposed properly; • Safety training should be given for the drivers; • Training on sanitation and hygiene, sexually transmitted diseases (STD)/HIV, education and communication should be incorporated by the OPDL-2 into new employee orientation programs; • Proper drainage system should be ensured in the project premises and surrounding area; • Instruct the workers about the waste generation and management; • Regular monitoring should be ensured by the OPDL-2 EHS department; • Greenbelt development in and around the power plant as early as possible after finishing the construction activity. • O&M company should form a grievance redress team to solve the social issue due to the project operation; • Proper waste management will be implemented as the surrounding people will not be affected; and • Prepare a CSR plan and implement accordingly for the local people.	**Implementation:** EHS team of power plant operation unit **Supervision:** OPDL-2

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
Impact on Traffic Movement	- Increase the number of traffic movement; - Increase the number of accidents; - Disturbance of local traffic; - Noise and dust pollution along the access road; - Impact on terrestrial flora and fauna	• The OPDL-2 should develop a Traffic management plan for the operational phase; • Regularly inspect the access roads conditions and, whenever necessary, repair damages related to traffic movement; • Establishment of safety sign, warning light post, speed breaker should be ensured by the project authority and all signs should be written in local language; • Limit the vehicle speed near the narrow approach road, school, bazar, mosque and settlement area etc.; • Instruct the driver to avoid unnecessary engine operation and horns in the approach road; • Use of mobile phone during driving is strictly prohibited.	**Implementation:** EHS team of power plant operation unit **Supervision:** OPDL-2
Creation of Employment (Positive Impact)	- Envisaged to generate direct and indirect employment opportunities, enhance skills development for both skilled and unskilled workers; - About 137 personnel will be required for operation, maintenance and administration purposes; - Contribute to providing meaningful job opportunities for the locals;	• OPDL-2 must endeavour to provide the local community for any job opportunities, prioritizing from the residents immediately neighbouring and/or displaced by the project; • Expertise should be sourced locally then nationally before resorting to engagement of international experts; • Job advertisements should be made through mediums that are easily accessible to the local community such as local newspaper and radios, etc; • The recruitment selection process should seek to promote gender equality and the employment of women where possible. • Management and enhancement measures for local employment should be included in the company's labour and human resources plan; • Promotion and prioritization of employment opportunities for the local community; and • OPDL-2 should make a conscious effort to promote local business people in the procurement of goods and services to assist in providing more economic and employment opportunities for the local community.	**Implementation & Supervision:** OPDL-2
Economic Growth	- Due to the power plant operation many industries will be developed surrounding the	• Ensure that economic opportunities are available or are created for the local community and that proper capacity building is afforded to	**Implementation:** EHS team of

Issues/Components	Potential Impacts	Mitigation/Enhancement Measures	Responsibility
	power plant which will enhance the local as well as the national economy	the local communities to enable them to benefit from the available economic opportunities; • Establish youth and women empowerment training centre and introducing diverse income generating activities training; • Extension of social safety nets for affected people and people underexposure of plant possessed risk; • The OPDL-2 should make deliberate efforts to source for all required supplies from the local provider to the extent possible,; • Tender documents should include guidelines for the involvement of local entrepreneurs, businesses and SMEs from the local sector; and • OPDL-2 should promote and support economic empowerment initiatives for the local community through its CSR programme,.	power plant operation unit **Supervision:** MoLE/ MoSW/ OPDL-2/ NGOs/ DC office/ Local administration
Impact due to Transportation of Primary Fuels	- Dust pollution during coal unloading; - Windblown dust will impacts on the surface water quality as well as the aquatic environment; - Air pollution due to emission from the combustion of fuels - Noise pollution from operation of vessels, coal unloading and handling system ; - Surface water polluted due to oil spillage, coal spillage and other malpractice like waste discharge, discharge of ballast and bilge water, etc.	• The ship to be engaged shall have to comply with the international and national standard; • Adopt enclose system for coal unloading and transportation; • Coal conveyor should be fully covered so that windblown dust cannot generate from the coal transfer process; • Maintain ECR 2023, IMO Conventions, MARPOL etc.; • The practice of dust suppression should be to moisten the coal not to wet the coal; • Use of personal protective equipment (PPE); • Regular checking, monitoring and carefully handing with safety procedure; • Spraying water like mist in order to reduce the risk of ignition; • Switch off / throttle down of all equipment and machinery when not in use; • Introduce speed limitation for ship; • Ensure no dumping of ballast water, no oil spillage, no discharge of wastewater, no waste dumping from ship; and • Monitoring activities of the foreign ships during coal transportation.	**Implementation & Supervision:** OPDL-2

9.4 Greenbelt Development

Increasing vegetation in the form of greenbelt is one of the preferred methods to keep the pollution under control. Plants serve as a sink for pollutants, act as a barrier to break the wind speed as well as allow the dust and other particulates to settle out there. It also helps to reduce the noise level up to some extent. The main objective of the green belt is to provide a buffer / barrier between the sources of pollution and the surrounding areas. The green belt helps to capture the fugitive emissions and attenuate the noise apart from improving the aesthetic quality of the region. Of the total area of the proposed project site, 33% area shall be developed as a green belt along the periphery of the plant. The goal of installing a greenbelt would also be to maximize both ecological functionality and scenic beauty of the project area. The greenbelt area will cover 30.6 acres of the total project area, and this greenbelt of different thickness will be established systematically. The ideal size of greenbelt shall be between 10 and 50 meters wide, run the length of roads, major structures, and open spaces. Width depends on the availability of land.

Selection of species

Local or indigenous species will be preferred under this programme and the species those have dust & noise tolerant capacity, enhance aesthetics and develop a habitat for wildlife especially for avifauna will be introduced. A plantation of sound and dust receptor, as well as aesthetically valuable species, is proposed which will help in reduction of pollution (both atmospheric & noise), reduction of stress and beautification of the area. Hardiness, longevity, a minimum of wind through and breakage, attractiveness and minimal maintenance requirement are some qualities of species which are to be taken into consideration during selection. A standard spacing of 3m and 2m for tree and shrub species respectively will be taken into consideration, whereas the pit size will be recommended as 45 cm x 45 cm x 5 cm for trees and 30 cm x 30 cm x 30 cm for shrubs. Selection of the plant species will also be based on the growth and morphological characters, i.e. height, crown cover and also on the basis of their adaptability in the region. Following types of species are proposed under greenbelt development:

- Native Plant Species- drought resistance
- Species that can minimize noise level
- Species that can absorb dust
- Habitat Improvement Species
- Fruit Species to enhance the Food Availability for Wildlife
- In the green belt, plant composition should be made considering plant of different height and different canopy size to facilitate deposition of ash
- Along the project area, local species, e.g. Raintree (*Albiza saman*), Neem (*Azadirachta indica*), Arjun (*Terminalia arjuna*), Krishnochura (*Delonix regia*), Jackfruit (*Artocarpus heterophyllus*), Pabon Jhau (*Casuarina equisetifolia*). Sil Koroi (*Albizia procera*), Narikel (*Cocos nucifera*), Aam (*Mangifera indica*), etc. should be planted
- Plantation should be made with the collaboration of the Department of Forest

Greenbelt around the Project area

In the context of air pollution attenuation, greenbelt will be developed around the project in a manner so as to effectively reduce the pollution caused by project activities. Design of effective greenbelts involves consideration of meteorological, physico-chemical, biological, and horticultural aspects relevant to pollutant source and the area where greenbelt has to be established. Such plantation will be carried out in three different layers. Species like Sonalu (*Cassia fistula)* and Palash (*Beutia monosperma)* will be planted inner side of the greenbelt (1st row), Koroi/Siris (*Albezia lebbek), Bot (Ficus species)*, Pabon Jhau (*Casuarina equisetifolia*). Sil Koroi (*Albizia procera*) will be planted in the middle of the greenbelt (2nd row) whereas species like Sissoo (*Dalberzia sissoo)*, Arjun (*Terminalia arjuna*), Krishnochura (*Delonix regia*), and Jackfruit (*Artocarpus heterophyllus*) species will be planted outside layer (3rd row) of the greenbelt.

Roadside plantation

The roadside plantation will be carried out with the species having the properties of control dust pollution and maintain the aesthetic value. Palash (*Butea monosperma)*, Krisnochura (*Delonix regia)*, Jam (*Syzygium cumini)* and Koroi/Siris (*Albezia lebbek)* will be planted under this plantation.

Avenue plantation in Adjacent Residential Colony

Tree species like Sonalu (*Cassia fistula)*, Krisnochura (*Delonix regia)*, Amloki (*Emblica officinais)*, and Debdaru (*Polyalthia longifolia)* will be used for such type of plantation along with shrubs Bagan Bilash (*Bougainvillea sp)*, *Dodonea sp*, and *Hibiscus rosasinenis*. The purpose of such plantation is to fill the blank areas with greenery and strengthen scenic beauty.

9.5 Rainwater Harvesting Plan

The proposed project area is located in the coastal area of Bangladesh and sufficient amount of rainfall occurs in the area. Adoption of rainwater harvesting technology can reduce the pressure on consumption of water resources. It deals with the collection, storage and use of rainwater from open land and rooftops of high-rise buildings. Rainwater harvesting helps in reducing the run-off, decrease pollution of groundwater and improve the groundwater table.

In Township, each building should be constructed with a rainwater harvesting system, which will help to harvest the water for different water activities as well as for domestic uses. In addition, water efficient technology should be adopted. This process will reduce the pressure of the river water.

9.6 Rehabilitation and Resettlement Plan

The proposed 635 MW coal-fired power plant project will be set up within the premises of the leased land from the Coal Power Generation Company Bangladesh Limited (CPGCBL). The land requirement for the proposed project is approximately 225 acres. The land has already been acquired, and the landowner got their compensation as per the Acquisition and Requisition of Immovable Property Ordinance 1982. No household will be displaced from the project site as the proposed project site is in the salt pan area. A total of 9 squatters are living beside the BWDB embankment in the project site and 12 squatters are living within the proposed coal conveyer belt area. Hence, a total of 21 squatters need to be displaced or resettle from the project site prior to start the construction. There is no titled structure within the project site, so, no resettlement action plan has been prepared. OPDL-2 has to prepare a plan to resettle the squatters.

9.7 Thermal Pollution Management

Coal fired power plants constitute a major source of thermal pollution. Common causes of thermal pollution is flue gas and use of water as a coolant by power plants. The proposed project will construct a stack considering 220 m height. The emitted gas will be rise to the upper atmosphere and attenuate at the upper atmosphere. It will not cause any harm related to heat to the surroundings of lower atmosphere of Matarbari and its adjacent areas.

The proposed coal-fired power plant will utilize a once-through cooling system for the condenser. For the cooling purposes, water will be withdrawn from Kutubdia Channel and heated water to be discharged into the Channel thereby raising the water temperature cannot be higher than 5°C of ambient water temperature at the discharge point as per environmental conservation rules 2023. Heated effluent will decrease the dissolved content of water resulting in death of fish and other aquatic organisms. The sudden fluctuation of temperature will also lead to "thermal shock" killing aquatic life that have become acclimatized to living in a steady temperature. Temperature changes cause total disruption to the entire ecosystem.

The following measures should be adapted by the proposed project to control thermal pollution caused by thermal discharge into the Kutubdia Channel:

- Cooling water will be discharged back to the source water (Kutubdia Channel) with almost no losses but at a higher temperature than the ambient water temperature;
- The heated effluents can be discharged into the Channel at one end and water for cooling purposes may be withdrawn from the other end;
- Thermal discharge from the power plant needs to be controlled to ensure that the discharge water temperature does not result in thermal pollution;
- After circulating water and heat exchange, it can be return to the Channel;
- RO concentrated water and circulating cooling effluent water can be mixed before discharge;
- The temperature of the condenser cooling water will be strictly maintained up to 3°C at the boundary of mixing zone;
- Design the outlet structure in a way that elevate the water temperature as lower as possible;
- The IFC environmental guidelines for Thermal Power Plants state, "The effluent should result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 meters from the point of discharge when there are no sensitive aquatic ecosystems within this distance";
- The project proponent must ensure regular monitoring of surface water temperature near the discharge point; and

9.8 Coal Washery

Coal plays a major role for power generation all over the world. Coal is highly variable with respect to the physical and chemical properties that affect its use. Coal based power plants that use coal specify a range of properties that are required for their intended process. The quality and quantity of coal for the proposed 635 MW coal fired power plant at Matarbari, Maheshkhali are specified which to be carried by mother vessels through distant countries like Indonesia, and South Africa.

Coal suppliers try to find coals that most closely match those requirements. For effective utilization, it is necessary to beneficiate them. Therefore, coal mines of South Africa and Indonesia has adapted to coal washery accompanied with other systems for processing the coal after mining. Coal is treated in a process called "beneficiation" to prepare a material that meets the customers' need and is as homogenous as possible. According to the OPDL-2, the proposed power plant project will use the washed coal. There will be no coal washery within the power plant. Therefore, coal washery will not be affecting the surroundings of the power plant.

9.9 Coal Yard Management

The imported coal will be the primary fuel for the proposed power plant operation. Annual total coal requirement for the proposed project is 1.47 million tons. During the construction and management of coal yard following thing needs to be followed by the project authority:

- Ash yard structures should be designed considering flood, cyclone, self-heating, aeration and heavy wind resistant;
- The total quantity of coal shall be stored in separate stockpiles, with proper drains;
- Coal stacking should be done adopting standard practice to avoid auto ignition;
- Continuous monitoring of the inside temperature of coal stockpile;
- Fire hydrants will be provided in the coal yard at suitable locations;
- Water sprinkling system shall be installed on stocks of coal in required scales to prevent spontaneous combustion and consequent fire hazards;
- The stock geometry shall be adopted to maintain minimum exposure of stock pile areas towards predominant wind direction;
- The equipment's and conveying system in the coal handling plant should be properly maintained to avoid fugitive emission;
- Suitable dust extraction system will be provided;

- Care should be taken to control aerosol formation after water spraying;
- The runoff and wash off from the stockpile and coal unloading system should be treated properly before discharging it to open environment;
- The recommended practice is to fog spray or mist the stockpile surface as frequently as necessary to maintain the surface of the coal in moist condition, not in wet condition; and
- Provision of regular monitoring has to be kept for inspection in proper pathway with entry and exit should be provided in stockpile area and conveyor belt.

9.10 CDM Intent

The CO_2 will be emitted from the proposed power plant project, which will be one of the major greenhouse gases. Since ultra-supercritical boiler technology has been considered for this project, the CO_2 emission is comparatively lower than other conventional coal based thermal power plant. For the same amount of carbon used, more electricity is generated. Ultra-Supercritical steam conditions improve the turbine cycle heat rate significantly over subcritical or supercritical steam conditions. The extent of improvement depends on the main steam and reheat steam temperature for the given supercritical pressure. A typical supercritical cycle will improve the station heat rate by more than 5% which results in fuel savings to the extent of 5%. Overall ultra-supercritical power plant efficiency of 42%- 43% is achievable with current ultra-supercritical parameters.

Improved heat rate results in a 5% reduction in fuel consumption and hence a 5% reduction in CO2 emissions per MWh energy output. Typically for a 660 MW Ultra-supercritical unit, the annual reduction in CO2 emission will be about 600,000 tons of CO_2 with respect to baseline emission established by CEA for 2008 – 2009.

Ultra-Supercritical technology-based thermal power project is a potential candidate to avail the benefits under Clean Development Mechanism (CDM) established by United Nations Framework Convention on Climate Change (UNFCCC). The estimated CO_2 emission from the proposed project is about 2.69 million tones/year. However, several green building concepts will be used in the project. Therefore, implementing energy efficiency programs in power sectors and other electricity consumers not only makes the production cost-effective but also reduces greenhouse gas emissions. The recommendations for reducing greenhouse gas emission are given below:

- Use of high-performance monitoring and process control techniques, good design and maintenance of the combustion system so that initially designed efficiency performance can be maintained. This will be achieved through online PM, SO_2, NO_2, CO, O_2 and CO_2 monitors in the stack.
- The township in the proposed project should be designed with 'Green Buildings' concept;
- Compact Fluorescent Lamps (lighting system), energy efficient refrigerators and air conditioners, water-cooled screw type HVAC system, CFC and HCFC free refrigerants and chillers have been considered;
- Energy efficient building materials should be considered for construction of structures. For external walls and boundary walls fly ash bricks and blocks should be considered. Fly ash, which is a waste of power plant, should be mixed with cement to make concrete;
- Natural ventilation system comprising screen walls, low emissive double-glazed glass with U value of less than 2.8 W/m^2K, shading coefficient of 0.5 should be considered for the buildings;
- Moreover, green belt and spot green should be developed maximum allowable areas.

Energy efficient process and building structures should achieve 20% reductions in energy consumption. It is recommended that the project authorities should undertake yearly energy audit for their entire manufacturing process and ancillary facilities.

9.11 Budget for EMP

The Project cost is inclusive of cost for implementing environmental management plan and installation of pollution abatement and mitigation measures described in the feasibility study report. The cost of implementing the EMP excluding monitoring is about BDT 21.45 million. The following **Table 9-4** shows the financial commitment of the OPDL-2 for various mitigation measures to ensure environmentally friendly operations of the proposed 635 MW coal-fired power plant at Matarbari, Maheshkhali, Cox's Bazar.

Table 9-4: Environmental and Social Mitigation Plan Estimated Costs

EMP for the Impacts	Mitigation/Enhancement measure	Institutional Responsibilities	EMP Cost (BDT. million)
Pre-construction Stage			
EMP in case of river dredging for site development	• Stakeholder consultation is prerequisite for selection of dredging spoil disposal; • Dredging spoil should be dumped in such a manner that it would not create any additional environmental issues as well as refill the dredged channel; • Monitoring the site of spoil disposal and its associated issues regularly	**Implementation:** Contractor **Supervision:** OPDL-2/DoE/ Local administrations	1.0
Drainage Management	According to the mitigation measures proposed under section 7.1.3	**Implementation:** Contractor **Supervision:** OPDL-2	(Include in project cost and external Tk. 0.5 million) 0.5
EMP for controlling air pollution	As stated in section 7.1.4	**Implementation:** Contractor **Supervision:** OPDL-2/DoE	(Included in project cost and Tk. 0.2 million) 0.2
EMP for controlling noise generation	As per the mitigation measures presented under section 7.1.5	**Implementation:** Contractor **Supervision:** OPDL-2/DoE	(Include in project cost and external Tk. 0.15 million) 0.15
EMP for controlling impacts on water bodies	According to the mitigation measures proposed under section 7.1.6	**Implementation:** Contractor **Supervision:** OPDL-2/DoE	Include in the project and external Tk. 0.3 million) 0.3

EMP for the Impacts	Mitigation/Enhancement measure	Institutional Responsibilities	EMP Cost (BDT. million)
EMP for controlling impacts on Soil	As stated in section 7.1.7	**Implementation:** Contractor **Supervision:** OPDL-2/DoE	(Include in project cost and Tk. 0.1 million external cost) 0.1
EMP for enhancing the socioeconomic condition	According to the mitigation measures proposed under section 7.1.8	**Implementation:** Contractor **Supervision:** OPDL-2/DC Office/ MoLE/MoSW/NGOs/ Local government and administration	(Included in project cost and Tk. 1.5 million external cost) 1.5
EMP for controlling impact on ecosystem	According to the mitigation measures proposed under section 7.1.9	**Implementation:** Contractor **Supervision:** OPDL-2/DoE/Fisheries department	1.0
Occupational Health and Safety	According to the mitigation measures proposed under section 7.1.10	**Implementation:** Contractor **Supervision:** OPDL-2	0.5
Sub-total (A)			**5.25**
Construction Stage			
EMP for controlling impacts on fisheries	According to the mitigation measures proposed under section 7.2.2.2	**Implementation:** Contractor **Supervision:** MoF/OPDL-2	(Include in project cost and external Tk. 0.5 million) 0.5
EMP for controlling air pollution	As stated in section 7.2.3	**Implementation:** Contractor **Supervision:** OPDL-2/DoE	(Included in project cost and Tk. 1.0 million) 1.0
EMP for controlling noise generation	As per the mitigation measures presented under section 7.2.4	**Implementation:** Contractor **Supervision:** OPDL-2/DoE	(Include in project cost and external Tk. 0.5 million) 0.5
EMP for controlling impacts on water bodies	According to the mitigation measures proposed under section 7.2.5	**Implementation:** Contractor **Supervision:** OPDL-2/DoE	Include in the project and external Tk. 0.3 million) 0.3

EMP for the Impacts	Mitigation/Enhancement measure	Institutional Responsibilities	EMP Cost (BDT. million)
EMP for controlling impacts on Soil	As stated in section 7.2.6	**Implementation:** Contractor **Supervision:** OPDL-2/DoE	(Include in project cost and Tk. 0.2 million external cost) 0.2
EMP for workers health, sanitation, and safety	As stated in section 7.2.7	**Implementation:** Contractor **Supervision:** OPDL-2	(Include in project cost and Tk. 2.0 million external cost) 2.0
EMP for Solid waste management	As per the mitigation measures presented under section 7.2.7.1 and 7.2.7.2	**Implementation:** Contractor **Supervision:** OPDL-2/DoE	(Include in project cost and Tk. 0.5 million external cost) 0.5
EMP for enhancing the socioeconomic condition	According to the mitigation measures proposed under section 7.2.10	**Implementation:** Contractor **Supervision:** OPDL-2/ MoLE/MoSW/ NGOs/Local government and administration	(Included in project cost and Tk. 2.0 million external cost) 2.0
EMP for wastewater generation and disposal	As per the mitigation measures presented under section 7.2.7.1 and 7.2.7.2	**Implementation:** Contractor **Supervision:** OPDL-2/DoE	(Include in project cost and Tk. 1.0 million external cost) 1.0
EMP for conserving ecosystem	As per the mitigation measures presented under section 7.2.13.1, 7.2.13.2 & 7.2.13.3	**Implementation:** Contractor **Supervision:** OPDL-2/DoE/Fisheries department	(Included in project cost and Tk. 1.5 million external cost) 1.5
Sub-total (B)			**9.5**
Operation Stage			
EMP for air pollution control	As per the mitigation measures presented under section 7.3.1.1 and 7.3.1.2	**Implementation:** EHS team **Supervision:** OPDL-2/DoE	(Include in plant operation cost and Tk. 1.0 million external cost) 1.0/year
EMP for controlling noise pollution	According to the mitigation measures proposed under section 7.3.3	**Implementation:** EHS team **Supervision:** OPDL-2/DoE	(Include in plant operation cost and Tk. 0.5 million external cost) 0.5/year

EMP for the Impacts	Mitigation/Enhancement measure	Institutional Responsibilities	EMP Cost (BDT. million)
EMP for controlling impacts on water bodies	As per the mitigation measures presented under section 7.3.4.1, 7.3.4.2 and 7.3.4.2	**Implementation:** EHS team **Supervision:** OPDL-2/DoE/WARPO	(Included in plant operation cost and Tk. 1 million external cost) 1.0/year
EMP for controlling solid waste generation	As per the mitigation measures presented under section 7.3.5.1	**Implementation:** EHS team **Supervision:** OPDL-2/DoE	Included in plant operation cost
EMP for controlling wastewater generation	As per the mitigation measures presented under section 7.3.5.2	**Implementation:** EHS team **Supervision:** OPDL-2/DoE	(Included in plant operation cost and Tk. 0.3 million external cost) 0.3
EMP for controlling impacts on soil and agriculture	According to the mitigation measures proposed under section 7.3.6	**Implementation:** EHS team **Supervision:** OPDL-2/Agricultural department	Included in plant operation cost
EMP for controlling impacts on groundwater resources	As per Mitigation measures presented under section 7.3.7	**Implementation:** EHS team **Supervision:** OPDL-2/DPHE	(Included in plant operation cost and Tk. 0.3 million external cost) 0.3/year
EMP for the produced ash from the power plant	As per the mitigation measures presented under section 7.3.8	**Implementation:** EHS team **Supervision:** OPDL-2	(Include in plant operation cost and Tk. 0.5 million external cost) 0.5/year
EMP for terrestrial ecosystem	As stated in section 7.3.9.1 and 7.3.9.2	**Implementation:** EHS team **Supervision:** OPDL-2/Forest Department	(Included in plant operation cost and Tk. 0.3 million external cost) 0.3
EMP for aquatic ecosystem	As stated in section 7.3.9.1 and 7.3.9.3	**Implementation:** EHS team **Supervision:** OPDL-2/Fisheries Department	(Included in plant operation cost and Tk. 1.0 million external cost) 1.0/year

EMP for the Impacts	Mitigation/Enhancement measure	Institutional Responsibilities	EMP Cost (BDT. million)
EMP for Occupational Health and Safety	As per the mitigation measures presented under section 7.3.10	**Implementation:** EHS team **Supervision:** OPDL-2/Fire Service	Included in plant operation cost
EMP for Public Health and Safety	As stated in section 7.3.11	**Implementation:** EHS team **Supervision:** OPDL-2	0.3/year
EMP for traffic movement and navigation	As per the mitigation measures presented under section 7.3.12	**Implementation:** EHS team **Supervision:** OPDL-2	0.2/year
EMP for enhancing better socio-economic condition/CSR	As stated in section 7.3.13	**Implementation:** Social Liaison officer **Supervision:** OPDL-2/MoLE/MoSW/ NGOs/Local administration	(Included in plant operation cost and Tk. 1.0 million external cost) 1.0/year
EMP for Coal Transportation and Handling	As per the mitigation measures presented under section 7.3.14	**Implementation:** EHS team **Supervision:** OPDL-2/Coal Transportation agent/ Port Authority/DG Shipping	Included in coal import cost and Tk. 0.3 million external cost 0.3/year
Sub-total (C)			**6.7**
Grand Total (A+B+C)			**21.45**

Note: These mentioned costs (e.g., the external cost) are tentative at the time of this study and might be changed during detail design of the project. The EPC contractor shall be appointed third party consultant after obtaining of EIA approval and Environmental Clearance Certificate from DoE

9.12 Contingency Plans

9.12.1 Turtle Conservation Plan

Coal for the power plant will be transported by the ship (60,000 to 70,000 dwt) from the coal sourcing point to the Matarbari deep seaport. The annual coal consumption for the proposed power plant is approximately 1.47 million tons. So, annually 25 ships will come to the port for coal unloading. Considering the number of water vessels and motorized fishing boat in the area, the number is insignificant. The major impact during the power plant operation is cooling water discharge to the sea. Hence, fish, turtle and other aquatic animals will be impacted.

All shipping and barging activities shall ensure zero waste dumping, zero ballast water dumping, zero pollution causing activities as per the IMO Conventions and national Environmental Regulations. DG Shipping, WARPO, BIWTA, Coast Guard should regularly inspect shipping and barging activities to enforce the relevant clauses of conventions and rules. In addition, the following measures should be taken into account during shipping and barging activities and other project related activities during power plant operation:

- Monitoring of temperature at the discharge point at a frequency of everyday;
- Discharge system shutdown in event that discharge temperature of effluent exceeds standard (maximum 5°C more than ambient water temperature as per Environmental Conservation Rule 2023, Schedule 4-Standards for Waste from Industrial Environment Units or Project Waste) and the applicable World Bank Group environmental requirements and World Bank/IFC guidelines);
- The temperature of the condenser cooling water will be strictly maintained up to 3° C at the boundary of mixing zone;
- A log of all dangerous chemicals be kept, how to be used, transported stored and disposed of;
- Keep all dangerous chemicals, oils, greases, solvents, and residues in a secure room;
- Have a standard operating procedure on how to deal with spills;
- Have a spill response team readily available to respond;
- Train worker on spills and how to deal with them;
- Restrict the night lighting along the coast line/coal conveyer belt area;
- Have a containment and disposal plan for all hazardous material (where to dispose);
- Collect and separate the spilled water from runoff water then store and treat separately;
- All oils and hazardous materials to be disposed of after proper treatment satisfying Environmental Conservation Rules 2023;
- Regular consultation, training and stakeholder meeting should be arranged with the local bodies and project personnel;
- Spot-check of shipping and barging activities by relevant agencies;
- The coal carrying ship has to follow the less biodiverse route and must avoid the Hilsha spawning zone;
- Enforcement of fishing ban during the breeding/nursing period;
- Discharge the concentrated saline water with the non-saline cooling water in the sea;
- Enforce the relevant law of restricting ballast water and haul water dumping in the River;
- Zero discharge from coal carrying vessel should be adopted;
- Follow standard practice for shipping and barging operation;
- Introduce speed limitation for the vessel;
- Avoid the area where the dolphin and other aquatic wildlife in abundant
- Awareness building activities should be carried out continuously;
- No trapping and killing of Dolphin; and
- A Turtle Conservation Plan should be developed. This plan should include conservation initiatives to insure both in-situ and ex-situ conservation of marine turtles.
- Vessels must not approach closer than 300m to any dolphin;
- Approach Dolphins from behind and to the side;
- Avoid the dolphins and turtles' movement path during dredging in the sea;
- Avoid dredging activities and movement of water vessels during surfacing, swimming time and season of Dolphin movement i.e., at dawn, evening and monsoon season;
- Protect the egg, breeding period and juvenile turtle of that region, if found;
- No trapping and killing of Dolphin and turtle in the project site;
- No waste water discharge from the power plant ETP and STP plant without treatment;
- Ensure the temperature of the cooling water in an acceptable limit before discharge into the Kutubdia Channel; and
- Ensure zero waste dumping, ballast water, oily water dumping to the Kutubdia Channel.

9.12.2 Fisheries Resources Management Plan

The fisheries resources management plan has been developed with the aim of avoiding pollution causing activities and to protect fisheries of the Kutubdia Channel and the Kohelia-Matamuhuri River and adjoining Bay of Bengal. The EMP includes the followings:

Measures for Navigational Activities in the Channel:

- Enforcement of ECR 2023, IMO Conventions, etc.;
- Ensure non dumping of ballast water, bilge water, non-spillage of oil, non-discharge of waste water and non-dumping of solid wastes;
- Awareness growing for fisherman and facilitate the fisherman to use nets/boats provided with signals and marking in the river;
- Reduce vessels speed if net is seen across the navigational route; and
- Fish migration and breeding season should be considered in planning.

Measures for Power Plant Operation:

- Should follow the EMP for effluent discharge from the power plant; and
- On-site wastewater should be treated in WTP, ETP and STP to achieve maximum reuse and recycling.

Measures for Water Intake Structure:

The project proponent must conduct a detailed study on fish in the Kutubdia Channel and the Kohelia-Matamuhuri River. At least one year monitoring should be conducted during construction and another one-year during operation phase of the project. Based on the suggestions from the study the monitoring duration will be changed or stopped;

- The water supply pipeline intake point from the feeder canal should be provided with sufficient screening to filter out larger aquatic organisms (e.g., fish, frogs and toads) and foreign matter, preventing this material from being drawn into the pumps;
- Drum screens need to be adopted in order to limit the entrainment of fish in the cooling water system and intake velocities should be as low as possible;
- The intakes for the water pumps in the main pump-house will meet the IFC guidelines including recommended intake velocity of 0.15 m/s and a mesh size of 9.5 mm;
- Temporary water reservoir can be built for water storage rather than direct abstraction from the sea;
- Monitoring should continue during construction and operation phase of the proposed project to ensure that the deterrents are working effectively; and
- Fish Conservation Program;

Measures for Water Discharge Structure:

- The project proponent must conduct a detailed study on fish in the Kutubdia Channel and Kohelia-Matamuhuri River. At least one year of monitoring should be conducted during construction and another one-year during operation phase of the project. Based on the suggestions from the study the monitoring duration will be changed or stopped;
- Ensure the temperature of the cooling water in an acceptable limit before discharge into the Kutubdia Channel;
- Avoid the fish breeding season and migration route dredging;
- Regular monitoring and ensure no fish death, disturb in the Kutubdia Channel and Kohelia-Matamuhuri River;
- No waste water discharge from the power plant ETP and STP plant without treatment; and
- Plan measures for accidental oil and chemical spillage from the power plant.

CHAPTER 10

Environmental Monitoring Plan

10 ENVIRONMENTAL MONITORING PLAN

The effectiveness of various mitigation measures is described and will be monitored through a well-defined environmental monitoring programme. This will be done by direct measurement of parameters related to environmental quality, emissions, discharges etc.

An environmental monitoring programme is important as it provides useful information on the following aspects:

a) It helps to verify the predictions on environmental impacts presented in this study;
b) It helps to identify the need for improvements in the management plans;
c) It helps to verify compliance with statutory and community obligations; and
d) It helps to indicate warnings of the development of any alarming environmental situations and thus, provides opportunities for adopting appropriate control measures.

The monitoring programme in different areas of environment, outlined in the next few sections, has been based on the findings of the impact assessment studies, described earlier.

10.1 Monitoring Plan

The purpose of the monitoring programme is to ensure that the intended environmental measures are achieved and result in desired benefits to the target population. To ensure proper implementation of the Environment Monitoring Plan (EMP), it is essential that an effective monitoring programme is designed and carried out.

The broad objectives of the environment monitoring program are:

- To monitor impacts on the surrounding environment and the effectiveness of mitigation measures during the pre-construction, construction and operation;
- To ensure that the environmental control systems installed at the power plant and are operating satisfactorily; and
- To suggest ongoing improvements in the management plan, if required, for subsequent effective monitoring.

10.1.1 Stack Emission Monitoring

The height of the stack will be 220 meter for the proposed 1x635 MW power plant. The emissions from the stack will be monitored continuously for sulfur dioxide, nitrogen dioxide and particulate matter. If the pollutant concentration levels exceed the standard limit, necessary control measures will be taken to bring them back within the standards. Sampling ports will be provided in the stacks according to the DoE guidelines.

10.1.2 Ambient Air Monitoring

A laboratory equipped with the necessary instruments for carrying out air quality monitoring will be provided within the plant. The concentration levels of PM_{10}, $PM_{2.5}$, SO_2, NO_2, and CO in the ambient air will be monitored for the project site and nearby villages. The monitoring will be done as per the ECR, 2023, Noise Pollution Control Rules 2006 and Air Pollution (Control) Rules 2022, Bangladesh.

10.1.3 Meteorological Monitoring

An automatic weather monitoring station will be installed within the power plant premises and daily observations of micro-meteorological parameters such as ambient temperature, wind speed, wind direction, relative humidity, cloud cover, rainfall and solar radiation etc. will be recorded.

10.1.4 Equipment and Ambient Noise

During construction phase noise level will be monitored at the noise generating locations. Noise level of the major noise generating equipment in regular interval to check the compliance. Ambient noise level will be monitored in the surrounding sensitive locations of project site and villages.

Noise level of the equipment will be monitored in regular interval to check the compliance during operation. Ambient Noise levels would be monitored at major noise generating locations within the project area and impact areas within the plant premises and neighboring areas.

10.1.5 Surface Water and Wastewater Monitoring

Monitoring of Water Consumption:

Continuous efforts would be made to reduce the water consumption and thereby to reduce the wastewater generation. Flow meters would be installed at all major water inlet points and flow rates would be continuously monitored during both construction and operation stages.

Monitoring of Surface Water:

During pre-construction and construction stage, pH, Suspended Solid, DO, COD, BOD_5, Total Coliform, NO_3-N, $PO4^{3-}$, Oil & Grease, Pb & Cr parameters will be tested of Kutubdia channel and sea water samples.

During Operation Phase, Temperature, pH, Suspended Solid, DO, COD, BOD_5, Total Coliform, Fecal Coliform, NO_3-N, $PO4^{-3}$, Oil & Grease, Phenols, Arsenic, Cadmium, Cyanide, Hexavalent Chromium, Lead and Mercury will be tested of Kutubdia channel and sea water samples.

Monitoring of Wastewater Treatment:

During construction phase, pH, Suspended Solid, DO, BOD5, COD, and Oil & Grease of wastewater of wastewater will be tested prior to discharge to the natural water body.

The treated effluent would be monitored for the flow rate and quality to identify any deviations in performance of effluent and sewage treatment plants. The monitoring parameters are as per stipulations of the DoE, Bangladesh. The parameters to be monitored including flow, pH, EC, temperature, turbidity, TDS, TSS, SO_4, NO_3, Oil and Grease, DO, BOD, COD, Cd, As, Cr, Pb, NH_3, PO_4^{3-} and Cl during operation phase.

Sewage water will be treated in the STP. Treated sewerage will be treated prior to discharge to the nearest waterbody. The monitoring parameters for sewerage water are temperature, pH, BOD_5, COD, Suspended Solids, Oil & Grease, NO_3, PO_4 and Total Coliform.

10.1.6 Ground Water Monitoring

Ground water will be used during construction stage only. Ground Water Quality and depth of water table will be monitored for any ground water contamination. The monitoring locations will be close to the ash pond area and nearest community.

10.1.7 Solid & Hazardous Waste Monitoring

Solid waste that will be generated in the proposed power plant premises like empty packing materials, drums, glass, paper, plastic, wood etc. will be properly collected and stored in a confined area. The EHS department will conduct regular monitoring of the waste generation volume and disposal. After storage all the solid wastes will be sold to the licensed vendors.

Spent oil and lubricants generated from various process equipment, machines, vehicles, instruments, oil storage tanks, are categorized as Hazardous Wastes. It should be stored in drums, properly sealed and stored in earmarked place for auction. Records of sale should be kept and annual report should be submitted to DoE. Used Batteries should be stored in earmarked place and given back to dealers as per buy-back arrangement. Electronic waste should be given to authorized re-processors.

The following hazardous materials like coal, LDO/diesel, and painting materials need to be stored at the project site during operation. All these materials would be stored as per international safety standards.

10.1.8 Flora and Fauna Monitoring

Ecological impact will also be monitored for symptoms of visible damage/death/kill/disturbance etc. during pre-construction, construction and operation stages.

10.1.9 Workers Health and Safety Monitoring

Occupational Health and Safety is very closely related to productivity and good employer-employee relationship. The main factors that will affect the occupational health and safety in the project site are dust, flue gas emissions noise and accidental injury. To avoid any effects on the health of workers due to emissions and noise, sufficient measures have been proposed which include:

- Provision of personal protection equipment (PPE) including clothing, helmets, dust mask, shoes, etc. to the workers;
- Awareness training on safety and ensure using personal protective equipment;
- Availability of first-aid facilities in the project premises;
- Regular health checkup of the workers should be ensured;
- Effective de-dusting system at loading, unloading and transportation; and
- Regular monitoring of working environment and implementation of safety and control measures to prevent hazard.

Health safety officer will monitor these issues regularly for all stages of the project.

10.1.10 Community Health Monitoring

The health and safety of the local community those are living immediate surrounding of the project site should be monitored. The parameters like respirable disorders, heart diseases, diabetes, reproductive health, child health and ENT problems can be monitoring or survey. The OPDL-2 should organize health camps in surrounding villages with qualified doctors and support staff, inviting surrounding people for health checkup in yearly basis. A traffic management plan will be prepared and implement by the OPDL-2 to reduce the road accidents at the approach road and coal transportation route.

10.1.11 Monitoring and CSR Activities

10.1.11.1 Proposed CSR Plan/Activities

The Orion Power Unit-2 Dhaka Limited (OPDL-2) should prepare a CSR plan in consultation with local Union Parishad and Upazila Parishad. OPDL-2 will be actively contributed to improve the socioeconomic conditions of the project surrounding area by providing assistance as CSR activates for the local community. The proposed project will create opportunities for direct and indirect employment, which will help in improving the socio-economic status of the region. The following social activities and development schemes can be implemented by the project company in the project area:

Livelihood initiatives:

Industrial training; Training support for skill development among women; providing vocational skill improvement training like- tailoring classes for village women for employment generation; employment generation scheme for disabled persons (Mobile Repair, Tailoring centre), Employment generation scheme for fishery training, income generation training and assistance for poultry and goatary.

Health and Sanitation:

- PP can develop primary health centre for the local people, provisioning of deployment of doctor on a weekly basis at health centres in the AOI and providing ambulance services in the peripheral villages;
- Supply of medicines for the poor and PAP's;
- Improvement of existing health care facilities & create awareness about sanitation.

Education and Sports:

- Provide school dress, books and stationery for the poor and meritorious students;
- Scholarship scheme for the economic backwardness and meritorious students;
- Promotion of sports for the students;
- Improvement of classrooms(s), drinking water facility, maintenance of toilets, electricity fans and providing bicycles to children etc. in the nearby village school as per requirement.

Community Infrastructure Development:

- Repairing, construction and donation in the nearby mosque as per requirement;
- Construction of community hall in the identified villages; construction work of low cost toilets; upgradation of village road, etc.

CSR for Salt Cultivators and Fishermen Community

There are many salt cultivators and fishermen community/villages within 10 km radius of the proposed project site. According to the Maheshkhali Upazila Fisheries office, there are 1,239 registered fishermen in Matarbari Union. Focus group discussion were conducted with the salt cultivators and fishing community to know their needs, problems and concern issues. They replied that, their income and livelihoods will be impacted by the implementation of the proposed project, due to the restriction in the jetty area, salt pan area and adjoining river, pollution from the power plant will impact on water quality as well as the fish resources in the area. As per discussion with them, the following CSR activities can be taken for the salt cultivators and fisherman community.

- Subsidy and loan for procuring modern fishing boats and equipment like fishing gear and craft for fishermen and giving priority to the salt cultivator in any kinds of opportunities for their livelihood;
- Training in modern fishing techniques such as GPS and Eco-sounder when they go for fishing in the deep sea like Bay of Bengal;
- Training on value addition;
- Providing electricity and provide necessary infrastructure including ice cutting machines for the fishermen;
- Training in hygienic handling of fish and export facilities for the fishermen; and
- Training and demonstration for alternative livelihoods opportunities for men and women.

Environment Protection program:

In addition to the green development programs, social forestry can be promoted as part of the CSR program by afforestation program in the public places, roadsides, riverbanks, government lands etc.

Others:

- Skill development training;
- Livelihoods improvement and women empowerment;
- Awareness program for the local community.

CSR Plan:

OPDL-2 will consult with Union Parishad and Upazila Parishad for preparation of need-based CSR and community engagement plan that will be implemented in a phase wise manner. This study will include:

- Need assessment in the villages;
- CSR plan in consultation with local people, panchayat, upazila and district authority, NGO & CBO;
- Community engagement plan for implementation of CSR plan.

Monitoring mechanism for CSR Activities:

The OPDL-2 will form a CSR cell in the project site for implementing CSR activities. The community liaison office of OPDL-2 will monitor implementation of the listed activities of CSR. He will prepare the annual report and submit to the project higher authority. The local Union Matarbari can be included in the monitoring plan and the Chairman of the Union Parishad will be engaged for conducting annual social audit once in a year.

10.1.12 Monitoring Plan for Pre-construction Phase

During the course of the pre-construction of the proposed 635 MW coal-fired power plant at Matarbari, Maheshkhali, regular environmental monitoring of all environment parameters will be required. The monitoring period is considered as six months during pre-construction phase. The suggested monitoring plan for the pre-construction of the proposed project is given in **Table 10-1**.

Table 10-1: Environmental Monitoring Plan for Pre-construction Phase

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
General	Inspection of mitigation compliance	Land filling, labor camp and dredging site	Visual inspection of all active work areas	Daily	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
Ambient Air Quality	Dust	Land filling site	Visual inspection to ensure dust suppression measures are in place	Daily	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
	PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO	2 sampling sites (project sites and surrounding area) • Project Site (21º44'51.7" N, 91º53'59.2" E); • Near Anamul Haque House, South Sikdarpara, 2 No: Ward, Matarbari (21º44'30.9" N, 91º54'08.2" E);	Onsite measurement and analysis	Monthly	Air Pollution Control Rules 2022 (Schedule- 1: Ambient Air Quality Standard)	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Ambient Noise Level	Noise Level in dB (A)	4 sampling sites (Project site and surrounding area) • NL-1: Project Site (21º44'44.8" N, 91º53'58.9" E); NL-2: Near Aminullah House, Baniakata, 2NO: Ward, Matarbari (21º44'44.3" N, 91º54'19.5" E); NL-3: Near Anamul Haque House, South Sikdarpara, 2 no. Ward, Matarbari (21º44'30.9" N, 91º54'08.2" E); ANL-4: Near Fokir Miyazee Jame Mosque,	Onsite measurement and analysis	Monthly	Noise Pollution (control) Rules 2006	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
		Miyazeepara, Matarbari (21º44'00.7" N, 91º53'33.4" E);				
Surface Water Quality	pH, Suspended Solid, DO, COD, Total Coliform, Fecal Coliform, NO_3-N, $PO4^{3-}$, Oil & Grease	3 sampling sites (nearest waterbodies from the landfill site, upstream and downstream of the dredging location)	Surface water sampling and laboratory analysis	Quarterly	Environmental Conservation Rules 2023 [Schedule-2 (a-2): Coastal water quality]	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Groundwater Quality	pH, Fe, Mn, As, FC, TC, Salinity, Zn, Pb, Ni, Fe, Hg, Cu, Cd etc.	2 sampling sites (project site and tube well from the nearest village)	Groundwater sampling and laboratory analysis	Quarterly	Environmental Conservation Rules 2023 [Schedule-2 (b): Drinking water quality standard]	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Dredged material Quality	Cd, Fe, Pb, Mg, Hg, P, Total N	Dredged material collection location	Dredged material sampling and laboratory analysis	Prior to land filling and quarterly	-	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Soil Quality	Pb, Cd, Fe, Mg, Hg, P, Total N	2 samples from surrounding area	Soil sampling and laboratory analysis	Quarterly	-	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Terrestrial Flora	Number of Trees felled	Project area	Visual inspection	Prior to land clearance	Monitoring and record keeping	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Terrestrial Fauna	Monitoring of Accidental death, disturbance, rescue,	Project area and surrounding	Visual inspection	Daily	Monitoring and record keeping	**Implementation:** Contractor

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
	and Rehabilitation of wildlife					**Supervision:** OPDL-2
Aquatic Ecology (Flora and Fauna)	Monitoring of death/ disturbance of aquatic flora and fauna	Dredging site, soil transportation route and Kutubdia Channel	Visual inspection and record keeping	Daily	Monitoring and record keeping	**Implementation:** Contractor **Supervision:** OPDL-2
Drainage congestion/ waterlogging	Monitoring the drainage condition of the project area and surroundings	Landfill site and immediate surrounding area	Visual inspection	Daily	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
River Traffic	Disturbance of the boat/vessel's movement	Dredging site, soil transportation route and Kutubdia channel	Visual inspection	Daily	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
Solid and Liquid Waste	Quantity/volume generated and disposal	Dredging and project site	Visual inspection of waste in generation and disposal site	Daily	Monitoring and record keeping	**Implementation:** Contractor **Supervision:** OPDL-2
Community Health and Safety	Accidents, incidents, diseases, dangerous occurrences and community complaints	Surrounding of the project site community and approach road	Visual inspection	Based on occurrence	Monitoring and record keeping	**Implementation:** Contractor **Supervision:** OPDL-2
Occupational Health and Safety	Near-misses, incidents, occupational diseases, dangerous occurrences	Dredging site, soil transportation route, approach road and project site	Visual inspection	Based on occurrence	Monitoring and record keeping	**Implementation:** Contractor **Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
Physical Displacement	Received technical/ financial assistance for the relocation and CSR activities	Relocated Location	Received technical and financial assistance for the relocation	Prior to start construction	As per the relocation plan	**Implementation & Supervision:** OPDL-2
Livelihood loss of salt and shrimp cultivator	Number of affected workers	Affected person	Inspection of records/ compensation disbursed.	Prior to start construction	As per the compensation plan prepared by OPDL-2	**Implementation:** NGO/3rd Party **Supervision:** OPDL-2

10.1.13 Monitoring Plan for Construction Phase

During the course of the construction of the proposed 635 MW coal-fired power plant at Matarbari, Maheshkhali, regular environmental monitoring of all environment parameters will be required. The monitoring period is considered as thirty months during construction phase. The suggested monitoring plan for the construction of the proposed project is given in **Table 10-2**.

Table 10-2: Environmental Monitoring Plan for Construction Phase

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
General	Inspection of mitigation compliance	Construction site and labor camp	Visual inspection of all active work areas	Daily	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
Meteorology	Wind speed, Wind direction, relative humidity, temperature and rainfall	One within the project site	Onsite measurement	24 Hourly	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
Ambient Air Quality	Dust	Construction sites and material storage sites	Visual inspection of all active work areas	Daily	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
	PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO	5 samples according to the baseline monitoring location (**Table 4-4** and **Figure 4-18**)	Onsite measurement and analysis	Monthly	Air Pollution Control Rules 2022 (Schedule- 1: Ambient Air Quality Standard)	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Ambient Noise Level	Noise Level in dB(A)	Construction site	Visual inspection to ensure good standard equipment are in use	Weekly	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
	Noise Level in dB (A) (Leq_{day} and Leq_{night})	5 samples according to the baseline monitoring location (**Table 4-7** and **Figure 4-26**)	Onsite measurement and analysis	Monthly	Noise Pollution (control) Rules 2006	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Surface Water Quality	Temperature, pH, Suspended Solid, Salinity, Turbidity, DO, BoD_5, COD, Total Coliform, Fecal Coliform, NO_3-N, $PO4^{3-}$, Oil & Grease, Pb, Cr	6 samples according to the baseline monitoring location (**Table 4-10** and **Figure 4-29**)	Surface water sampling and laboratory analysis	Quarterly	Environmental Conservation Rules 2023 [Schedule-2 (a-2): Coastal water quality]	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Groundwater Quality	pH, Fe, Mn, As, FC, TC, Salinity, Zn, Pb, Ni, Fe, Hg, Cu, Cd etc.	4 locations according to baseline sampling (**Table 4-12** and **Figure 4-31**)	Groundwater sampling and laboratory analysis	Quarterly	Environmental Conservation Rules 2023 [Schedule-2 (b): Drinking water quality standard]	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Soil Quality	Pb, Cd, Fe, Mg, Hg, P, Total N, Oil &Grease	2 samples from adjacent agricultural/salt pan area of project site	Soil sampling and laboratory analysis	Bi-annual	-	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Sediment Quality	Pb, Cd, Fe, Mg, Hg, P, Total N, Oil &Grease	3 sampling sites (Near proposed water intake point, Kutubdia Channel- 21º45'02.9"N 91º52'40.5" E, Upstream of Kutubdia	Sediment sampling and laboratory analysis	Quarterly	-	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
		Channel- 21º46'54.2"N 91º53'26.7" E and Downstream of Kutubdia Channel- 21º43'07.3"N 91º52'04.5" E)				
Terrestrial Flora	Plant Health Monitoring (Plant Growth, Canopy Coverage, Disease, etc.)	Within 2 km buffer area of power plant site and 500 meters of coal corridor	Visual inspection and record keeping	Quarterly	Applicable international standard	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Terrestrial Fauna (wildlife)	Diversity and abundance of herpetofauna, mammals and residential birds	Project site and adjacent areas	Visual inspection and record keeping	Quarterly	Applicable international standard	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Terrestrial Fauna (migratory bird)	Diversity and abundance of migratory bird	Project site and adjacent areas	Visual inspection and record keeping	Twice in a Yearly (December and March)	Applicable international standard	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Aquatic Ecology (Fisheries resources)	Species Composition, Diversity, abundance, habitat suitability, etc	3 km upstream and 3 km downstream from the adjacent project Area	Boat to boat Survey, Stakeholder consultation	Bi-annual	Applicable international standard	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Aquatic Ecology (Plankton and Benthos)	Diversity and abundance	Jetty area, upstream (1000m from Jetty area) and Downstream (1000m from jetty area)	Sample collection and Laboratory analysis	Bi-annual	Applicable international standard	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Aquatic Ecology (Turtle)	Species Diversity, Occurrence of turtle for nesting and laying eggs, Number of eggs during breeding months	Matarbari Sandy beach	Visual inspection, Consultation with national/ international NGO working for turtle Conservation, Consultation with local Community and different stakeholder	Monthly (November to February)	Applicable international standard	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
Solid Waste	Quantity, volume and waste management	Construction camp and construction sites	Visual inspection that solid waste is disposed at designated site	Weekly	Monitoring and record keeping	**Implementation:** EHS team of Contractor **Supervision:** OPDL-2
Liquid Waste	pH, Suspended Solid, DO, BOD_5, COD, and Oil & Grease of wastewater	Prior to discharge location	Sample collection and Laboratory analysis	Quarterly	Environmental Conservation Rules 2023 (Schedule-4: wastewater standard of industry or project)	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Hazardous Waste	Hydrocarbon and chemical storage	Construction site	Visual inspection of storage facilities	Weekly	Monitoring	**Implementation:** EHS team of Contractor **Supervision:** OPDL-2
Drainage congestion/ waterlogging	Monitoring the drainage condition	Project construction site and immediate surrounding area	Visual inspection	Weekly	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
Erosion	Mark of erosion	Construction areas and material storage sites	Visual inspection	Weekly	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
River Traffic	Kutubdia Channel	Jetty construction area, material and equipment transportation routes	Visual inspection to ensure local river traffic	Weekly	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
Road Traffic	Traffic safety	Approach road	Visual inspection to ensure local roads are not damaged, placement of traffic signs and proper traffic management	Weekly	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
Material handling and storage	Handling and storage of material and equipment at plant	Construction site and jetty area	Visual inspection	Monthly	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
Drinking water and sanitation	pH, Hardness, Fe, Cl, F, Fecal Coliform, Total Coliform, Salinity,	Construction camp	Ensure the construction workers are provided the safe water and sanitation facilities in the site	Weekly	Monitoring	**Implementation:** Contractor **Supervision:** OPDL-2
Community Health and Safety	Accidents, incidents, diseases, dangerous occurrences and community complaints	Construction site and approach road	Visual inspection	Based on occurrence	Monitoring and record keeping	**Implementation:** EHS team of Contractor **Supervision:** OPDL-2
Occupational Health and Safety	Near-misses, incidents, occupational diseases, dangerous occurrences, first aid, PPE	Construction site, jetty site, and construction camp	Visual inspection	Based on occurrence	As defined in the H&S Plan	**Implementation:** EHS team of Contractor **Supervision:** OPDL-2

10.1.14 Monitoring Plan for Operation Phase

During the operation of the proposed 635 MW coal-fired power plant at Matarbari, Maheshkhali, regular environmental monitoring of all environment parameters will be required. The suggested monitoring plan for the operation of the proposed project is given in **Table 10-3**.

Table 10-3: Environmental Monitoring Plan for Operation Phase

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
Compliance monitoring	EIA, Mitigation Measures, Condition of Environmental Approval	All areas	-	Monthly	Environmental Management and	**Implementation & Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
					Monitoring Plan (EMMP)	
Meteorology	Wind speed, wind direction, temperature humidity, rainfall, solar radiation, cloud cover	Project site	Establishment of weather station	Continuous	-	**Implementation & Supervision:** OPDL-2
Stack Emission	O_2, PM, SO_2, NO_2, CO_2, HC, CO, Flow rate and Temperature	At the stack	Onsite measurement	Continuous	International Standard	**Implementation & Supervision:** OPDL-2
	O_2, PM, SO_2, NO_2, CO_2, HC, CO	At the stack	Onsite measurement	Semi-Annual	International Standard	**Implementation:** 3rd party **Supervision:** OPDL-2
Ambient Air Quality	Fugitive dust emission	Coal handling Jetty, ash yard, stock house, crushers mills, approach road	Visual inspection	Daily	-	**Implementation:** Contractor **Supervision:** OPDL-2
	PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO	5 samples according to the baseline monitoring location (**Table 4-4** and **Figure 4-18**)	Onsite measurement and analysis	Quarterly	Air Pollution Control Rules 2022 (Schedule- 1: Ambient Air Quality Standard)	**Implementation:** 3rd party **Supervision:** OPDL-2
Power Plant Noise Level	Average Leq values and maximum values of SPL in dB(A)	3 sampling sites (Project boundary, equipment and workplace)	Onsite measurement and analysis	Monthly	Noise Pollution (control) Rules 2006	**Implementation & Supervision:** OPDL-2
Ambient Noise Level	Noise Level in dB (A)	5 samples according to the baseline monitoring location (**Table 4-7** and **Figure 4-26**)	Onsite measurement and analysis	Quarterly	Noise Pollution (control) Rules 2006	**Implementation:** 3rd party **Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
Surface Water Quality	Temperature, pH, Suspended Solid, DO, COD, BOD_5, Total Coliform, Fecal Coliform, NO_3-N, $PO4^{-3}$, Oil & Grease, Phenols, Arsenic, Cadmium, Cyanide, Hexavalent Chromium, Lead and Mercury	6 samples according to the baseline monitoring location (**Table 4-10** and **Figure 4-29**)	Surface water sampling and laboratory analysis	Quarterly	Environmental Conservation Rules 2023 [Schedule-2 (a-2): Coastal water quality]	**Implementation:** 3rd party **Supervision:** OPDL-2
Groundwater Quality	pH, Fe, Mn, As, FC, TC, Salinity, Zn, Pb, Ni, Fe, Hg, Cu, Cd etc.	Groundwater at coal storage yard, ash storage area and the nearest village	Groundwater sampling and laboratory analysis	Bi-annual	3rd Party Environmental Consultant	**Implementation:** 3rd party **Supervision:** OPDL-2
Storm Water	Oil and grease, Cl, TSS, COD, BOD	Discharge Channel	Surface water sampling and laboratory analysis	Weekly during monsoon		**Implementation & Supervision:** OPDL-2
Soil Quality	Pb, Cd, Fe, Mg, Hg, P, Total N, Oil &Grease	2 samples from adjacent agricultural/salt pan area and Ash yard	Soil sampling and laboratory analysis	Bi-annual	-	**Implementation:** 3rd party **Supervision:** OPDL-2
Sediment Quality	Pb, Cd, Fe, Mg, Hg, P, Total N, Oil &Grease	3 sampling sites (Near proposed water intake point, Kutubdia Channel- 21º45'02.9"N 91º52'40.5" E, Upstream of Kutubdia Channel- 21º46'54.2"N 91º53'26.7" E and Downstream of Kutubdia Channel- 21º43'07.3"N 91º52'04.5" E)	Sediment sampling and laboratory analysis	Quarterly	-	**Implementation:** 3rd party **Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
Effluent (Wastewater) quality	Flow, pH, EC, temperature, turbidity, TDS, TSS, SO_4, NO_3, Oil and Grease, DO, BOD, COD, Cd, As, Cr, Pb, NH_3, PO_4^{3-} and Cl	At the point where effluent leaves the power plant boundary	Sampling and laboratory analysis of effluent	Monthly	Environmental Conservation Rules 2023 (Schedule-4: wastewater standard of industry or project)	**Implementation:** 3rd party **Supervision:** OPDL-2
Effluent (Cooling Water Discharge)	Flow, Salinity, Temperature	At point of discharge for effluent and 100m downstream and upstream in the Kutubdia Channel/Sea	Sampling, Analysis and record keeping	Daily	Environmental Conservation Rules 2023 (Schedule-4: wastewater standard of industry or project)	**Implementation & Supervision:** OPDL-2
	Flow, Salinity, Turbidity, Temperature	At point of discharge for effluent and 100m downstream and upstream in the Kutubdia Channel/Sea	Sampling, Analysis and record keeping	Quarterly	Environmental Conservation Rules 2023 (Schedule-4: wastewater standard of industry or project)	**Implementation:** 3rd party **Supervision:** OPDL-2
Sewerage Water	Temperature, pH, BOD_5, COD, Suspended Solids, Oil & Grease, NO3, PO4 and Total Coliform	Prior to Discharge Point	Sampling, Analysis and record keeping	Once need to discharge	Environmental Conservation Rules 2023 (Schedule-3: Sewerage discharge standard)	**Implementation:** 3rd party **Supervision:** OPDL-2
Non-hazardous Solid Waste (domestic and office waste)	Quality, quantity, collection system and disposal locations	Disposal site in project premises	Visual checks to assess the situation	Daily	Monitoring and record keeping	**Implementation & Supervision:** OPDL-2
Hazardous Solid Waste	Types, quantity, storage, associated hazards, disposal method	Fly ash, bottom ash generating sources like ESP hopper, air preheated, and disposal point all units of the plant	Visual checks to assess the situation	Monthly	Monitoring and record keeping	**Implementation & Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
Coal and fly ash Specification	Heavy metals (As, Be, Cd, Cr, Pb, Hg and Ni)	Coal storage and ash pond area	Sampling and laboratory analysis	Every lot of coal (ash produced) received from abroad or quarterly	Test in recognized laboratory	**Implementation & Supervision:** OPDL-2
Hazardous Liquid Waste (from WTP, ETP and STP)	Types, quantity, storage, associated hazards, disposal method	Storage and discharge point	Visual checks to assess the situation	Monthly	Monitoring and record keeping	**Implementation & Supervision:** OPDL-2
Hazardous Spill	Spill on land, spent oil and lubricants	All operational areas and storage area	Visual checks to assess the situation	Daily	-	**Implementation & Supervision:** OPDL-2
Fire and Safety	Fire hazards & safety protocols	All operational areas	Visual inspection	Daily	-	**Implementation & Supervision:** OPDL-2
Road Traffic	Traffic management plan in the project area and disturbance in approach road	Entry exits routes of the plant and approach road	Visual inspection	Daily	TMP	**Implementation & Supervision:** OPDL-2
River Traffic	Kutubdia Channel and Kohelia-Matamuhuri River	Fuel and coal unloading jetty area	Visual inspection to ensure local river traffic and no disturbance	Daily	Monitoring	**Implementation & Supervision:** OPDL-2
Accidents	Inspection and record keeping	All areas	Visual inspection	Based on occurrence	Health and Safety policy of OPDL-2	**Implementation & Supervision:** OPDL-2
Terrestrial Flora	Plant Health Monitoring (Plant Growth, Canopy Coverage, Disease, etc.)	5 sample plots within 2 km Buffer Area (3 samples in Downwind direction; 2 samples in upwind direction)	Sample Plot Survey, Visual inspection	Half yearly for 5 years	Monitoring and Reporting	**Implementation:** 3rd party **Supervision:** OPDL-2

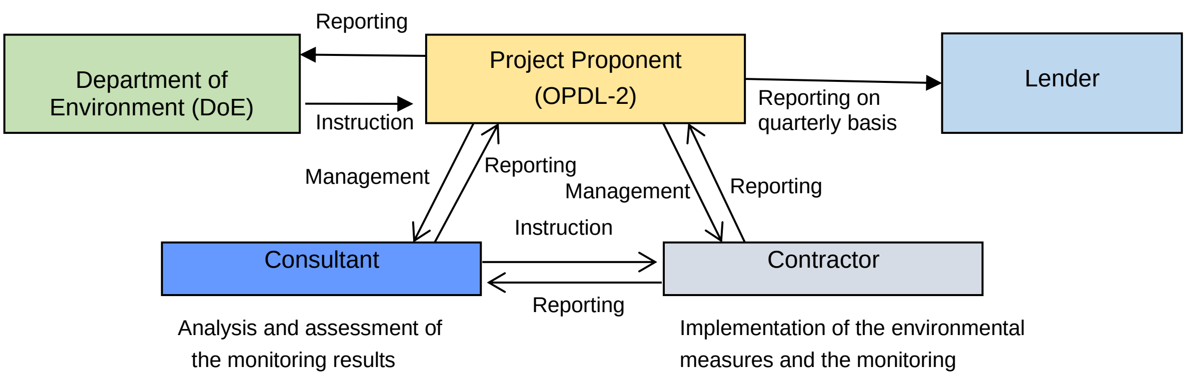
Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
Terrestrial Fauna	Diversity and abundance of herpetofauna, mammals and residential birds	Project site and adjacent areas	Visual observation	Bi-annual	Monitoring and Reporting	**Implementation:** 3rd party **Supervision:** OPDL-2
Migratory Birds	Diversity and abundance of Migratory bird	Project site and adjacent areas	Visual observation	Yearly (December and March)	Monitoring and Reporting	**Implementation:** 3rd party **Supervision:** OPDL-2
Aquatic Ecology (Fisheries resources)	Capture/Death/Killing/ Disturbance/migration etc.	Water intake and cooling water discharge in Kutubdia Channel at project site	Visual inspection that has no disturbance of fishing activities	Daily	Monitoring and record keeping	**Implementation & Supervision:** OPDL-2
	Species Composition, Diversity, abundance, habitat suitability, etc	5km upstream and 5km downstream from the adjacent project Area	Boat to boat Survey, Stakeholder consultation	Quarterly for 5 years	Applicable international standard	**Implementation:** 3rd party **Supervision:** OPDL-2
Aquatic Ecology (Plankton and Benthos)	Diversity and abundance	Jetty area, Water intake and discharge point	Sample collection and Laboratory analysis	Quarterly	Applicable international standard	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2
Aquatic Ecology (Turtle)	Species Diversity, Occurrence of turtle for nesting and laying eggs, Number of eggs during breeding months	Matarbari Sandy beach	Visual inspection, Consultation with national/ international NGO working for turtle Conservation, Consultation with local Community and different stakeholder	Monthly (November to February) for 5 years	Applicable international standard	**Implementation:** 3rd party of Contractor **Supervision:** OPDL-2

Aspect/ Environmental Indicator	Parameters/Units	Monitoring Locations	Means of Monitoring	Frequency	Applicable Standard	Responsibility
Drainage Congestion	Monitoring the drainage condition	Project surrounding area	Visual inspection	Daily	Monitoring	**Implementation & Supervision:** OPDL-2
Green belt development	Number of trees are planted and survival rate	Project premises and surrounding area	Plantation of trees and record keeping	Periodic and need based	Monitoring	**Implementation & Supervision:** OPDL-2
Community Health and Safety	Respirable disorders, Hearth diseases, Fluorosis, Diabetes, Reproductive Health and Child Health, ENT problems	Surrounding village around the project	Health camp in surrounding villages with qualified doctors and health check-up	Yearly	-	**Implementation & Supervision:** OPDL-2
Occupational Health and Safety	Number of accidents, first aid, PPEs, Health check-up of workers	Operational areas (all places where there is presence of worker all the time)	-	As per Health safety Policy	Health and Safety Policy of OPDL-2	**Implementation & Supervision:** OPDL-2
Road Condition	Damage to local roads	Approach road	Visual inspection to ensure local roads are not damaged	Monthly	Monitoring	**Implementation & Supervision:** OPDL-2
CSR activities	Number of benefitted persons or family, activities	Surrounding villages around the project	Stakeholder consultation	Periodic and need basis	CSR Policy of OPDL-2	**Implementation & Supervision:** OPDL-2

10.1.15 Institutional Setting and Implementation Arrangement

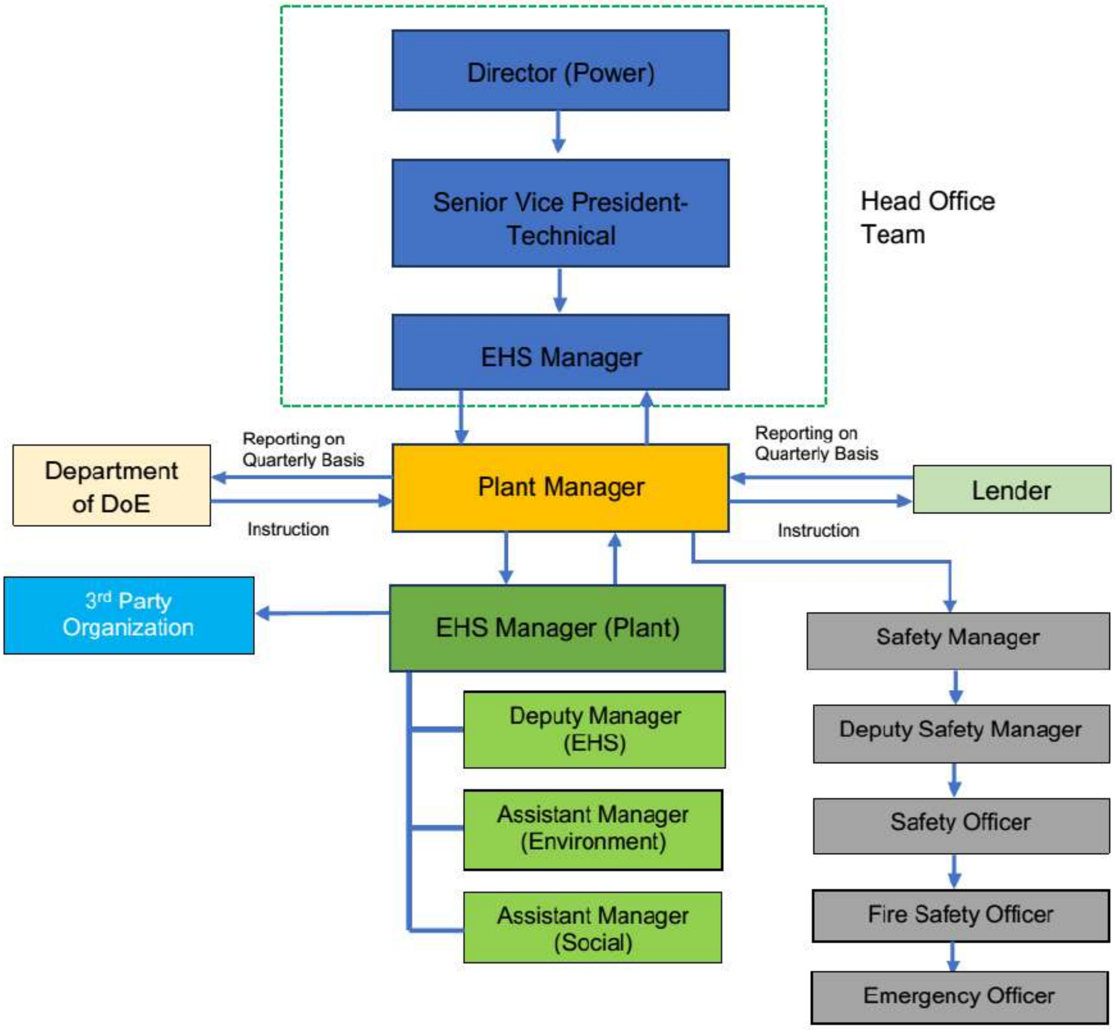
The main purpose of this environmental assessment is to delineate the correct measures to enhance the environmental sustainability of the proposed project through providing suggestion on design considerations, implementation, management and operation as suggested in the EMP. The effective implementation and operation of EMP depends on regular monitoring. The organogram of the proposed Environmental management &monitoring during construction phase directorate is presented in **Figure 10-1.** Contractor will implement Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP) and submit the environmental monitoring report to OPDL-2 and Consultant based on the EIA. OPDL-2 will submit the monitoring report to DoE and lender based on the results of implementation of EMP and EMoP. The EHS officer of contractor will be responsible for implementation of the environmental and health safety aspect as per EMP and EMoP of the project during construction phase. EHS manger and officer of OPDL-2 and consultant will supervise the EMP and EMoP.

Figure 10-1: Implementation Structure of Environmental Management and Monitoring during Construction Phase



Environmental management will require specific approach to handle the issues effectively. Manager EHS will assign the roles and responsibilities to be performed during the operation stages of 635 MW coal-fired power plant project of OPDL-2. It is expected that a certain degree of redundancy is inevitable across all management levels but should be in order to ensure that compliance with the environmental management plan can be cross-checked. The suggested organizational structure for environmental management during operation stage is given below in **Figure 10-2**.

Figure 10-2: Suggested Organizational Structure for Environmental Management during Operation Stage



Compliance with EMP will be the responsibility of OPDL-2 project management at each stage of the project. OPDL-2 management will ensure that all executive activities during pre-construction and construction stage do not create adverse environmental effects. All environmental and social officers will work in environment friendly manner under the supervision of EHS department of OPDL-2. All the regulatory agencies, including DoE will be contacted as and when required to get advice for environmental management and they will be kept informed of the environmental conditions of the area periodically by OPDL-2 management. Some of the approaches to be followed during the environmental management practices are given below:

- Complying with the relevant legislation and regulations of Bangladesh;
- Regularly reviewing of the impacts on the environment in the project site;
- Developing appropriate indicators to monitor core impacts;
- Setting appropriate annual objective, targets and publicly reporting on progress;
- Monitoring supplier's environmental management arrangements;
- Using sustainable materials for office supplies and environmentally safe raw materials with recycling options where appropriate; and
- Communicating openly with internal and external stakeholders on environmental issues.

10.1.15.1 Roles and Responsibilities

Environmental management will be an integral part of corporate policy of the OPDL-2. Therefore, committing to reduce the environmental impacts will reflect the management approach and belief that good governance and performance in this area is synonymous with running a well-managed efficient business. Overall responsibility for environmental performance rests with the Managing Director/Chief Executive Officer of OPDL-2 while the daily management will be performed under the direction of Manager EHS. OPDL-2's EHS officer and contractor will execute environmental management under the supervision of Manager EHS during construction and operation stages. The contractor will carry out field activities as part of the proposed OPDL-2 project that includes relevant and subsidiary construction work. The contractor will have certain liabilities under the environmental laws of the country, which will be specified in the contract document with the OPDL-2 Management. The overall responsibility for all matters pertaining to the environment will be that of the organizational head of assigned contractor.

A brief make-up of the roles and responsibilities of the system is given below:

1. Managing Director/Chief Executive Officer (CEO) of OPDL-2

The MD/CEO of OPDL-2 will regulate the EMP. The key roles and responsibilities of CEO are given below:

- To consider and react to issues and solutions proposed by the HSE Department of OPDL-2;
- To cooperate and consult the relevant environmental agency to perform better;
- To evaluate the progress of development and implementation of EMP; and
- To approve any change in decision-making and authorities in consultation with Manager EHS, if appropriate.

2. Manager EHS

The success of EMP depends on proper and effective management provided by the EHS manager. The roles and responsibilities assigned to Manager EHS are given below:

- To ensure that the points of views of staff, contractors and EHS officers are considered and placed likewise in the EMP;
- To identify issues and propose solutions for inclusion in the EMP review process;
- To improve coordination and exchange of information between top management, employees, and contractors;
- To contribute to actions required to deliver the management plan and ensure its continued development;
- To review EMP every year, tracking issues and changing EMP in accord with the solutions and suggestions; and
- To monitor the progress of development and implementation of the EMP.

3. EHS Office

The role of EHS officer will be authorized by the EHS manager. The responsibilities of HSE officer will include:

- To integrate, as far as possible, the aims and objectives of different users within an agreed plan;
- To maintain a balanced, holistic approach to the solution of concerned issues in accordance with and compliance of legislative requirements;
- To provide professional guidance on questions relating to the environment management and issues raised by contractors/relevant personals; and
- To develop the EMP process by its implementation.

4. Contractor

The role and responsibilities of the contractor consist of the following:

- To carry out construction activities in environmentally sound manner;
- To coordinate with the EHS officer to resolve issues arising during construction phase;
- To manage and implement environmental management practices as given in the impact assessment report as well as EHS policies adopted/prepared by OPDL-2;
- To administer construction crew and reduce the environmental risks;
- To appoint a dedicated environment officer to understand and handle environmental issues more easily in coordination with OPDL-2's EHS officer/coordinator.

5. The Supervision Consultant

The OPDL-2 shall appoint an Independent Monitoring Consultant, who will oversee the construction activities which are in consonance with the provisions of the EIA. He shall be responsible for the preparation of monthly reports on the project progress. The consultant will maintain records, decisions made at meetings, progress on civil works, certified achievements and milestones, financial records, and any deviations from or changes to the contract plans. The consultant will assist the OPDL-2 and contractor in preparing quarterly project progress reports, a project completion report, and monitoring and evaluation reports as required under the agreement.

10.2 Action during Abnormal Operating Condition

During abnormal operating conditions like process upsets or failure of pollution control devices, the emission concentration would exceed the prescribed limit. Air emissions from major stacks are measured using online instruments with real time display facility. In case of abnormal emissions, the Manager of EHS will directly contact the Managing Director (MD)/Chief Executive Officer (CEO) and head of all departments and assess the situation. The emission load should be brought down to the barest minimum level by reducing the production. In case it is observed that the failure/upset condition is likely to exceed reasonable time (say 8 hours or more) then the unit should be shut down till the defect is corrected. The proposed power plant projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. The accident and fatality rates of the specific facility may be benchmarked against the performance of facilities in this sector in developing countries through consultation with published sources.

10.3 Budgets for Monitoring

The project proponent and EPC contractor will allocate separate budget for environmental and social management plan implementation, training, environmental monitoring, reporting and capacity building. Cost estimates are prepared for all the monitoring measures proposed in the report. The details of the cost estimates and the budget during pre-construction (6 months), construction (36 months) and first year of operation stage for the monitoring measures are given in **Table 10-4**. In addition to that, a separate budget will be allocated for CSR activities, which will be conducted by the project proponent for community development.

Table 10-4: Summary of costs for Environmental Monitoring

SL#	Item/Activities	Unit	Unit Cost	Qty.	Total cost (BDT)
A.	**Monitoring Cost during Pre-Construction Stage**				
1.	Ambient Air Quality Monitoring (2 locations @ monthly over 6 months)	Location	20,000	12	240,000

SL#	Item/Activities	Unit	Unit Cost	Qty.	Total cost (BDT)
2.	Ambient Noise Quality Monitoring (4 locations @ monthly over 6 months)	Location	5,000	24	120,000
3.	Surface Water Quality (3 locations @ Twice)	Sample	15,000	6	90,000
4.	Groundwater Quality (2 locations @ Twice)	Sample	20,000	4	80,000
5.	Dredged Material Quality (2 locations @ Twice)	Sample	20,000	4	80,000
6.	Soil Quality Monitoring (2 locations @ Twice)	Sample	20,000	4	80,000
7.	Contingency	LS	200,000	1	200,000
				Grand Total (A)	**890,000**
B	**Monitoring cost during Construction Stage**				
1.	Ambient Air Quality Monitoring (5 locations @ monthly over 36 months)	Location	20,000	180	3,600,000
2.	Ambient Noise Quality Monitoring (5 locations @ monthly over 36 months)	Location	5,000	180	900,000
3.	Surface Water Quality (6 locations @ quarterly over 36 months)	Samples	20,000	72	1,440,000
4.	Groundwater Quality (4 locations @ quarterly over 36 months)	Samples	25,000	72	1,800,000
5.	Soil Quality (2 locations @ quarterly over 36 months)	Samples	25,000	24	600,000
6.	Sediment Quality (3 locations @ quarterly over 36 months)	Sites	25,000	36	900,000
7.	Monitoring of Terrestrial Flora and Fauna @ quarterly over 36 months	LS	100,000	12	1,200,000
8.	Fisheries Survey@ Bi-annual over 36 months	LS	100,000	6	600,000
9.	Turtle Survey@ Monthly for Nov-Feb over 36 months	LS	100,000	12	1,200,000
10.	Wastewater Quality (1 location @ quarterly over 36 months)	LS	10,000	12	120,000
11.	Contingency	LS	500,000		500,000
				Sub-Total (B)	**12,860,000**
C.	**Monitoring Cost during Operation Stage/year**				
1.	Meteorology	Included in O&M cost			
2.	Stack emission monitoring	Location	15,000	2	30,000
3.	Ambient Air Quality Monitoring (5 locations @ monthly over 12 months)	Location	20,000	20	400,000

SL#	Item/Activities	Unit	Unit Cost	Qty.	Total cost (BDT)
4.	Ambient Noise Quality Monitoring (5 locations @ monthly over 12 months)	Location	5,000	20	100,000
5.	Surface Water Quality Monitoring (6 locations @ quarterly over 12 months)	Samples	20,000	24	480,000
6.	Groundwater Quality Monitoring (3 locations @ quarterly over 12 months)	Samples	25,000	24	600,000
7.	Storm Water Quality Monitoring (1 location @ weekly over 4 months (June to September))	Samples	5,000	16	80,000
8.	Soil Quality Monitoring (2 locations @ quarterly over 12 months)	Samples	20,000	8	160,000
9.	Sediment Quality Monitoring (3 locations @ quarterly over 12 months)	Samples	20,000	12	240,000
10.	Effluent (wastewater) Quality (1 location @ monthly over 12 months)	Samples	20,000	12	240,000
11.	Effluent (cooling water discharge) Quality (1 locations @ quarterly over 12 months)	Samples	5,000	12	60,000
12.	Effluent (Sewerage water discharge) Quality (1 locations @ need basis)	Samples	15,000	1	15,000
13.	Coal and fly ash specification (Quarterly over 12 months)	Sample	50,000	4	200,000
14.	Monitoring of Terrestrial Flora and Fauna @ quarterly over 12 months	LS	100,000	4	400,000
15.	Monitoring of Migratory Bird @ 4 months of a year	LS	75,000	1	75,000
16.	Fisheries Survey@ Quarterly over 12 months	LS	100,000	4	400,000
17.	Phytoplankton, Zooplankton and Benthos (3 locations @ quarterly over 12 months)	Sites	25,000	12	300,000
18.	Turtle Survey@ Monthly for Nov-Feb over 12 months	LS	100,000	4	400,000
19.	Contingency	LS	1,000,000	1	1,000,000
				Sub-Total (C)	**5,180,000**
				Grand Total (A+B+C)	**18,930,000**

10.4 Reporting

A robust reporting system will provide the project with the necessary feedback mechanisms to ensure quality and timely implementation of the works. The reporting system will provide a mechanism for ensuring that the measures proposed in the EMP are implemented. Before starting the civil works, the EHS officer of OPDL-2 will finalize the format for reporting on the status and progress of environmental monitoring. The format will be designed to meet all the compliance conditions associated with the environmental clearance from the Department of Environment and the Government of Bangladesh. The contractor will be required to submit the duly filled up reporting form on a monthly basis to the Project Developer (i.e., OPDL-2). A further report, detailing the results of pollution monitoring for air, noise, water, soil and sediment will be submitted as envisaged in the monitoring plan. A health and safety incident/ accident report will be prepared and submitted in the event of an incident or accident.

The EHS personnel will monitor the effectiveness of the EMP implementation. Quarterly Progress Reports that can be submitted to the regional office and head office of the DoE required as a part of environmental clearance process shall also be prepared and submitted based on the necessary monitoring and reporting formats. The below **Table 10-5** indicates the types of report and corresponding actions to be taken.

Table 10-5: Summary of Report Type

SL#	Report Type	Frequency	Responsibility
1.	Environmental Quality Performance	Monthly	Consultant/OPDL-2
2.	Environmental Quality Performance	Quarterly	Consultant/OPDL-2
3.	Annual Environmental Report	Annual	Consultant/OPDL-2

CHAPTER 11

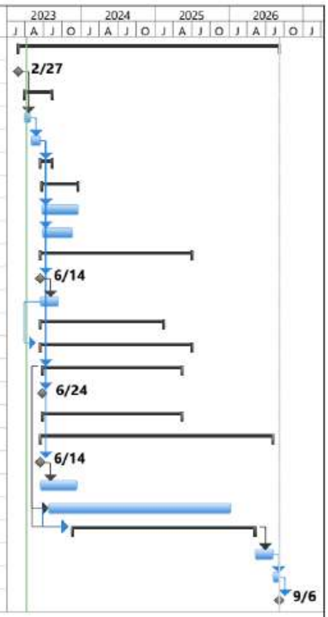
Work Plan

11 WORK PLAN

The tentative work plan for the proposed 635 MW coal-fired power plant project is shown in the following **Table 11-1**. The pre-construction phase will be 6 months duration and construction phase will be 36 months duration. The expected commercial operation will be started in September 2026.

Table 11-1: Tentative Work Plan for the Proposed Project

ID	WBS	Task Name	Duration	Start	Finish
1	**1**	**OPDL-2 635 MW Project Execution Plan**	**1288 days**	**Mon 2/27/23**	**Sun 9/6/26**
2	1.1	Land Lease Agreement Signing	0 days	Mon 2/27/23	Mon 2/27/23
3	**1.2**	**Legislative Permissions**	**138 days**	**Wed 3/29/23**	**Sun 8/13/23**
4	1.2.1	Local Authority NOC	30 days	Wed 3/29/23	Thu 4/27/23
5	1.2.2	Site Clearance by DOE	45 days	Mon 5/1/23	Wed 6/14/23
6	1.2.3	Other legislative Permissions	60 days	Thu 6/15/23	Sun 8/13/23
11	**1.3**	**Land Development**	**180 days**	**Thu 6/22/23**	**Mon 12/18/23**
12	1.3.1	Peripheral Dike Construction	180 days	Thu 6/22/23	Mon 12/18/23
13	1.3.2	Sand Filling With Compaction	150 days	Sun 6/25/23	Tue 11/21/23
14	**1.4**	**Civil Works**	**750 days**	**Wed 6/14/23**	**Thu 7/3/25**
15	1.4.1	NTP to Civil Contractor	0 days	Wed 6/14/23	Wed 6/14/23
16	1.4.2	Detailed Design for Civil Works	90 days	Thu 6/15/23	Tue 9/12/23
17	1.4.3	Process Buildings	610 days	Thu 6/15/23	Thu 2/13/25
54	**1.4.4**	**Non Process Buildings**	**750 days**	**Thu 6/15/23**	**Thu 7/3/25**
67	**1.5**	**BTG Supply**	**690 days**	**Sat 6/24/23**	**Wed 5/14/25**
68	1.5.1	NTP to BTG Supplier	0 days	Sat 6/24/23	Sat 6/24/23
69	**1.5.2**	**Major Item Supply**	**690 days**	**Sun 6/25/23**	**Wed 5/14/25**
83	**1.6**	**EPC**	**1150 days**	**Wed 6/14/23**	**Fri 8/7/26**
84	1.6.1	NTP to EPC	0 days	Wed 6/14/23	Wed 6/14/23
85	1.6.2	Engineering Detail Design	180 days	Thu 6/15/23	Mon 12/11/23
86	1.6.3	BoP Supply	900 days	Tue 7/25/23	Fri 1/9/26
87	**1.6.4**	**IEC**	**900 days**	**Tue 11/21/23**	**Sat 5/9/26**
304	1.6.5	Trial Operation	90 days	Sun 5/10/26	Fri 8/7/26
305	1.7	Performance Test	30 days	Sat 8/8/26	Sun 9/6/26
306	1.8	Commercial Operation Date	0 days	Sun 9/6/26	Sun 9/6/26



Project: ERBL_R7
Date: Sat 4/8/23

Task		Inactive Summary		External Tasks	
Split		Manual Task		External Milestone	
Milestone		Duration-only		Deadline	
Summary		Manual Summary Rollup		Progress	
Project Summary		Manual Summary		Manual Progress	
Inactive Task		Start-only			
Inactive Milestone		Finish-only			

CHAPTER 12

Public Consultation

12 STAKEHOLDER ANALYSIS AND ENGAGEMENT PLAN & PUBLIC CONSULTATION

12.1 Introduction

Stakeholder engagement is the continuing and iterative process by which the Borrower identifies, communicates, and facilitates a two-way dialogue with the people affected by its decisions and activities, as well as others with an interest in the implementation and outcomes of its decisions and the project. It considers the different access and communication needs of various groups and individuals, especially those more disadvantaged or vulnerable, including consideration of both communication and physical accessibility challenges. Engagement begins as early as possible in project preparation because early identification of and consultation with affected and interested parties allows stakeholders views and concerns to be considered in the project design, implementation, and operation.

Stakeholder consultations are a necessary step to obtain the views of people who may be affected by development projects or may otherwise have an interest in their outcomes, and to inform them about changes that may affect them, according to the World Bank's borrower Guidance Note on Stakeholder Consultations in Investment Operations. Such feedback is particularly crucial in the case of people who may be negatively affected.

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

12.2 Scope and Specific Objectives

The broad objective of the stakeholder engagement and involvement process is to provide authorities, as well as interested and affected stakeholders with the opportunity to identify issues, concerns, and opportunities regarding the proposed Project and to address key stakeholder concerns during the preparation of the EIA for the Project. Specific objectives for stakeholder consultations are as follows;

- To address relevant issues including those perceived as being important by other sectoral agencies, public bodies, local communities, affected groups and others;
- To improve information flows between proponents and different stakeholders, improving understanding of a project;
- To identify important environmental and social characteristics or mitigation opportunities;
- To ensure that the magnitude and significance of impacts has been assessed properly; and
- To improve the acceptability and quality of mitigation and monitoring process.

12.3 Identification of Stakeholders

The stakeholder identification is one of the most important processes throughout the project life cycle and documenting relevant information regarding their interests in the project, independencies, influence, and potential impact on the project. Stakeholders vary in terms of the degree of interest, influence and control they have over the project. While those stakeholders who have a direct impact on or are directly impacted by the project are known as **Primary Stakeholders**, those who have an indirect impact or are indirectly impacted are known as **Secondary Stakeholders.** Identification of stakeholder was carried out by EQMS in discussion with the client OPDL. Keeping in mind the nature of the project and its setting, the stakeholders have been identified and listed in the **Table 12-1** presented below:

Table 12-1: Identification of Stakeholder

SL	Stakeholder Group/Category	Key Stakeholders	Description of the Stakeholder Profile
Primary Stakeholders			
1.	Project Affected Persons (PAPs)	• Affected Landowners • Affected Land Users	• Landowner who sold their land to the project owner • Land user who are residing the project area
2.	Institutional Stakeholders	• Regulatory Authorities • Local Administration-Union Parishad	• Regulatory authorities at the district and national level that are responsible for various permits and licenses pertaining to the project.
3.	Other Primary Stakeholders	• Project Owner • EPC contractor	• Responsible for the whole project implementation
4.	Project Financing Agencies/ Institutions	• Financers and Investors	• Investors who are evaluating a potential investment opportunity into the project.
Secondary Stakeholders			
5.	Local Community	• Local community residing near the project footprint area • Labor of existing plant from local community	• The community residing near the vicinity of the project area. • This group is expecting to be indirectly impacted by the Project activities.
6.	Institutional Stakeholders	• Department of Agriculture • Department of Fisheries • Forest Department • Department of Primary and Higher Education • Department of Public Health and Engineering	• This stakeholder groups comprises of expert on different sector for providing inputs and information which are crucial for designing and project implementation.
7.	Additional Secondary Stakeholder	• Local NGOs • Civil Societies	• This stakeholder groups comprises of expert for providing input during project implementation.

12.4 Stakeholder Mapping

Stakeholder Mapping is a process of examining the relative influence that different individuals and groups have influence over a project as well as the influence of the project over them. The purpose of a stakeholder mapping is to:

- Study the profile of the stakeholders identified and the nature of the stakes;
- Understand each group's specific issues, concerns as well as expectations from the project that each group retains;
- Gauge their influence on the project.

Based on this understanding, the stakeholders are categorized into High Influence/ Priority, Medium Influence/ Priority and Low Influence/ Priority. The stakeholders who are categorized as high influence are those who have a high influence over the project or are likely to be heavily impacted by the project activities and are thus high up on the project proponent's priority list for engagement and consultation.

Similarly, the stakeholders categorized as medium influence are those who have a moderate influence over the project or even though they are to be impacted by the project, it is unlikely to be substantial and these stakeholders are thus neither high nor low in the project proponent's list for engagement. On the other hand, the stakeholders with low influences are those who have a minimal influence on the decision-making process or are to be minimally impacted by the project and are thus low in the project proponent's engagement list.

12.5 Approach and Methodology for Stakeholder Mapping and Analysis

The approach adopted for mapping and analyzing involves mapping of the key stakeholders (directly and indirectly) and assessing their significance, influence and impact on the project. The methodology adopted is described below:

The significance of a stakeholder group is categorize considering the magnitude of impact (type, extent, duration, scale, frequency) or degree of influence (power, proximity) of a stakeholder group and urgency/likelihood of the impact/influence associated with the particular stakeholder group in the project context. The magnitude of stakeholder impact/influence is assessed taking the power/responsibility of the stakeholder group and is categorized as negligible, small, medium and large. The Urgency or likelihood of the impact on/influence by the stakeholder is assess in a scale of low, medium and high. The overall significance of the stakeholder group is assessed as per the matrix provided in **Table 12-2** below:

Table 12-2: Stakeholder Mapping Matrix

		Sensitivity /Vulnerability / Important Resource / Receptor		
		Low	**Medium**	**High**
Magnitude of Impacts	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Urgent
	Large	Moderate	Urgent	Urgent

The following section provides brief profiles of the various stakeholders in the project as discussed in the previous sub section along with their degree of influence. The details are provided in below **Table 12-3.**

Table 12-3: List of Identified Key Project Stakeholders Basis on Influence

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
Project Management				
Project Owner	Primary	• Orion Power Dhaka Unit-2 Ltd. (OPDL) is the primary project proponent who own a controlling stake of 100% in the project	Urgent	• Primary project proponents. • Primary financial beneficiaries. • Responsible for all the project risks and impact liabilities. • Responsible for establishment and operation of this project.
Project Financiers	Primary	• Financiers at the corporate and project level of OPDL for the project. • May include local and regional bank, national and international banks as well as development partner organization.	Urgent	• Engagement is limited at the corporate management level. • Key participants in the decision-making process. • Compliance to funding agencies' safeguards/operation policies and other policies.
EPC contractor	Primary	• Construct to deliver a functioning facility or asset to their clients	Moderate	• Carry out the detailed engineering design of the project • Procure all the equipment and materials necessary • Carry out the works in accordance with the agreed scope of works and in accordance with the Contract
Migrant Worker and Labor	Primary	• Labors and workers inside, outside of Maheshkhali upazila for participating in construction and production activities	Moderate	• Responsible for undertaking mostly skill and unskilled based work during construction phase. • Skilled based work during operation/production period.

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
Community				
Project affected person	Primary	Affected landowner from whom lands were acquired	Moderate	• Impact on these families due to land acquisition.
Local Community	Primary	Primarily includes community residing adjacent to the project site including women and vulnerable households.	Moderate	• Receptor of potential air, water pollution and other environmental risks. • Potential beneficiaries of the infrastructural and other development activities. • Potential beneficiaries of business and job opportunities.
Squatters	Primary	Primarily includes families living in the project area without legal entitlements	Moderate	• Impact on these families due to relocation • Resettlement assistance expected to be provided
Women	Primary	Includes women residing villages around the project site	Moderate	• No major direct impacts on women community except the potential air, water and other environmental impacts. • Mostly, no major stake on households' income and decision making • Expected to be the beneficiaries of work opportunities.
Regulatory/Administrative Authorities & Agencies				
Dept. of Environment, Bangladesh, DoE	Primary	The Department of Environment is the primary government regulatory authority for Environmental protection in Bangladesh.	Urgent	• Government Regulatory agency to provide Environmental Clearance (EC) to the project based on evaluation and approval of Environmental Impact Assessment (EIA) study • Responsible for monitoring project's Environmental compliance throughout the project lifecycle.

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
Department of Agriculture	Secondary	Local governmental agency responsible for implementation of governmental agricultural activities.	Moderate	• Very scanty impact on total Upazilas' agriculture land and agricultural production. • No major potential impact is envisaged on rest of the agricultural land and production activities.
Department of Fisheries	Secondary	Local governmental agency responsible for implementation of governmental fisheries activities.	Moderate	• Very scanty impact on total Upazilas' fisheries and fish production. • Potential impact is envisaged on shrimp cultivation
Upazila Bit/Range Office of Forest	Secondary	Local government agency responsible for the protection and maintenance of forests and wildlife	Moderate	• Potential impact envisaged on the upazillas forest area
Political Administration				
Union leaders & local representatives	Secondary	Elected representative at union level	Moderate	• Plays important role in providing public opinion and sentiment on the project • Empowered to provide consent and authorization for establishment of project on behalf of the community

12.6 Information Disclosure, Consultation and Participation

Several consultation exercises were conducted during this phase of EIA study preparation. The stakeholders consulted include local people, community, farmers, fishermen, women, businessmen etc. in the vicinity of the project area, local elected representatives and other external stakeholders such as government officials. The details of consultations held, with issues raised or discussed and suggestions provided by the respective stakeholders, are well noted and incorporated in the EIA report.

A combination of mixed methods of information disclosure and consultation process was adopted at this stage of E&S study preparation. The method selected for consultation was basically designed keeping in mind the profile of the stakeholders, type of information desired and level of engagement required. In each consultation session, the consultant introduced themselves, introduced the project and the purpose of engagement with the respective stakeholder. The methods used in the consultation process were:

- Individual or Key Informant Interview (KII)
- Focus Group Discussion (FGDs)
- Public Consultation Meeting (PCM)

The consultation and information disclosure were held in a free and fair environment giving prior information about the same to the stakeholders. On all occasions the date, time and venue of the consultation was decided by the stakeholders keeping in view their prior engagement and availability.

12.6.1 Individual and Key Informant Interview (KII)

Individual and KII techniques have been used to disclose the information regarding this project during EIA exercise. During EIA preparation, KII has been conducted with the relevant authorities. The detail of the KII is presented in **Table 12-4**.

Table 12-4: Details of Consultations Held for the Project

Date	Stakeholder Details	Details of Participants	Issues Discussed/Raised	Response/Suggestions Made
19.10.2022	Department of Agriculture	Zubida Akter Sub Assistant Agriculture Officer Maheshkhali Upazila	• Understanding and Broad overview of the agricultural sector in Maheshkhali Upazila • Information on the cropping pattern in the area and agricultural practices, • Wage rate in agricultural labor • Crop varieties in the Sonargaon Upazila • Suggestions or recommendations for the proposed project	• Total agriculture land of the Maheshkhali Upazila is 11500 acres, whereas 2375 ha is single crop, 7945 ha is double crop, 225 ha is triple crop land. • Cropping pattern in the area are Aush, Aman, Boro; Vegetables, Fallow, Aman and Fallow, Fallow, Aman. • Wage rate in agricultural labor varies from season to season 700-800 tk. • Common agricultural products are Paddy, and vegetables such as radish, brinjal, cucumber etc. • Must monitor the activates to mitigate the environmental haphazard.
19.10.2022	Department of Fisheries	Md. Abdur Rahman Khan Senior Upazila Fisheries Officer Maheshkhali Upazila	• Role and responsibility of the local fisheries department; • Where is the primary fishing point located in and around Matarbari Union; • Details on the key species of fishes observed in Maheshkhali Upazila; • Type of fishing activities; • Changes in fishing patterns (if any) over the last 2-3 decades in the area; • Available fishing sanctuary in Matarbari Union; • Suggestions or recommendations for the proposed project	• The Fisheries Department is basically responsible for technology transfer and ensuring that all government regulations are followed, and schemes are implemented. • The primary fishing point located in and around Matarbari Union is the Bay of Bengal and Matamuhuri river • Various types of fishes including hilsha, shrimp, rui, aier, pangash etc. are the noteworthy fishes found in the natural water bodies in the project area • Fishermen uses traditional methods for fishing • Many types of fish are gradually becoming endangered;

Date	Stakeholder Details	Details of Participants	Issues Discussed/Raised	Response/Suggestions Made
				• There is no fishing sanctuary in Matarbari Union • Maintain ETP and the flow and temperature of the water bodies should not be disrupted.
19.10.2022	Upazila Bit/Range Office of Forest	Abul Kalam Azad Bit Officer Kalarmarchhara Bit Maheshkhali Upazila	• Are there any designated forest area/protected area/national park/wildlife sanctuary in the proposed project site? • Do you have any suggestions or comments or opinion that needs to be considered during the implementation of the proposed project?	• No designated forest area or protected area near the project site. • Project proponent must realize the importance of forestation and should not harm wild animals and bird species that contribute to environmental balance.
17.10.2022	Fire Service and Civil Defence	Pulok Kanti Sarker Station Officer Maheshkhali Upazila	• Safety instruction for the proposed project during construction period and operational period; • Do you think project staff need to get training regarding firefighting from you? If yes, how often?	• A safety plan provided from the Fire Service and Civil Defense which need to be complied during construction and operation period; • A safety officer needs to be appointed, • Emergency stair, fire light, fire pump needs to be powered from separate generator; • Project Staff and the labor of the project should take part in training which is mandatory. Twice in a year the management should arrange drill sessions with the help of Fire and Civil Defense. Awareness should build up among the adjacent people of the project location and the locality. Internal training must be ensured.
18.10.2022	Union Parishad	S.M Abu Haider Union Parishad Chairman	• Livelihood pattern of the union; • General perception about the project;	• Day Labor and salt/shrimp cultivation is the primary source of income for the majority of the people of the union.

Date	Stakeholder Details	Details of Participants	Issues Discussed/Raised	Response/Suggestions Made
		Matarbari Union	• Is any kind of NoC require for the project? • How will the new coal-based power plant impact your area? • Is there have any possibility of social conflict during the implementation of the project? • Are there any specific development projects in the pipeline? • Any specific programs for women and vulnerable groups? • Expectations, suggestions and recommendations for the proposed project	• Positive view regarding this new coal-based power plant project as this will create employment opportunities and contribute to the overall development of the area; • NoC is required for the project from the Union Parishad; • The new power plant can increase local people engagement in both construction and operation phase according to skills and qualification; • As a union we have very friendly relationship with everyone, and local representatives are very much cordial; • There are no specific development projects in the pipeline; • There are no programs specifically for women or vulnerable groups; • The project proponent can donate in schools and mosques; • Proponent should give priority to local people and project affected person for employment during construction and operation phase.

12.6.2 Focus Group Discussion

FGDs are important when gauging with a group of stakeholders on issues related to the project activities. FGD has been used to understand the needs, perceptions, and concerns of the group. The discussion also gave space for the members to voice their concerns and suggestions. During EIA preparation, FGD with various groups including women and affected people were conducted.

A total of ten (10) focus group discussions were held with different group of local people. The focus group discussions were conducted as part of the consultation purpose. The participant detail is presented in **Table 12-5**. A summary of the FGDs is provided in the following sections. Attendance and Photographs of FGDs are shown in **Appendix J-1** and **Appendix K-1**. The discussions were designed to gather information from the participants regarding the following outcomes:

- To understand about their general perception and the status of their awareness about the proposed project
- To know about their expectations from the project proponent
- To understand about the potential threats and benefits associated with this project

Table 12-5: Participant Details of Focus Group Discussion

S/N	Date	Location	Participants	Category of participants
1.	16/10/2022	Purba Para (Ward 2), Matarbari, Cox's Bazar	10	Local Fishermen
2.	16/10/2022	Bandi Sikdar Para (Ward 2), Matarbari, Cox's Bazar	07	Local Saltpan Workers
3.	17/10/2022	Baniakata, Matarbari, Cox's Bazar	07	Local Salt/Shrimp Cultivators
4.	17/10/2022	Bandi Sikdar Para (Ward 2), Matarbari, Cox's Bazar	05	Local Drivers
5.	17/10/2022	Baniakata, Matarbari, Cox's Bazar	12	Local Women-1
6.	18/10/2022	Uttar Sikdar Para (Ward 2), Matarbari, Cox's Bazar	07	Local Women-2
7.	18/10/2022	Uttar Sikdar Para, Matarbari, Cox's Bazar	07	Local Businessmen
8.	18/10/2022	Uttar Sikdar Para, Matarbari, Cox's Bazar	11	Local Community-1
9.	20/10/2022	Bandi Sikdar Para, Matarbari, Cox's Bazar	08	Local Community-2
10.	04/03/2023	Uttor site para, Sagarpar, Matarbari	10	Squatters

12.6.2.1 Summary of FGD

The FGD were conducted with different groups to understand their views about the project, expected impact and benefit. The following tables shows the summary of the FGDs.

Table 12-6: Summary of Discussion with Local Fishermen

Issues Discussed	Participant's Opinion, comments, and Suggestions
Production Rate	300-400 mann per 200-300 acres in a year.
Availability of labors and their monthly wages.	Labors are available and their monthly wages varies from 8000-12000 BDT.
Issues of Women Employment (Number/ Percentage, Wage disparity)	The majority of the women in the project area are unemployed. The are working at home as housewife.
Do you anticipate any issues arising as a result of the project's construction and operation activities? Or Any criteria you would recommend considering during project design, construction and operation stage?	The local fishermen anticipates that the project's construction and operation activities might create disturbance to the adjacent water resources. They suggested the project proponent to protect the water resources so that their fishing activities remain uninterrupted.
During the construction of the coal-based power plant, there may be an influx of workers living temporarily in the area. Do you think they will create any conflict with local people and vice versa?	According to the local fishermen, the influx of workers will not create any conflict with local people and vice versa.
General perception of local fishermen about the proposed project	The participants anticipated that the proposed project would raise the value of the land in the area.
Expectations from the project proponent	Local people should be given preference in terms of employment prospects. During the discussion, local fisherman also suggested that they should be given opportunity to apply for work at the plant depending on their ability.

Table 12-7: Summary of Discussion with Local Saltpan Workers

Issues Discussed	Participant's Opinion, comments, and Suggestions
Salt Production Rate	Salt production in the area is approximately 500/550 mann per acre.
Selling Price of Salt	Approximately 1000 tk per mann
Seasonal Variation in Production	Mid November – Mid May (Agrahayan – Baishakh)
Availability of labors and their monthly wages.	20000 – 25000 BDT per month with meal facility and 30000 – 35000 BDT per month without meal facility.

Issues Discussed	Participant's Opinion, comments, and Suggestions
Total number of salt pan worker in the project site	Approximately 205 workers
Do you anticipate any issues arising as a result of the project's construction and operation activities? Or Any criteria you would recommend considering during project design, construction and operation stage?	The project site land already acquired. However, the project site is currently being used for salt cultivation since there is no construction activities yet. They anticipated that they would have to shift to other location once the construction of the project is started.
Expectations from the project proponent	They expect that the project proponent will adequately compensate them for the loss of their livelihood. Local saltpan laborers should be given preference in terms of employment prospects.

Table 12-8: Summary of Discussion with Local Shrimp Cultivators

Issues Discussed	Participant's Opinion, comments, and Suggestions
Shrimp Production Rate	Shrimp production in the area is approximately 15 to 20 per acre.
Selling Price of Shrimp	Approximately 600-700 tk per kg
Seasonal Variation in Production	Mid May – Mid November (Jayashtha – Kartik)
Availability of labors and their monthly wages.	20000 – 25000 BDT per month with meal facility and 30000 – 35000 BDT per month without meal facility.
Total number of workers in the project site for shrimp culture	Approximately 15-20 workers
Do you anticipate any issues arising as a result of the project's construction and operation activities? Or Any criteria you would recommend considering during project design, construction and operation stage?	Participants anticipated an increase in dust and noise as a result of the project's construction and operation activities. As a result, they would want dust suppression and noise reduction be taken into account. They also suggested the project proponent to protect the water resources so that their fishing activities remain uninterrupted.
During the construction of the coal-based power plant, there may be an influx of workers living temporarily in the area. Do you think they will create any conflict with local people and vice versa?	According to the saltpan/shrimp laborers, the influx of workers will not create any conflict with local people and vice versa.

Issues Discussed	Participant's Opinion, comments, and Suggestions
General perception of local fishermen about the proposed project	The participants anticipated that the proposed project would increase the value of the surrounding land.
Expectations from the project proponent	Local saltpan/shrimp laborers should be given preference in terms of employment prospects.

Table 12-9: Summary of Discussion with Local Drivers

Issues Discussed	Participant's Opinion, comments, and Suggestions
Common secondary occupation for drivers	Salt/Shrimp Laborers
Types of vehicles available in the area	Easy bike, Motorcycle, Truck, Pickup van etc.
Common Travel Route	Shikdarpara, Notunbazar, Rajghat
Daily average income	Approximately 800 to 900 BDT
General perception of local drivers about the proposed project	The participants anticipated that the proposed project would raise the living standard of the area.
Expectations from the project proponent	When it comes to job opportunities, locals should be given preference. They also suggested that they be allowed to apply for jobs at the plant based on their skills. They also asked that the project's proponents invest in road development because local roads are in poor condition.

Table 12-10: Summary of Discussion with Local Women

Issues Discussed	Participant's Opinion, comments, and Suggestions	
	Local Women Group-1	Local Women Group-2
Livelihood pattern of women in the project area	The majority of women are involved in household activities.	
Do women own land here? What are the uses of the land?	The participants stated that there are no female landowners in the community.	
Level of education of women in the village	The majority of the women in the village are uneducated. Few of them know how to write or sign their names.	Previously, most women were uneducated, but this is gradually changing. Many girls are currently enrolled in primary and secondary schools.
Child Mortality Rate and Child Marriage Rate	According to local women, the area's child mortality rate is high,	According to local women, the area's child mortality rate is

Issues Discussed	**Participant's Opinion, comments, and Suggestions**	
	Local Women Group-1	**Local Women Group-2**
	while the rate of child marriage is very low.	high, while the rate of child marriage is very low.
Do women in this village take part in any community level decision making activity?	In this village, the women do not take part in any community level decision making activity.	Women of this village sometimes take part in community level decision making activities.
Do women in this village face Gender based violence (GBV)?	The participants stated that women do not face Gender based violence (GBV) in the community.	
Are there any special health care facilities for women in the village?	No special health care facilities for women in the village. Female patients are often attended by the male doctors.	
What all can be seen as potential employment opportunities for women? What kind of support (in the form for training, skill development activities, infrastructure) can help?	As per the local women, sewing can be a potential employment opportunity for them. They wish to get support and develop their skills in the form of training.	As per the local women, poultry farming and sewing can be a potential employment opportunity for them. They wish to get support and develop their skills in the form of training.
During the construction of the coal-based power plant, there may be an influx of workers living temporarily in the area. Do you think they will create any conflict with local people and vice versa?	According to the local women, the influx of workers will not create any conflict with local people and vice versa.	
Expectations from the project proponent	They requested the project proponents to invest in improving healthcare facilities for women. They also mentioned providing various types of training to women in the project area.	

Table 12-11: Summary of Discussion with Local Businessmen

Issues Discussed	**Participant's Opinion, comments, and Suggestions**
Types of Business in the area	Salt and shrimp Business, Poultry, Small Shops etc.
Trend of Business (changes in the last few years)	Profit/ Income decreasing from the last few years.
Availability of labor, goods or other facilities	Labor and goods are available in the area.
Any association of Businessman in the area	No association of Businessman in the area

Issues Discussed	Participant's Opinion, comments, and Suggestions
Any women employed in the business?	There are no women employed in the business.
During the construction of the coal-based power plant, there may be an influx of workers living temporarily in the area. Do you think they will create any conflict with local people and vice versa?	According to the local communities, the influx of workers will not create any conflict with local people and vice versa.
Expectations from the project proponent	Locals should be given priority in terms of any contracting or small business opportunities. During the discussion, local fisherman also suggested that they should be given opportunity to apply for work at the plant depending on their ability.

Table 12-12: Summary of Discussion with Local Community

Issues Discussed	Participant's Opinion, comments, and Suggestions
Livelihood pattern of the community	Majority of the people are dependent on salt and shrimp cultivations and fishing activities.
Livelihood pattern of women in the project area	Most of the women in the area are engaged in household chores.
General perception about the proposed project	The participants expected that the proposed project would increase the value of the surrounding land.
What are the characteristics of the lands those are going to be taken for the proposed project?	The landscape of the project site is salt pan and shrimp cultivation
Are there any protected areas (national parks, protected forest, religiously sensitive sites, historical or archaeological sites) within 2 Km from here?	As per the locals, no protected areas (national parks, protected forest, religiously sensitive sites, historical or archaeological sites) within 5 km from the project site.
Does any indigenous or tribal community live in and around the project site who may be affected by the project intervention?	According to the locals, no indigenous or tribal community live in and around the project site who may be affected by the project intervention
Do you anticipate any issues arising as a result of the project's construction and operation activities? Or Any criteria you would recommend considering during project design, construction and operation stage?	Participants anticipated an increase in dust and noise as a result of the project's construction and operation activities. As a result, they would want that dust suppression and noise reduction be taken into account.

Issues Discussed	Participant's Opinion, comments, and Suggestions
During the construction of the coal-based power plant, there may be an influx of workers living temporarily in the area. Do you think they will create any conflict with local people and vice versa?	According to the local communities, the influx of workers will not create any conflict with local people and vice versa.
Expectations from the project proponent	Locals should be given preference when it comes to job opportunities. During the discussion, the locals also suggested that they be given the opportunity to apply for work at the plant based on their abilities. They also requested that the project's proponents invest in road development because local roads are in bad condition.

Table 12-13: Summary of Discussion with Squatters Living in the Project Area

Issues Discussed	Participant's Opinion, comments, and Suggestions
Basic profile of the squatters	There is total 9 HHs living at this area as squatters, who don't have any legal rights of land ownership. They are living here more than 20 years.
Availability of land parcels	They don't have any land parcels of their ownership
Livelihood pattern of women in the project area	Most of the women in the area are engaged in unpaid household activities.
Livelihood pattern of the community	The majority of people rely on salt and shrimp cultivation, as well as fishing and day labourer.
Do you anticipate any issues arising as a result of the project's construction and operation activities?	They will be relocated due to the intervention of the project. They seek resettlement assistance during their relocation process.
During the construction of the coal-based power plant, there may be an influx of workers living temporarily in the area. Do you think they will create any conflict with local people and vice versa?	According to local communities, the influx of workers will not cause conflict with locals and vice versa.
Expectations from the project proponent	Locals should be given preference when it comes to job opportunities. During the discussion, the locals also suggested that they be given the opportunity to apply for work at the plant based on their abilities. They also requested that the project's proponents invest in road development because local roads are in bad condition.

12.6.3 Public Consultation Meeting/Stakeholder Consultation Meeting

A public consultation meeting is a process that involves the public in providing their views and feedback on a project to consider in the decision making. Two public consultation meetings were conducted during the EIA preparation of which one was conducted during scoping stage and another one on draft EIA report as disclosure.

The first public consultation meeting held on 11 December 2022 at Notun Bazar Kindergarten School, Matarbari, Maheshkhali, Cox's Bazar. A total of 79 people were presented in the meeting from different groups. Details of the meeting is as follows.

12.6.3.1 Overview of the Meeting

The objective of the meeting was to inform and obtain opinions of the public regarding the proposed 635 MW coal-based power plant, its potential environmental impacts and mitigation measures. The stakeholders and public were invited through invitation letters hand to hand. A list of stakeholders and the representatives of the project implementation authority who were present at the meeting are given at **Appendix J-2**. Photographs of the meeting are shown in **Appendix K-2**. Health and safety measures considering the COVID19 pandemic have been taken for the PCM including body temperature measurement, hand sanitizing and mask distribution upon arrival of participants at the venue. A total of 79 person (all were male) participated in the meeting, including day labourer (31), Businessman (21), Community Leader (5), Service holder (5), Teacher (4), Engineer (3), Salt Worker (3), Farmer (2), Driver (2), Student (1) and Others (2). Mr. Abu Hayder, Chairman, 1 No. Matarbari Union Parishad was present in the meeting as chief guest. Mr. Abduhu Ruhullah, Director, Energy and Power of Orion Group presided over the meeting.

12.6.3.2 Opening of the Meeting

The meeting was opened by reciting from the Holy Quran by a local Qari Faysal Islam. Then Mr. Mehedi Islam Aneek, Vice President- Orion Power welcomed all participants and briefly explained the objectives and agenda of the meeting. He emphasized that this meeting is strategically important. Also, stated that the project will take 3-4 years to operate and will run for about 25 years and in this span of time they want to work together with the local people. He also shared about the story of the Orion Group that has been started business here in Bangladesh in 1980's and till now they have installed six (6) power plants in the country. He said, this 635 MW power plant at Matarbari will be a coal based thermal power plant.

He added that we need development as well as we must be concerned about our environment. That's why we are going through a detailed Environmental Impact Assessment study that helps us to find out the most possible impacts and mitigation measures that should be taken to protect our lovely environment. This study will be done by EQMS Consulting Ltd.

He also stated that in this project international standardized advanced technology and modernized machineries will be used for the sack of our environment that have minimal impact to the nature and subsequently that will help to keep pace with our socio-economic status and improved lifestyle. He said that all are cordially invited to ask any questions to us regarding this project and the floor will be opened for all after the presentation about the project.

12.6.3.3 Presentation

The presentation began with Mr. Tauhidul Hasan, Principal Consultant of EQMS Consulting Limited, expressing a sincere greeting to the participants. In order to put the project in the context of the demands of the current days, he outlined some essential aspects.

The world is currently experiencing a fuel shortage, he continued, as a result of the war in Russia vs Ukraine's immediate aftermath, which has made the power and energy crisis worser than ever. In order to produce electricity during this crisis, coal may be one of the suitable options. Because of this, the majority of nations have restarted coal-based power plants once again to provide the essential electricity to their country. Our government also decided to take the opportunity to produce electricity from coal.

After that, Mr. Hasan highlighted about the proposed project that are listed below:

- Background and Objectives
- Project Location
- Scope of the project
- Basic Information of the project
- Lay out and main part of the project site
- Draft diagram of a coal based thermal power plant
- Land use Summary of the project
- Physical Environment (Meteorology, Geology, Topography, Seismology, Hydrology)
- Baseline information of the environment in terms of Air Quality, Noise Quality, Surface Water Quality, Ground Water Quality, Soil Quality, Ecology and Biodiversity etc.
- Socio-economic Environment
- Land Acquisition and Social Survey
- Positive and Negative Impacts of the proposed project
- Environmental and Social Impacts during construction phase
- Environmental and Social Impacts during operation phase
- Project Schedule etc.

In concluding remarks, he said that EIA study is still ongoing and after completing the study with different scientific and technical modelling, findings of potential environmental and socio-economic impacts of the project will be shared. The presentation of 1st public consultation meeting is shown in the **Appendix L**.

12.6.3.4 Question and Answer Session

After the presentation, a question-and-answer session were held, which is summarized in **Table 12-14**. While many questions and opinions were raised by the participants, once their concerns were answered, nobody expressed any objection towards the Project. Mr. Abduhu Ruhullah, Director, Energy and Power of Orion Group and Mr. Mehedi Islam Aneek, Vice President- Orion Power answered all the questions.

Mr. Ruhullah started answer giving session after getting all the questions from the participants. At start, he gave some overall summary and objectives of the project then answered the questions one by one. Mr. Ruhullah mentioned that the project will be developed by OPDL-2 as Independent Power Producer. Ultra-super critical technology will be used for this project which has less environmental impact. He also mentioned that the surrounding environment will be examined first. Later, during construction and operation stages environment degradation will be prevented by considering all the environmental parameters. Then both started to answer the question one by one.

Table 12-14: Summary of Question-and-Answer Session of PCM

No	Name	Question/Opinion	Answer
1.	Md. Alauddin, (Member, Matarbari Union Parishad)	He asked which types and how many vehicles will commute through the access road and how will you assess whether the access road is accessible or not? Secondly, he asked how the socio-economic improvement will be ensured in the community who lived close to the project site. As we know, the majority of the people who give their land to the govt. are earning their livelihood by producing salt and fish in their land and what will be the ultimate fate of their occupation?	Mr. Mehedi Islam Aneek answered that large and medium types of vehicles will commute through the access roads regularly as the construction period will be more than 3 years and the project will run up to 25 years. In this regard, we will pursue with respective authority as to ensure the accessibility of the roads for all kinds of vehicles regularly. Most importantly, the approach road from the main road to the project site will be developed by own finance of Orion Power Unit-2 Dhaka Limited. In response to the second question, Mr. Aneek added that we need technical person as well as unskilled person for the project and if any applicant has that much skill and quality for those positions then definitely, they will get priority for those position in this project. Apart from this a new community will develop here due to this project, their accommodation will be established where a lot of people can engage themselves to build their accommodation and many more work positions will be generated for the sake of this project. We will engage the local people here on a priority basis. Thus, the whole economy of this area will surely be raised.

No	Name	Question/Opinion	Answer
2.	Mr. Md. Abu Bakkar Siddik, (Businessman, Matarbari)	He said everyone assured us that they will prioritize us in term of employment, unskilled works and so on. But at the end of the day, the scenario is not as much as their assurance. We gave everything for the fulfillment of the project. We gave our agricultural land, Salt production land, fish production land, our occupation and everything for the Matarbari project. He added, at the earlier project here in Matarbari the govt. said they will prioritize us, but they didn't. We are requesting please do some favor to us. Just not say that you will priority us in terms of employment and unskilled jobs, implement this priority in the community level.	Mr. Mehedi Islam Aneek answered that as stated earlier the local people and project affected person will get job as per their skill. Besides, the local people will get benefited by renting the house, business and supply the different goods during both construction and operation phases of the project.
3.	Mr. Md. Rafikul Islam (Assistant Teacher, Matarbari High School)	He said that this coal based thermal power plant will surely imbalance of the ecosystem here in Matarbari. But we the people of Matarbari gave our land, occupation and so on for the nation needs. In return we get less amount of money which is not enough for us to survive. If we want to develop the social condition of a community, we must ensure their economic growth first. But unfortunately, we deprived of employment, unskilled/skilled workers and other opportunities in the ongoing project in Matarbari. We have many day-laborer in Matarbari. Hence, we are requesting to engage local people as much as possible.	Mr. Abduhu Ruhullah in response to this question said, the Orion family believe that we will ensure your priority in any kinds of opportunities here in this project in construction and operation phases. We also planned to establish a health care center and a school for the people of the community in Mtarabari. We think we will be able to ensure the improvement of the socio-economic condition of this area following a proper management approach.
4.	Mr. Abdul Khaleq (Member, Matarbari Union Parishad)	He added that as far as I know this is a priority project of our country. I would like to say that you should look forward to the sanitation system of the project area as a priority basis. He also stated that we gave our all for this project. We hope project developer will provide opportunity to work of the local people.	OPDL-2 will ensure the job opportunity of the local people as much as possible. Proper sanitation facility will be provided in the labor camp. Hence, the pollution to the surrounding can be accessed as low.

No	Name	Question/Opinion	Answer
5.	Mr. Abu Hayder, Chairman 1 No. Matarbari Union Parishad	He started his speech by delivering greetings to all the guests and the audience. We are lucky enough that we have been able to increase the land price due to the new act. Also, the land price of the Matarbari area has been increased due to the Matarbari 600X2 MW power plant construction. It is noted that we are not getting any other opportunity in the earlier project here in Matarbari Power Plant. The salt cultivation is being carried out on the acquired land for proposed power plant and it will take more than 3-4 months for getting salt in next season. Hence, we are requesting to hold the construction work up to this time. Also, it is suggested to demark the proposed power plant boundary line. He also added that people are losing opportunities in terms of employment. Hence, land and livelihood looser due to the project must be given higher priority during project construction and operation. Also, there are enough qualified unskilled/ skilled workers, day labor, security guard and so on candidates in Matarbari. So, OPDL-2 should prioritize them for employment. We are very eager to accelerate this development project and work with you in the coming days.	Mr. Ruhullah said that we want to work for the project along with local people. We will start our construction work 3-4 months later and with minimal effect on salt production. We believe we will be able to work in collaboration with local people and ensure a good relationship with all. This project will be developed by OPDL-2 which is an Independent Power Producer). Hence, we will try our level best to prioritize the PAPs and local people in the most possible options.

12.6.3.5 Speech by the guest and Closing of the Meeting

Mr. Abu Hayder, Chairman 1 No. Matarbari Union Parishad delivered speech as a chief guest. Then Mr. Abduhu Ruhullah, Director, Power and Energy, Orion Group made a short speech after question-and-answer session and also made the conclusive speech and declared the closing of the meeting. At the end, the participants were entertained with refreshment snacks.

12.7 Stakeholder Engagement Plan

Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively. They can comprise individuals, communities, social groups, organizations etc. It is often observed that the poor and the marginalized are often ignored either due to the fact that they are unaware or do not have a forum to voice their opinion.

The purpose of the Stakeholder Engagement Plan (SEP) is to ensure that the direct and indirect impacted stakeholders of the project are regularly apprised of the project activities. The plan has been developed in order to draw out an outline wherein the communication process associated with the activities of the project cycle is to be undertaken.

Communication Methods

Stakeholder engagement becomes a successful exercise when proper and participatory communicative methods are used. This ensures that the stakeholders are kept engaged and well informed of the project development at every stage. A combination of communicative methods is usually used to engage with the stakeholders. To determine which option is best suited to the various stakeholders, a benefit analysis of each option has been carried out. The communicative methods are:

- General Information consisting of the project's various activities, the operation stage and impacts that might arise shall be made available:
    i. on information board of OPDL-2's site office
    ii. on OPDL-2's website
    iii. in local newspaper
- Detailed information including documents like EIA report; Environment, Health & Safety and Social Policy, Environment Management Plan, Social Management Plan including environmental decisions shall be in hard copies and disseminated to:
    i. OPDL-2's site office
    ii. An electronic version of these documents will be made available at OPDL-2's website.
- In addition to this, a host of tools and techniques can be adopted to engage with the stakeholders in a transparent and accountable manner. Below a list of the tools and techniques which can be adopted are mentioned:
    - Public Meeting: This tool can be used to disclose information on a large scale involving the stakeholders of a particular village. A schedule of the meeting can be circulated well in advance and discussions can involve feedback session from the stakeholders. The meeting can be conducted on the premise of the village school for proximity and familiarity purposes.
    - Focus Group Discussion (FGDs): FGDs are important when gauging with a particular group of stakeholder on issues related to the project activities. It can be used to understand the needs, perceptions and concerns of the group. The discussion will give space for the members to voice their concerns and suggestions.
    - Participatory Workshops: Participatory workshops are meetings which enable local people to analyze, share and enhance their knowledge to plan, manage and evaluate development projects and programs. Visual aids – such as mapping, videos, illustrations, timelines, card sorting and ranking, Venn diagrams, seasonal calendar diagramming and body maps are often used in participatory workshops to engage participants and capture knowledge.
    - Participatory Rural Appraisal (PRA) Techniques: PRA techniques are usually adopted to emphasize local knowledge by enabling local people to make their own appraisal, analysis and plan. PRA uses group animation and exercises to facilitate information sharing, analysis and action among stakeholders. This process can be useful when the project proponent initiates any developmental activities in the area and uses the local knowledge to plan and strategies so that they feel responsible for delivery of the objectives.

The communicative methods that shall be adopted for each stakeholder have been provided below **Table 12-15**.

Table 12-15: Communicative Method of Stakeholder Engagement

Sl.	Stakeholder	Communication Methods	Frequency	Monitoring Indicators
1.	**Community** (Affected persons if any, vulnerable groups, farmers, fisherman, community adjacent project site, Local Workers and Labourers)	• Verbal Communication • Information Board of OPDL-2's site office • On OPDL-2's website • Local Newspaper • Public Meeting	Quarterly	Meeting Minutes
2.	**Government Authorities** (DC, DoE, Department of Agriculture, Department of Fisheries, Forest Department, Department of Education, DPHE, LGED, DSW, Other Regulatory & Permitting Authorities)	• Information meetings and consultations • Permits and Approvals	Need Basis	Report/ Meeting Minutes
3.	**EPC/Developers**	• Meetings with contractors and their respective managers • Training/ Workshops	Need Basis	Report/ Meeting Minutes
4.	**Financiers**	• Reporting • Direct Meeting	Need Basis	Report/ Meeting Minutes
5.	**Direct Employees** (Migrant Workers and Labourers and Other employees)	• Internal meetings of direct employees and managers • Day to day contact • Training/Workshops	Need Basis	Meeting Minutes

12.7.1 Stakeholder Engagement Program

The consultation with the stakeholders will be conducted with the EHS Officer/Grievance officer/Community Liaison officer who will also look at the social aspects and work in collaboration with the nominated (Grievance Officer) and Site Supervisor (Developer) and at the site level. Any grievances from the community relating to any issues that might arise from the project activities will be managed by the nominated Grievance Officer based at the Site Office. All grievances will be addressed to the developers during the construction and operation phase. For any unresolved grievances and grievances related community health and safety, livelihood status of the affected persons, the developer will forward the grievances to OPDL-2 who in turn will subsequently forward them to the appropriate authority for redress.

Consultations with the government agencies will be conducted as per the schedule that will be created with the Site Supervisor of the Developer and Project Manager of OPDL-2. These stakeholders will be informed in advance of the planned project activities. The development of the facilities will be based on the EIA procedures and mitigation issues once an EIA study has been completed.

Consultations with the primary stakeholders will involve meetings, information boards announcements and an Intranet system to appraise the direct employees of Developers regarding the procedures of emergency response system, incident/accident reporting, grievance redress mechanism, Human Resources Policies and Procedures, welfare measures etc. In addition, communication of general employment conditions, company's code of conduct for the work site, EHS concerns, use of PPEs, information and awareness about the requirements of labour laws and minimum wages, working hours, grievance redress, retrenchment process etc. should also be conducted with workers engaged with contractors.

Project related information will be posted on the informational boards at the site office as well as at the corporate level. Information on the project milestones will be published in advance on the company's website to be available for the public and non-governmental organizations in the area to comprehend the attitude of the secondary stakeholders. In addition, the company will publish information on the project in the local newspapers.

In turn, if any issues are raised by the stakeholders, the project proponent management comprising of the Grievance Redress Committee at the Site Level will respond accordingly in the shortest possible time. Details of which have been provided in the Grievance Redress Mechanism section of the report.

The responsibility for the SEP implementation will be held by the EHS Officer/Grievance officer/Community Liaison officer, and he will be supported by Project Manager (OPDL-2), Site Supervisor (Developer) and EHS Manager (Developer) and nominated Grievance Officer at the site level.

A summary of the consultation activities that the project proponent shall undertake as part of the engagement plan pertaining to the villages around the project area and other stakeholders have been provided in **Table 12-16**.

Table 12-16: Consultation Activities Summary

Stakeholder	Information to be shared	Proposed timeline	Responsibility
Affected persons if any, vulnerable groups, farmers, fisherman, community adjacent project site, Local Workers and Labourers	• The progress of the work under each phase. • Information on job opportunities • Tenders for petty contractors and vendors • Local Area Development Activities • Grievance Mechanism	Ongoing process throughout the Project	Project Manager and Local Leaders (chairman/ word members) of the villages.
Government Authorities	• Permits and Approvals • Grievances related to land issues and unresolved grievances • Environment Monitoring reports	Ongoing process throughout the project	Project Manager
Direct Employees	• Training on dealings with local communities • Grievance Mechanism	Ongoing process throughout the project	• Developers: Site Supervisor • EHS Manager & Admin Officer
Contractors (Third Party)	• Training on dealing with local communities • Other EHS training	Ongoing process throughout the project	EHS Manager & Site Supervisor

Stakeholder	Information to be shared	Proposed timeline	Responsibility
Lenders	• Information on project status • Submission of annual reports, information on any project-related events that could potentially create an increased risk of the project	Ongoing process on a permanent basis	Project Manager and a designated person from OPDL-2

The stakeholder engagement process should be carried out at two levels, namely, local community and local governing bodies. A summary of the proposed plans that are to be initiated by the developer(s) and OPDL-2 have been described below in **Table 12-17** below.

Table 12-17: Proposed Plan Activities Summary

Sl.	Key Stakeholders	Proposed Plan of Activities
1.	Positively Influenced Stakeholders/ Local Communities	• The announcement of vacancies (skilled/unskilled) at proposed site; • The announcement of contract work for small-scale work associated with the proposed project; • Local area development activities as per OPDL-2 of action for community development; • Consultation with village people/local government about the movement of heavy vehicles; • Information on route and timing of vehicle movement to be provided to village administrations; • Set up a grievance redress mechanism and inform the community about the procedure; and • Discuss the management plan with the community and incorporate the comments.
2.	Local Governing Bodies	• Compliance with legal requirements; and • Involvement of various Local Area Development Activities.
3.	Lenders	• Compliance with International Guidelines (World Bank Operational Policies, IFC Sustainability Framework& other national and local legal requirements) • Regular Reporting

It is to be noted that the proposed plan of activities relating to the stakeholder engagement can change as per the future planning of activities by Developer(s) and OPDL-2.

12.7.2 Monitoring and Reporting

12.7.2.1 Monitoring

Monitoring of project activities is necessary to cater the stakeholder's concerns by ensuring transparency in guaranteeing the project proponent's commitment to implementing the mitigation measures that address the environmental and social impacts arising from the project.

Through this information flow, the local stakeholders will feel the sense of responsibility for the environment and welfare in relation to the project and feel empowered to act on issues that might affect their lives.

Internal monitoring of project related activities, as well as associated activities involving the local communities, should be contemplated upon on a regular yearly basis (by identified staff from the corporate level) to bring in openness in OPDL-2's commitment. In addition, external monitoring of a company's environmental and social commitments can strengthen stakeholder engagement processes by increasing transparency and promoting trust between the project and its key stakeholders.

OPDL-2 should undertake a commitment to undertaking internal audits once every quarter. All related information shall be readily maintained at the site office and produced at the time of the audits.

Audit reports shall be accordingly created after every quarterly audit and submitted to Project Manager of OPDL-2. All records of these reports shall be maintained at the site office as well as the corporate Office. In addition, an external auditor shall be engaged every biannually to assess the activities of the project and its mitigation measures. The auditor shall accordingly submit a report to the company for review, and this should be forwarded to the lender financing the project as well.

12.7.2.2 Reporting

Performance of developers and OPDL-2 will be reviewed yearly against the Stakeholder Engagement Plan. The report will include, but not be limited to, the following:

- Informative materials disseminated, its types, frequency, and location;
- Place and time of formal engagement events and level of participation;
- Activities of community welfare undertaken;
- Feedback on Local Area Development initiatives;
- Other interactions with the community; and
- Numbers and types of grievances (both from the community and workers) and the nature and timing of their resolution.

12.8 Grievance Redress Mechanism

Grievance Redressal Mechanism (GRM) is an important criterion for development projects wherein ongoing risks and impacts of projects are expected. The GRM provides an approach to reduce risks for projects, offer communities and workers an effective means for expressing concerns and achieving solutions and promote a mutually beneficial relationship. It is an important tool through which the affected community and workers' concerns, and complaints are registered and addressed. This mechanism is a significant pillar of the stakeholder engagement process as it creates opportunities for the project proponent and communities to identify problems and determine solutions together. The mechanism tends to meet the requirements of stakeholder engagement process, prevent and address community and workers' concerns, reduce risk, and assist the processes that create positive social change. A well-functioning grievance mechanism contains the following elements:

- Provides a predictable, transparent, and credible process to all stakeholders, resulting in outcomes that are seen as fair, effective, and lasting;
- Builds trust as an integral component of broader community relation activities and between employees;
- Enables more systematic identification of emerging issues and trends, facilitating corrective action and community engagement.

The GRM prepared by OPDL-2 has been developed with an intention of it being an effective tool for early identification, assessment, and resolution of complaints during project implementation. It is a means through which acceptance, assessment, and resolution of community and workers' complaints concerning the performance or behavior of the project proponent, its contractors, and employees are ascertained and addressed. The prepared GRM would be implemented to the entire life cycle of the project prior to the construction phase.

12.8.1 Grievance Mechanism Principle

Grievance Mechanism would respond to the project needs if they are developed early in the project cycle as a measure to anticipate rather than respond to the rise of apprehension with surrounding communities. As per WBG's Good Practice Note on Addressing Grievances from Project-Affected Communities, September 2009, five principles have been recommended to ensure that the mechanism becomes acceptable to the communities. The five principles relate to:

- Proportionality: A mechanism scaled to risk and adverse impact on affected communities
- Cultural Appropriateness: Designed considering culturally appropriate ways of handling community concerns
- Accessibility: Clear and understandable mechanism that is accessibility to all segments of the affected communities at no cost
- Transparency and Accountability: To all stakeholders
- Appropriate Protection: A mechanism that prevents retribution and does not hinder approaches to other remedies

12.8.2 Approach to Grievance Redressal

Grievance Redressal has three interlinked steps. The steps are provided in the following:

- A risk-based assessment of potential grievances, disputes, or conflicts that may arise during project preparation and implementation
- Identification of the client's existing capacity for grievance redress
- An Action Plan that identifies priority areas for strengthening grievance capacity, or if necessary, establishing new mechanisms at the project level.

12.8.3 Process involved in Effective Grievance Management

Effective grievance management encompasses a step-by-step process that is necessary along with competent personnel for proper completion of grievances handled. WBG's Good Practice Note on 'Addressing Grievances from Project Affected Communities' highlights five steps that would be considered in implementing an effective grievance mechanism. The five process steps have been detailed in the following,

- **Publicizing Grievance Management Procedures:** An effective grievance mechanism can be determined by how popular and approachable it is to the stakeholders. By publicizing the grievance mechanism in line with the cultural characteristics and approachability factor, the success of its acceptability can be determined among the stakeholders.
- **Receiving and Keeping Track of Grievances:** Once publicizing the grievance mechanism is undertaken the project proponent would have the capacity of collecting grievances, recording, registering, and tracking them throughout the processing cycle to reflect their status and important details.
- **Reviewing and Investigating Grievances:** A successful grievance mechanism reflects the transparency and speed by which it records, registers, and addresses the grievances.
- **Developing Resolution Options and Preparing a Response:** Once acknowledgment and understanding of the grievances is done, resolution options to commensurate with the nature of grievances by considering community preferences, project policy, past experiences, current issues, and potential outcomes are to be developed.
- **Monitoring, Reporting, and Evaluating a Grievance Mechanism**: The tools of monitoring and reporting are important components for measuring the effectiveness of the grievance mechanism. Monitoring helps identify common or recurrent claims that may require structural

solutions or a policy change, and it enables the project proponent to capture any lessons learned in the resolution of grievances.

12.8.4 Grievance Mechanism Development and It's Requiring Steps

The Developers/EPC while developing the Grievance Mechanism are required to adhere to the following steps:

12.8.4.1 Development of Procedures

The developers/EPC must ensure that procedures for registering and addressing grievances are in place before implementing the plan at the site level. These procedures should include identifying personnel (Grievance Officer at the Site level) responsible for receiving and addressing grievances at the site level and handling cases at the escalation level. The developed procedures should also include assessment and decision-making processes, appropriate time frames for each step in the grievance resolution process, and notification procedures to the complainant about eligibility, assessment results, and proposed settlements.

12.8.4.2 Develop Resolution Options and Response

After creating procedures, Developers/EPC should also create options for resolving grievances, both formally and informally, and prepare responses accordingly. General approaches to grievance resolution many include proposing a solution, reaching a resolution through discussion or negotiation, using the third party to either informally or formally resolve the matter through mediation and through traditional and customary practices.

12.8.4.3 Publicize the Grievance Mechanism

After creating a Grievance Mechanism, developers/EPC should publicize it through various stakeholder engagement activities as outlined in the Stakeholder Engagement Plan and share it with stakeholders. The local community should be the first to be informed, and reminders should be given during the project construction and operation phases. Different communication methods such as printed materials, displays, face-to-face meetings, and website updates can be used to disseminate information. The Grievance Redress Mechanism should be documented in English and Bangla and kept at the project and corporate office, with a notice displayed at the project site office. Orientation training on the GRM should be provided, and contractors should inform workers about the mechanism during recruitment and make it easily accessible. All relevant contact information should be made available to workers.

12.8.4.4 Training / Workshops on Grievance Redress Mechanism

Developers/EPC should conduct a specific training or workshop for the community and workers to explain how to register a grievance, provide the details of the local contact person or grievance officer responsible for receiving grievances, explain the importance of grievance boxes, clarify the timelines for addressing grievances, and identify the personnel involved in the redressal process.

Training sessions for the community and workers should be held every six months. Feedback and suggestions from the community should be acknowledged, and changes to the Grievance Redress Mechanism should be made accordingly to enhance its user-friendliness.

12.8.4.5 Recording of Grievances

Once stakeholders use the mechanism to raise grievances, the developer(s) must acknowledge them and maintain the complainant's anonymity. The developer(s) should collect grievances every fifteen days from the grievance boxes, record them in the identified formats, and track them throughout the redressal process, reflecting on their status and essential details. An identified Grievance Officer should maintain a Grievance Log or database at the site level, emphasizing the records and status of the grievance. The Grievance Log can be used to analyze trends in grievances and conflicts, community issues, and project operations to anticipate future conflicts, ensure the grievance mechanism is prepared to handle such issues, and suggest organizational or operational changes.

12.8.4.6 Appeal

If the complainant does not agree with the grievance redressal solution, an appeal process should be offered. Developers/EPC should establish the circumstances under which an appeal can be made to promote accountability and transparency in every step.

12.8.4.7 Resolve and Follow Up

Once the corrective action has been agreed upon, a good practice is to collect proof of those actions in terms of taking photographs, documentary evidence, getting confirmation from the complainant and filing the same within the case documentation. In addition, monitoring and follow up on the resolution agreed upon should be conducted once to close the case accordingly. Developers/EPC are required to provide regular (yearly) reports to OPDL-2 that track the number of complaints received, resolved, not resolved and referred to a third party. In addition, the funding agency also needs to be constantly apprised of the yearly reports in order to support the identification of developing risks.

12.8.5 Proposed Grievance Redress Mechanism for OPDL-2 / Developer

The process of lodging grievances, the subsequent steps to be taken, and the time limit for resolving issues to the satisfaction of complainants (community members, project-affected individuals, and workers) are outlined in the Grievance Redress Mechanism. A three-level approach is proposed to be developed for all cases of grievances. As per the severity of each case, resolution of the grievances can be undertaken at each level. All complaints will be recorded and addressed in a uniform and consistent manner, with time-bound schedules and specific personnel assigned to handle grievances. The steps of grievance redressal for OPDL-2 has been provided below

12.8.5.1 Receive and Register a Complaint

- Any worker/ stakeholder with concerns pertaining to onsite work such as occupational health and safety, terms of employment, wages paid, issues with community or among co-workers, management, etc. may register their complaint in writing to the nominated person/grievance officer at site (Level-I);
- Secured grievance boxes shall be placed at a various strategic location within the site area, site office, labor camp, and community level;
- If the complainant wishes to remain anonymous, he/she can write down the grievances and drop them in the available complaint boxes;
- Once a complaint has been received it shall be recorded in the grievance log register or data system and an acknowledgment slip is provided to the complainant;

12.8.5.2 Assessment and Address of Complaint

The identified Grievance Officer at Level I (site office) would open the complaint boxes every fifteen (15) days and forward the grievances to the Plant Manager for further action. In addition, in turn of the physical receipt of compliant, the same would be forwarded to the Plant Manager;

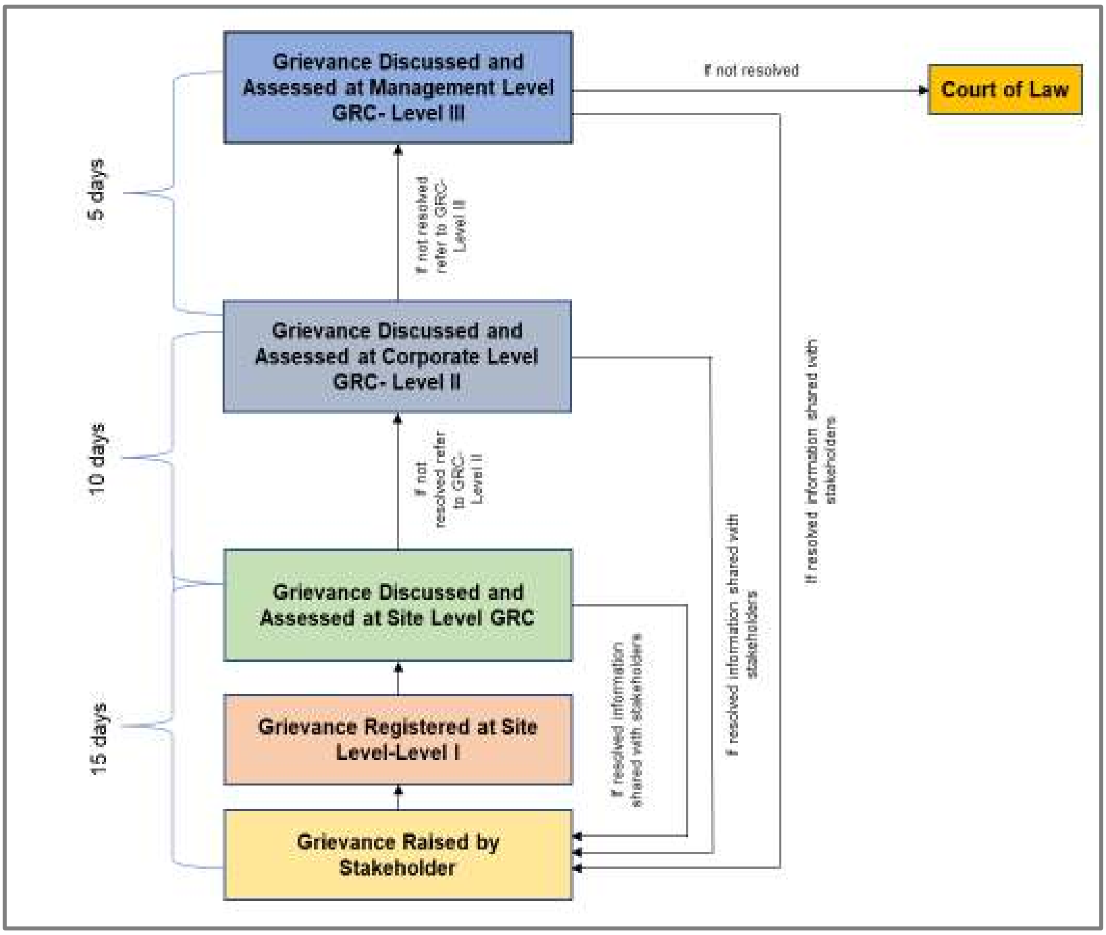
The grievance would be assessed to determine if the issues raised by the complaint fall within the mandate of the grievance mechanism;

- During the assessment of complaints, the team at Level I (project office) comprising the Grievance Redressal Committee (in cases concerning Contract Workers then Contractor Site Supervisor would also be involved) would gather information about the key issues and concerns and helps determine whether and how the complaint might be resolved. The GRC would comprise of the Chairman of Matarbari Union Parishad, Project Manager- OPDL-2, Plant Manager – OPDL-2 and EHS Personnel – OPDL-2.

- If no decision is made within 5 days by the Committee at Level I, the issue would be forwarded to the Chief Grievance Officer based at the Corporate Office (Level II) to screen and assess the grievance. If the complaint seems to require intervention, then it would be considered for further action, otherwise, it would be rejected and the same would be communicated to the concerned complainant by the Grievance Officer/ EHS Personnel based at the site level within 5 working days;
- The grievances would be addressed at Level-I by the GRC and Contractor Supervisor (in cases involving contract workers) within 15 working days;
- If the grievance is failed to be addressed at Level-I within stipulated time period or to the satisfaction of the complainant, the grievance would be referred to the Chief Grievance Officer (Level – II) to take the final decision pertaining to the complaint;
- At this level, the Chief Grievance Officer (identified by the Company) would discuss the issue with the Director (Human Resource & Administration) and Director (Operation) and try to address the grievance. The Chief Grievance Officer shall provide support in terms of decision-making. If necessary, meetings would be conducted with the complainant and evidence would be examined. The grievance would be closed within 7 working days of referral;
- The worker/ complainant would have the opportunity to be present at the committee meetings and discuss the grievance at both levels if the grievance remains unresolved even after going through both levels, the complainant would have the option to approach the appropriate court of laws for redress.

The Grievance Mechanism proposed for OPDL-2 to consider and implement has been provided in below:

Figure 12-1: Proposed Grievance Mechanism Structure for OPDL-2



12.8.5.3 Grievance Redress Committee

A site level approach is proposed to be developed for redressing all cases of grievances. All grievances are to be redressed at this stage. The representatives proposed for the grievance committee is provided below **Table 12-18**.

Table 12-18: List of Members of Grievance Redressal Committee

SL	Member	Role
1.	Director	Chairperson & Head of the Grievance Redressal Committee
2.	Plant Manager	Chief Grievance Officer
3.	EHS Manager/Personnel/ Grievance Officer	Member
4.	EHS Assistant Manager/Personnel/ Assistant Grievance Officer	Member
5.	Chairman Matarbari union	Community Representative
6.	Matarbari union Male member of adjacent Village	Community Representative
7.	Matarbari union Female member of adjacent Village	Community Representative

The functions of GRC are as follows:

- To provide support to affected communities on problems arising from environmental or social impacts;
- To record grievances of the affected community by categorizing and prioritizing them, and provide solutions within a stipulated time period; and
- To report to the aggrieved parties, developments regarding their grievances and decisions of the GRC.

12.8.5.4 Receive and Register a Complaint

To implement the Grievance Redress Mechanism, the developers/EPC must appoint a Grievance Officer who will be responsible for registering grievances, initiating the process for resolution, and ensuring that the timeline for each step is followed. The contact information of the Grievance Officer must be maintained and updated regularly in a format that is prominently displayed in public areas and throughout the project site.

Table 12-19: Contact Details of Grievance Officers

Sl. No	Name of the Grievance Officer	Telephone No.

- Any stakeholder such as worker, a person from the local community or any other stakeholder, with concerns pertaining to on-site work such as community health and safety, local employment, community risk, migrant labor or any issues etc., may register their complaint in writing to the nominated person/grievance officer at the site level;
- All grievances will be addressed by the developers/EPC during the construction and operation phase. For any unresolved grievances or any grievances related to land(N/A for this project as land is acquired voluntarily), the developer/EPC will forward the grievances to OPDL-2 who in turn will subsequently forward them to appropriate authority for redressing;
- Secured grievance boxes shall be placed at the entrance of the site office ;

- If any stakeholder or community member wishes to remain anonymous, he/she can write down the grievances and drop in the available complaint box; and
- Once a complaint has been received, it shall be recorded in the grievance log register or data system.

Details of grievance received shall be maintained by the Grievance Officer in a register as per the following format.

Table 12-20: Records of Grievance Received

Sl.	Date of Receipt	Particulars of Complainant				Particulars of Grievance			
		Name	Address	Contact No	Whether acknowledgement is given at the time of receipt	The subject of the Grievance	Office	Brief Description	Date of acknowledgement/ Date of redress

12.8.5.5 Documentation

- The Grievance Redress Mechanism will be documented in English and Bangla and copies will be kept at the project site office;
- The GRM will also be displayed at notice board at the project site office and labor campsites and will be included in worker documentation;
- The developers/EPC should inform the local community and workers about Grievance Redress Mechanism during the project construction and operation phases. Various communicative methods can be adopted in disseminating information like printed materials, displays and face to face meetings;
- The Contractor or Admin Officer will inform the workers about the grievance mechanism at the time of recruitment or induction training and make it easily accessible to them;
- The Grievance Officer's contact number will be made available to them. The project office phone number will be posted in public areas within the project area;
- The mechanism will address concerns promptly, using an understandable and transparent process and provide timely feedback to the concerned stakeholder;
- Verifiable records of implementation of corrective action like dated photographs, documentary evidence, getting confirmation from the complainant and filing the same within the case documentation should be kept;
- A Grievance Log or database emphasizing the records and status of the grievance shall be maintained by the Grievance Officer at the site level.

12.8.6 Resources Required for Grievance Mechanism Implementation

A Grievance Mechanism becomes successful if adequate resources are assigned in its implementation. Adequate resources here refer to people, systems and processes and associated financial resources. In order to incorporate the responsibility of designing, implementing and monitoring the grievance mechanism, the senior management of the Developers/EPC at the corporate level should be involved in executing the various tasks. For a grievance mechanism to function effectively, it is important to establish a governance structure and assign responsibilities for the mechanism's implementation. The following roles and responsibilities have been identified for grievance mechanism implementation:

12.8.6.1 Nominated Grievance Officer

Admin Officer based at the Site Level is to be nominated as the Grievance Officer. The incumbent is to work in tandem with the Site Supervisor, EHS Manager and Safety Officer. They cumulatively form the Grievance Committee at the site level.

12.8.6.2 Engagement of Third Party

To ensure complete transparency and accountability of the grievance mechanism process, third parties such as local governments and communities can sometimes be involved in the grievance redress process. These third parties can serve as organizers, facilitators, witnesses, advisors, or mediators. By involving third parties, the level of trust from communities can be increased, and limitations of the project-level mechanism can be overcome. Involving third parties can also enhance the project proponent's reputation and increase trust from stakeholders. Furthermore, involving third parties can be cost-effective and supplement internal resources.

12.8.6.3 Monitoring and Reporting

Monitoring and reporting are essential tools for measuring the effectiveness of the grievance mechanism, ensuring efficient use of resources, identifying broad trends, and addressing recurring problems before they escalate. They also provide a foundation of information that can be used by the project proponent to report back to stakeholders.

12.8.6.3.1 Monitoring

The Developers/EPC can adopt monitoring measures based on the project's impacts and the volume of grievances, such as internal audits by identified corporate-level staff and external audits by third-party consultants, once a year depending on the complexity of the grievances. Grievance records should be maintained to provide background information for these regular monitoring exercises. Through the review and analysis of each grievance, the Developers/EPC can identify systematic deficiencies and evaluate the effectiveness and efficiency of the grievance mechanism. Additionally, monitoring the grievance mechanism ensures that it adequately responds to stakeholder feedback in a cost-effective manner.

12.8.6.3.2 Reporting

All grievances registered have to be recorded and regularly updated. The site management or Grievance Officer is responsible for discharging this responsibility, and he should be able to produce this document whenever any audits take place. All minutes of meetings with stakeholders, complainants and Grievance Committee are to be recorded and documented regularly for reference purposes. In addition, through the process of monitoring and the reports produced thereafter, assurance of continual improvement of the company’s operations is guaranteed. The company can also use these monitoring reports to report back to the community on its implementation of the mechanism, and the modification/ changes proposed to make it more user-friendly.

12.8.7 Budget

The OPDL-2 administration shall ensure adequate budgeting and resource allocation for implementing the grievance redress mechanism.

CHAPTER 13

Hazards and Risk Assessment

13 DISASTER IMPACT ASSESSMENT AND HAZARDS AND RISK ASSESSMENT

13.1 Disaster Impact Assessment

Disasters can create considerable damage and losses related to any development projects. To avoid disasters/hazards, impact mitigation measures can be taken from the beginning of the project activities. If the Disaster Impact Assessment (DIA) system is incorporated into the processes in development projects, the extent of damage and losses can be avoided or minimized to higher degrees. Therefore, disaster impact assessment for evaluating project takes a high importance in its existence. Disaster Impact Assessment (DIA) is a methodology to assess the project from the viewpoint of disaster risk reduction by identifying improvement point. Based on the findings of the DIA, revisions to the projects will be incorporated for reduction of disaster risks and mitigation of potential effects happened to and from the project activities.

13.1.1 Approach and Methodology

Both the quantitative and qualitative data (primary and secondary) were collected for the present disaster impact assessment study. Primary data collection using the field visit, KII, public consultation, focus group discussions and GIS tools and secondary data collection using and review method were followed to attain the study objectives. Secondary data were collected from the published news on different disasters in locally/nationally published Bengali and English newspapers, disaster report, scientific articles, books, thesis papers, journal papers, bulletins and annual reports of relevant authority and organizations like Bangladesh Meteorological Department (BMD), Department of Disaster Management (DDM), Disaster Forum, Network for information, response and preparedness activities on disaster (NIRAPAD), Bangladesh Space Research and Remote Sensing Organization (SPARRSO) and Bangladesh Red Crescent Society (BDRCS) etc. The major daily newspaper included the Bangladesh Observer, the United News of Bangladesh, Bangladesh Sangbad Sangstha, the Daily Star, the Daily Ittefaq, the Pakistan Observer were carefully reviewed. After careful review of all these materials, a disaster database has been prepared based on the historical chronology, nature, location, extent, severity, property damage, causalities of disasters. The same approach has been followed by many researchers.

For the primary data collection and field verification field visit was conducted several times in the proposed project site. During the field visit, discussions were conducted with the local people to evaluate the potential disasters in the project area, the previous occurrence of disasters and their impacts on the local community. Key informant interview and discussions were conducted with the local knowledgeable persons who have knowledge of various disasters in the proposed project area. GIS technology has been used for the analysis of the spatial database related to the hazards and disasters in the proposed project area.

13.1.2 Disasters in Bangladesh

The natural or manmade events that adversely affect the entire environment in an area, including human beings, shelters and the resources essential for livelihoods are termed as disasters. Now Bangladesh is considered as one of the most vulnerable countries in the world in terms of natural and anthropogenic hazards. The population density is also very high compared with the other countries. The geographical setting and meteorological characteristics have made the country vulnerable to different geo-hazards and hydro-metrological hazards. The major disasters (natural and manmade) concerned in the country are floods, cyclones and storm surges, droughts, tidal surges, tornadoes, flash flood, earthquakes, lightning, erosion, landslide, fire, infrastructure collapse, high arsenic contents of ground water, water logging, water and soil salinity and various forms of pollution etc.

13.1.3 Disaster Impact Assessment in the Project Area

The disaster impact assessment for the proposed solar and wind project has been carried out using qualitative and quantitative methods based on the available secondary data and primary data from the field visit and consultation with the local people.

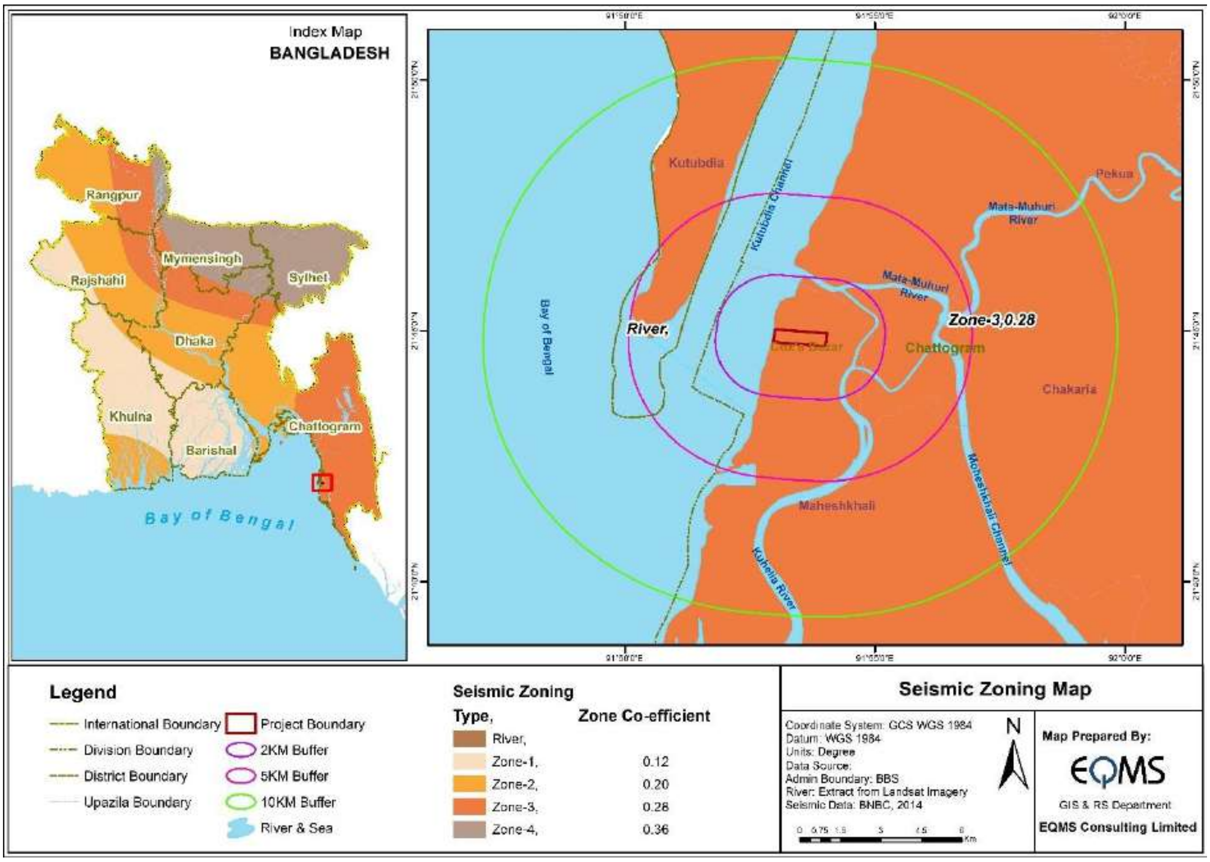
13.1.3.1 Earthquake and Seismic Activity

A region's seismic zone indicates how vulnerable it is to earthquakes, both now and in the past and into the future. Greater seismicity is seen in areas where huge earthquakes happen more frequently than in areas where smaller earthquakes happen less frequently. Bangladesh is located on the northeast junction of Indian plate and Eurasian plate, so it will be affected by the medium to intense seismic activities. It has suffered from the earthquakes above Grade 7.0 in the past 150 years, and the epicenter is in Bangladesh.

Based on the distribution of earthquake epicenters and morphotectonic behavior of different tectonic blocks Bangladesh has been divided into four seismic zones (**Figure 13-1**). The northeastern part of the county, which includes Mymensingh, Sylhet, and a part of the greater districts of Rangpur are in the zone - 4. The seismic coefficient of this zone is 0.36. Zone – 3 consists of the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur and the greater districts of Dinajpur and Chittagong having seismic coefficient 0.28. The greater districts of Rajshahi, Dhaka and Cumilla lie in Zone-2 with the seismic coefficient of 0.02. The Southern part of the county is the least active region, where the seismic coefficient of not more than 0.12 is in Zone-1. Project site is located in zone 3 having seismic coefficient of 0.28. The project site falls under the moderate seismic zone.

The strongest earthquake in Bangladesh happened on 06/02/1988 in the Sylhet; India (Tipura-Assam) region with a magnitude of 5.8 on the Richter scale. The shifting of tectonic plates in a depth of 45 km resulted in 2 deaths. Moheshkhali island experienced an earthquake on 22/07/1999 with a magnitude of 4.2 on the Richter scale resulted in 6 deaths. **Table 13-1** shows the major earthquakes in Bangladesh.

Figure 13-1: Seismic Zone Map of Bangladesh showing the Study Area



Data source: Bangladesh National Building Code (BNBC)

Table 13-1: Major Earthquakes in Bangladesh

Date	Region	Depth	Magnitude	Deaths
10.09.2010	Narayanganj	16 km	4.8	0
12.01.2008	Rangamati, Bangladesh	47 km	5.0	0
07.11.2007	Chittagong, Bandarban, Rangamati	21 km	5.1	0
26.07.2003	Rangamati	17 km	5.7	2
20.06.2002	Rangpur, Thakurgaon, Almanagar	43 km	4.5	0
19.12.2001	Dhaka	7 km	4.5	0
22.07.1999	Maheshkhali Island, Cox's Bazaar	11 km	4.2	6
12.06.1989	Banaripara	9 km	5.1	1
06.02.1988	Sylhet; India (Tipura-Assam)	45 km	5.8	2

Source: WorldData.info (statistics are based on datas from the National Geophysical Data Center / World Data Service)

13.1.3.2 Cyclone and Storm Surges

Devastating cyclones hit the coastal areas of Bangladesh almost every year usually accompanied by high-speed winds, sometimes reaching 250 km/hr or more and 3-10m high waves, causing extensive damage to life, property and livestock. Because of the funnel shaped coast, Bangladesh repeatedly becomes the landing ground of cyclones formed in the Bay of Bengal. The project area is prone to cyclones. These cyclones occur in two seasons, April-May and October-November – i.e., before and after the monsoon.

Cyclones in Bangladesh are presently classified according to their intensity and the following nomenclature is in use:

- Depression (winds up to 62 km/hr).
- Cyclonic storm (winds from 63 to 87 km/hr);
- Severe cyclonic storm (winds from 88 to 118 km/hr); and
- Very severe cyclonic storm of hurricane intensity (winds above 118 km/hr).

The project site is near the estuaries of the Kutubdia Channel, the Matamuhuri, the Kuhelia, and the Bay of Bengal, which is prone to tropical cyclone activity, particularly from April to June. Annually twice on average, and occasionally up to four times cyclone occurs in this area. During the years 1960 to 2022, Bangladesh was hit by more than 60 severe cyclones, more than 30 of which were accompanied by storm surges. Below **Table 13-2** shows the disasters with reference to the wind speed, surge height, and loss of life. The height of the surges is limited to a maximum of 10 meters in the bay. The most severe event was SIDR (2007) and cyclone 1970. From the public consultation meeting and review of historical secondary documents, it can be easily said that the proposed project area is highly vulnerable due to the cyclone and storm surge. Cyclone affected areas in Bangladesh have been shown in **Figure 13-2**.

Table 13-2: List of Major Cyclonic Storms from 1960-2021

Date of Landfall	Nature of Phenomenon	Landfall Area	Maximum Wind Speed in Kph	No. of Deaths	Surge Height (m)
11.10.1960	S.C.S	Chittagong	160	3450	6.0
19.05.1997	S.C.S	Chittagong	193	5149	6.6
09.05.1961	S.C.S	Chittagong	160	11468	5.0
30.05.1961	S.C.S	Chittagong (Near Feni)	160	-	2.0-4.4
28.05.1963	S.C.S	Chittagong-Cox's Bazar	200	11520	6.0
11.05.1965	S.C.S	Chittagong-Barishal Coast	160	19279	3.7
05.11.1965	S.C.S	Chittagong	160	-	6.1-7.6
15.12.1965	S.C.S	Cox's bazar	210	873	2.4-3.6
23.09.1966	S.C.S	Noakhali Coast	139	850	6-6.67
07.12.1966	S.C.S	Cox's bazar	81	-	-
08.11.1967	C.S	Khulna (Sundarbans)	111 (Sandheads)	1000 (India)	-
23.10.1967	S.C.S	Near Cox's Bazar	107 (Cox's) 145 (M.mar)	51	-
23.10.1970	S.C.S of hurricane intensity	Bangladesh-West Bengal coast	163	300	4.7
12.11.1970	S.C.S of hurricane intensity	Chittagong	224	300000	3-10
08.05.1971	C.S	Chittagong	81	-	2.4-4.24
29.09.1971	S.C.S	Sundarbans coast	97-113	-	0.6
06.11.1971	S.C.S	Chittagong-Noakhali Coast	-	-	-
18.11.1973	S.C.S	Chittagong	102	-	-
30.05.1974	C.S	Patuakhali	74-83	-	-

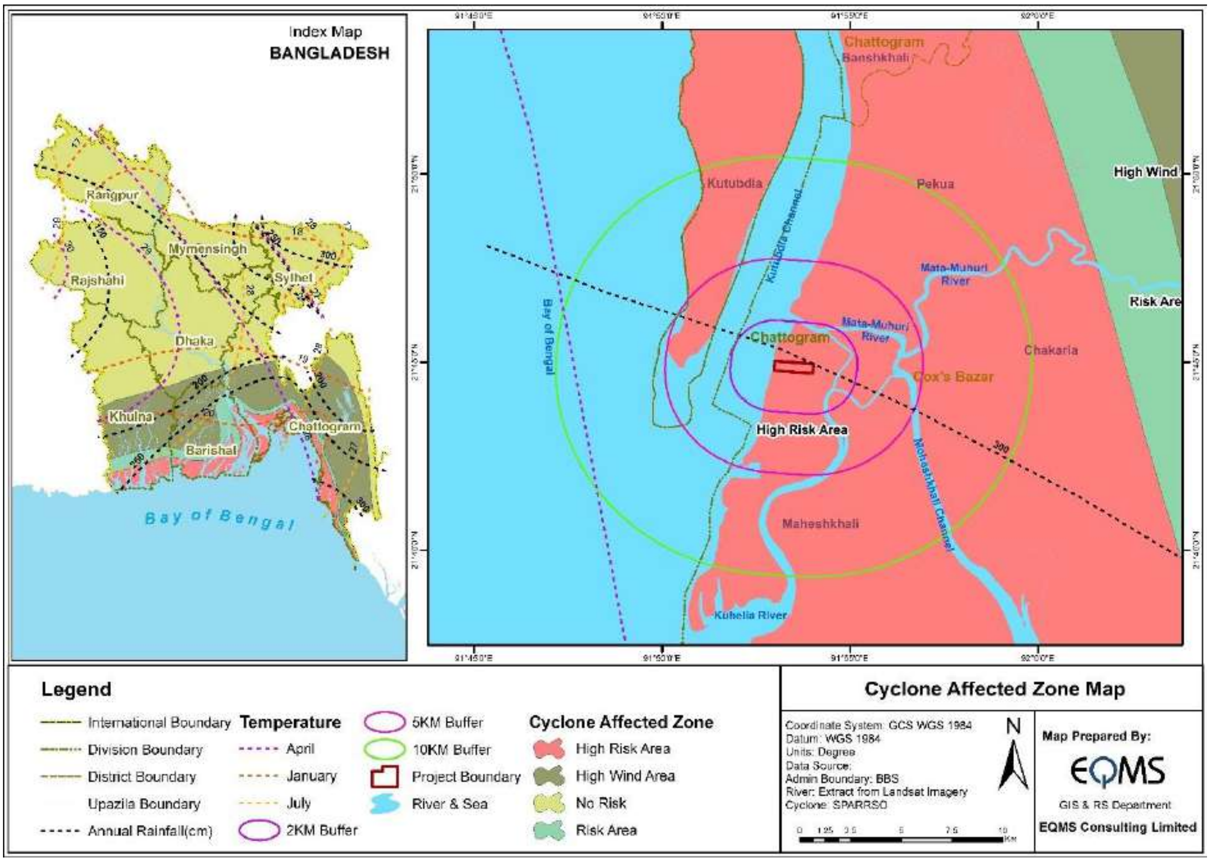
Date of Landfall	Nature of Phenomenon	Landfall Area	Maximum Wind Speed in Kph	No. of Deaths	Surge Height (m)
28.11.1974	S.C.S	Chittagong-Cox's bazar coast	163	20	3.0-5.1
10.12.1981	C.S	Khulna	120	72	2.12-4.55
15.10.1983	C.S	Chittagong	93	43	-
09.11.1983	S.C.S	Chittagong-Cox's bazar coast	136	300	1.5
24.05.1985	S.C.S	Chittagong	154	4264	4.55
29.11.1988	S.C.S with a core of hurricane winds	Khulna Coast	160	5683	4.4
18.12.1990	C.S	Cox's Bazar Coast	115	-	-
29.04.1991	S.C.S with a core of hurricane winds	Chittagong	225	138882	6-7.6
31.05.1991	C.S	Noakhali coast	83	-	2.5
02.05.1994	S.C.S with a core of hurricane winds	Cox's Bazar-Teknaf Coast	200-250	184	3.64-4.85
25.11.1995	S.C.S	South of Cox's Bazar	55	-	-
26.10.1996	C.S	Sundarbans Coast	70	9	1.5-2.0
19.05.1997	S.C.S with a core of hurricane winds	Sitakunda	232	155	4.55
27.09.1997	S.C.S with a core of hurricane winds	Sitakunda	150	67	3.0-4.55
20.05.1998	S.C.S with a core of hurricane winds	Chittagong Coast near Sitakunda	173	14	0.9
17.10.1999	S.C.S of hurricane intensity	Orissa coast	-	-	-
25.10.1999	S.C.S of hurricane intensity	Orissa coast	-	-	-
28.10.2000	Deep depression (Probably Cyclonic Storm)	Sundarbans coast near Mongla	50-60	3	0.6-1.2
16.10.2001	S.C.S	Andhra coast	65-85	-	-
12.11.2002	C.S	Sundarbans coast near Raimangal River	65-85	2	1.5-2.1
20.05.1003	C.S	Myanmar coast	65-85	-	0.9-1.5
16.12.2003	S.C.S	Andhra coast	98-115	-	-
19.05.2004	C.S	Cox's Bazar and Akyab coast	65-90	-	0.6-1.2
28.10.2055	C.S	Andhra coast near Ongole	-	-	-
10.12.2005	Cyclonic Storm (Crossed land as depression)	Tamilnadu coast near Nagapattanam	-	-	-
29.04.2006	S.C.S with a core of hurricane ''Mala''	Arkan coast of Myanmar between Akyab and Sandoway	-	-	-
15.05.2007	C.S "AKASH"	Chiitagong – Cox's Bazar coast	83	-	-
15.11.2007	S.C.S ''SIDR" with a core of hurricane winds	Khulna-Barishal coast near Baleshwar River	223	3363	4.6-6.1

Date of Landfall	Nature of Phenomenon	Landfall Area	Maximum Wind Speed in Kph	No. of Deaths	Surge Height (m)
02.05.2008	S.C.S ''NARGIS" with a core of hurricane winds	Myanmar coast near bassein	-	-	-
26.10.2008	C.S ''Rashmi"	Khulna – Barishal Coast near Patharghata	-	-	1.5-2.1
27.11.2008	C.S ''Nisha"	Tamilnadu coast near Nagapattanam	-	-	-
17.04.2009	C.S ''BIJLI"	Chittagong-Cox'sBazar coast near Chittagong	90	-	-
25.05.2009	C.S ''AILA"	West Bengal-Khulna (Bangladesh) coast near Sagar inland of India	92	190	2.1-2.4
16.05.2013	C.S (MAHASEN)	Noakhali-Chittagong coast	95		1.0-1.5
30.07.2015	C.S (KOMEN)	Chittagong-Cox's Bazar coast	75		1.0-2.0
21.05.2016	C.S (ROANU)	Barisal-Chittagong coast near Patenga	100		2.0
30.05.2017	S.C.S (MORA)	Chittagong-Cox's Bazar coast near Kutubdia	110	-	1.2-1.5
12.10.2018	S.C.S (TITLI)	Palasa, Andhra Pradesh	130	-	0.6
28.10.2019-11.11.2019	S.C.S (BULBUL)	Khulna, Barisal, Chittagong	139	-	1.2-1.5
15.05.2020-21.05.2020	S.C.S (AMPHAN)	Khulna, Rajshahi, Dhaka, Rangpur	241	20	4.6
23.10.2022-24.10.2022	C.S (SITRANG)	Barisal, Dhaka	83	29	1.5-2.0

*S.C.S= Severe Cyclonic Storm, C.S= Cyclonic Strom

Source: Bangladesh Meteorological Department and Worlddata.info

Figure 13-2: Cyclone Strom Trucks in Bangladesh showing the Project Study Area



Source: SPARRSO

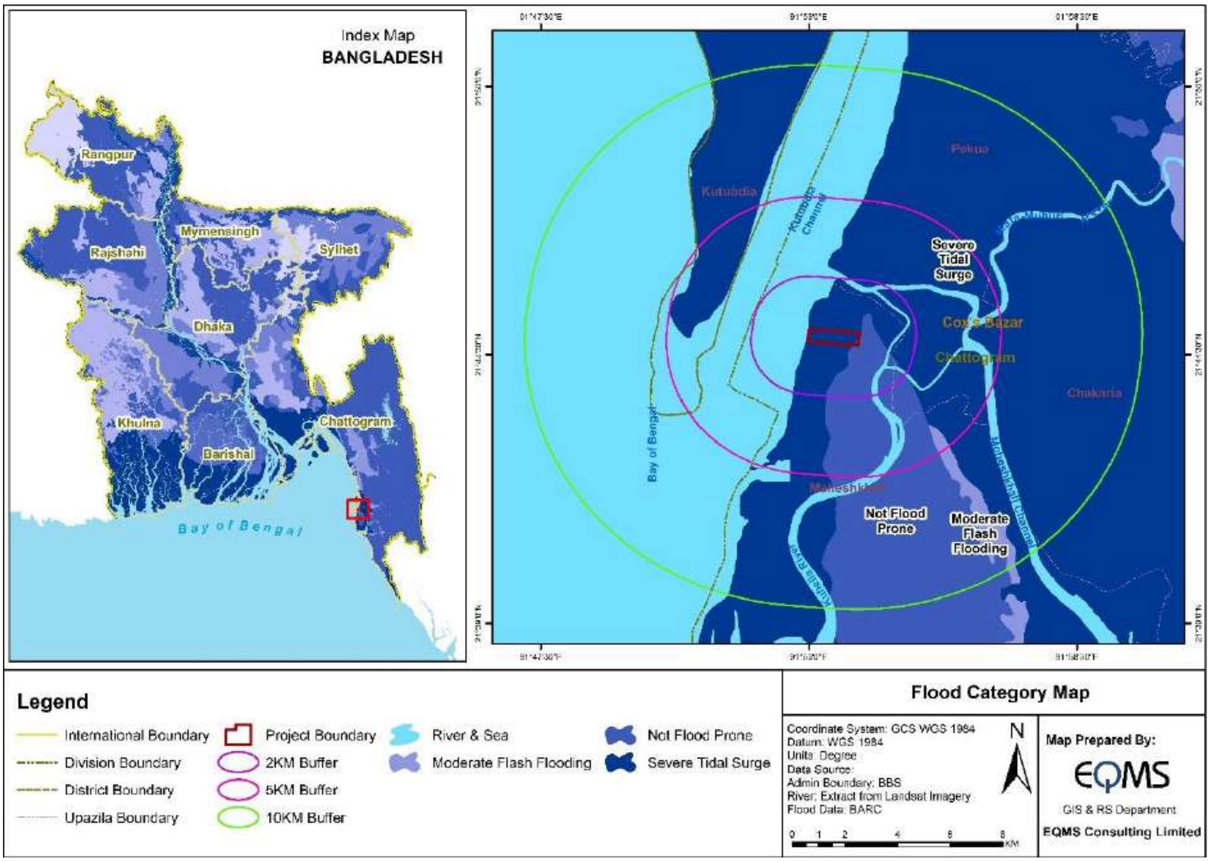
13.1.3.3 Floods

Every year about one-fifth of Bangladesh undergoes flooding during the monsoon season. A flood season in Bangladesh may start as early as May and can continue until November.

Flood in Bangladesh can be divided into three categories; (i) monsoon flood – seasonal, increases slowly and decreases slowly, inundate vast areas, and causes huge loss to the life and property; (ii) flash flood- from sudden torrential flows, following a brief intense rainstorm or the bursting of natural or manmade dam or level; and (iii) tidal flood – duration, is generally 3-6 m, prevents inland flood drainage.

The following **Figure 13-3** shows the flood affected areas of Bangladesh. The AOI is characterized by coastal plain and flat topography. The area receives 2,962 mm - 4,253 mm amount of rainfall annually. The rivers related to the AOI are Matamuhuri, Kohelia Rivers, Maheshkhali Channel and other small rivers. Considering the above geographical situation, it is evident that large parts of the AOI have potential to be affected by both floods. The main reason for flooding in the AOI is storm surge. Storm surges are likely to occur due to flood tides from cyclones and south-western monsoon winds. This kind of flood mostly occurs along the coastal areas of Bangladesh.

Figure 13-3: Flood Map of Bangladesh showing Project Study Area



Source: BARC

13.1.3.4 Tornado

It is the pre-monsoon period when most of the abnormal rainfall or drought conditions frequently occur in different parts of Bangladesh. Also, there are severe local seasonal storms, popularly known as nor'westers (kalbaishakhi). Severe nor'westers are generally associated with tornadoes. Tornadoes are embedded within a mother thundercloud and move along the direction of the squall of the mother storm. The frequency of devastating nor'westers usually reaches the maximum in April, while a few occur in May, and the minimum in March. Nor'westers and tornadoes are more frequent in the afternoon. Nor'westers may occur in late February due to early withdrawal of winter from Bangladesh. The occasional occurrence of nor'westers in early June is due to the delay in the onset of the southwest monsoon over the region (Karmakar, 1989). List of the nor'westers and tornadoes is given in **Table 13-3**. The project site is more vulnerable to cyclone rather Tornado.

Table 13-3: List of Tornadoes that had Hit in Bangladesh

Date	Location
14th April, 1969	Demra (Dhaka)
17th April, 1973	Manikganj (Dhaka)
10th April, 1974	Faridpur
11th April, 1974	Bogra
9th May, 1976	Gazipur
1st April, 1977	Faridpur

Date	Location
26th April, 1989	Saturia (Manikganj)
14th May, 1993	Southern Bangladesh
13th May, 1996	Tangail
4th May, 2003	Brahmanbaria
21st March, 2005	Gaibandha

13.1.3.5 Tsunami

Tsunamis are caused by earthquakes or other seismic eruptions on the ground of the oceans and can cause massive tidal waves, which run with enormous force on land, causing great devastation. Especially in regions with only few tsunamis, the damage is often drastic, as the population does not expect tsunamis and thus hardly takes any protective measures. Even relatively small flood waves can lead to high losses and financial damage.

Bangladesh lies between medium to low risk of tsunami. The project area also lies in medium risk of tsunami showing **Figure 13-4**. The largest tsunamis in Bangladesh are listed in below **Table 13-4** with fatalities and maximum tidal wave.

Figure 13-4: Tsunami Hazard level Zone Map of Bangladesh showing Study Area

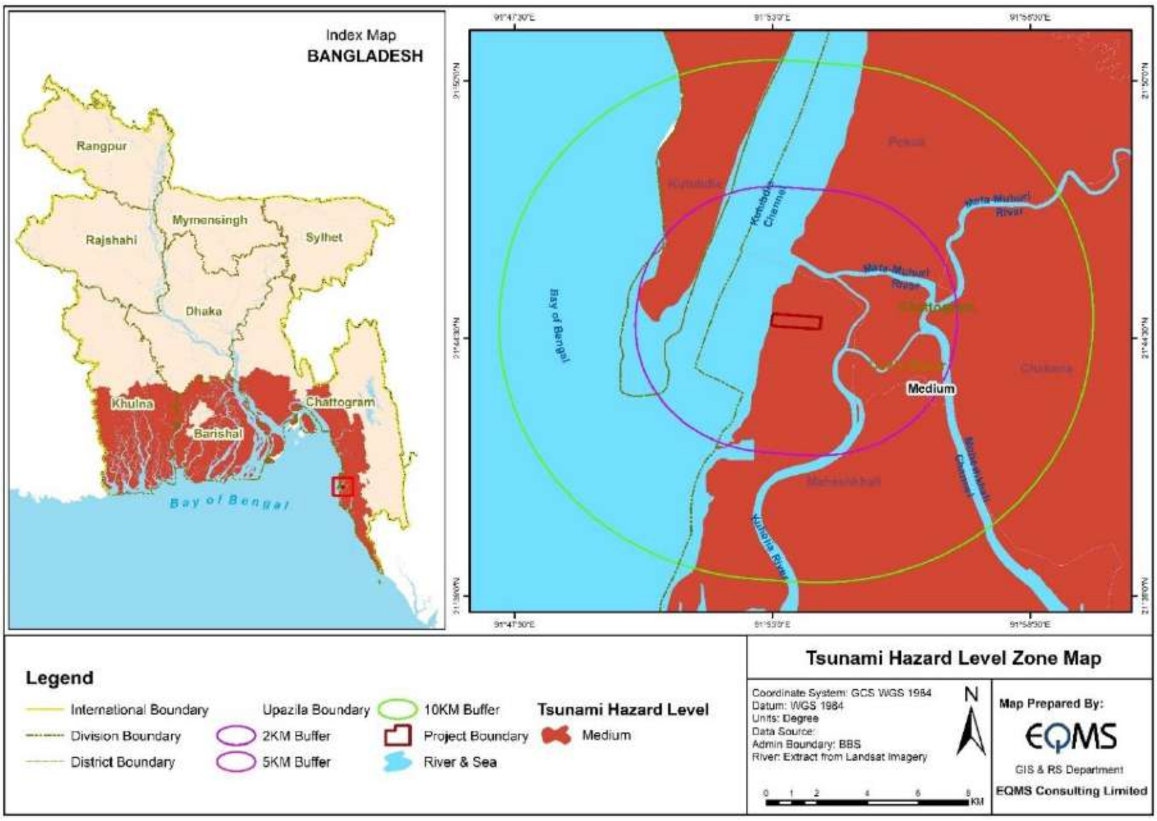


Table 13-4: List of Largest Tsunamis in Bangladesh

Date	Cause	Max. tidal wave	Fatalities
12.26.2004	Earthquake in Indonesia (Off W. Coast of Sumatra) with a magnitude of 9.1. The tsunami caused damage in 20 further countries. A total of 227,899 humans died.	2.4 m	2

Date	Cause	Max. tidal wave	Fatalities
04.02.1762	Earthquake in Bangladesh (Northern Bay of Bengal)	1.8 m	0

Source: WorldData.info (data acquired from the Global Historical Tsunami Database of the National Geophysical Data Center, NOAA, and World Data Service)

13.1.3.6 Sea Level Rise

Sea level rise is a crucial issue of climate change and has various impacts on Bangladesh. The coastal zone of Bangladesh is the most vulnerable to climate change because of its geographic location, flat topography, high population density, high levels of poverty. The average elevation of the southeast coastal zone is 4 to 5 m. The low elevation, active delta and dynamic morphology play a significant part in its vulnerability to sea level change. Its potential threats will come even more strongly in the future. Shore line erosion, riverbank erosion, salinity intrusion, flood, damage to infrastructures, crop failure, destruction of fisheries, loss of biodiversity may be caused due to the sea-level rise etc. The average increase in temperature of Bangladesh would be 1.3°C and 2.6°C by the year 2030 and 2075 respectively with respect to the base year 1990 (Ahmed and Alam, 1999). Two estimations of potential future sea level rise for Bangladesh are 0.30-1.5 m and 0.30-0.50 m for 2050 (DoE, 1993). Analysis of historical data from 1977 to 1998 shows annual sea level rise at the rate of 7.88 mm, 6 mm and 4mm respectively in Cox's Bazaar (Shamsuddoha and Chowdhury, 2007). Maximum rise in the water level is observed in the Southeast region at the Maheshkhali station which is 7.5 mm/year[43].

13.1.4 Mitigation Measures for the Significant Disaster

The following mitigation measures should be taken by the project proponent and contractor to reduce the damage, loss and causalities of any disaster event in the proposed project (**Table 13-5**). Disaster/risk insurance can be introduced in the proposed project.

Table 13-5: Mitigation Measures for the Significance Disasters in the Proposed Project Site

Risk/Hazards	Mitigation/Enhancement/Management Measures	Responsibility	
		Construction	Operation
Earthquake	• Adopting and enforcing updated building code of BNBC provisions to reduce earthquake damage risk; • The proposed project and its associated infrastructure shall be designed and developed considering the applicable zone wise seismic risk and impact; • Make all utilities like water supply system, communication networks, electricity lines etc. earthquake proof; • The proposed project operating personnel and other key personnel shall be trained to manage emergency situations during an earthquake; • Emergency firefighting system should be ensured in the project site; • Fire drill can be conducted once in a year; • Adequate first aid provision in the project site;	Contractor	OPDL-2

[43] Assessment of Sea Level Rise on Bangladesh Coast through Trend Analysis, Department of Environment, Bangladesh

Risk/Hazards	Mitigation/Enhancement/Management Measures	Responsibility	
		Construction	Operation
	• The high-risk electrical area should be clearly marked with warnings to avoid dangerous practices in the vicinity so that there would be less chance of accidents from those installations.		
Cyclones	• Consideration of cyclonic wind/wind velocity in the design of the project and associated infrastructures; • Construction of dike around the proposed project site. The dikes should be designed to prevent flooding during high astronomical tides and during cyclone-generated storm surge too; • Suitable dike height can be selected based on the analysis of last 50 years historical data; • Plantation of selected species at different layer around the proposed project site as well as parallel to the coastline in response to cyclone wind; • Regular monitoring of the weather news/bulletin especially for the cyclone disasters during April to May and October to November; • Close communication with the volunteers of the Cyclone Preparedness Programme (CPP) for the preparedness of cyclone disaster; • Establishment of site emergency evacuation and management plan for the cyclone disasters; • Foundation structure of machines and buildings should be elevated to avoid cyclones associated storm surges water; • Breakwaters along the coast can be provided the necessary cushion against cyclone hazards; • The proposed project operating personnel and other key personnel will be trained to manage cyclone disasters.	Contractor	OPDL-2
Storm Surges	• Consideration of storm surge height in the design of the project and associated infrastructures; • Construction of dike around the proposed project site. The dikes should be designed to prevent flooding during high astronomical tides and during cyclone-generated storm surge too;	Contractor	OPDL-2

Risk/Hazards	Mitigation/Enhancement/Management Measures	Responsibility	
		Construction	Operation
	• Suitable dike height can be selected based on the analysis of last 50 years historical data; • Plantation of selected species at different layer around the proposed project as well as parallel to the coastline in response to storm surges; • Regular monitoring of the weather news/bulletin especially for the cyclone disasters during April to May and October to November; • All electrical parts of the plant including modules, combiner boxes, inverters, transformers and switchgear etc. would require an elevated supporting structure; • Breakwaters along the coast can be provided the necessary cushion against cyclone hazards; • The high-risk electrical area should be clearly marked with warnings to avoid dangerous practices in the vicinity so that there would be less chance of accidents.		
Droughts	• The proposed project area (Maheshkhali) is located very close to the Bay of Bengal. The soil moisture content is higher than the other areas specially the highland areas. Actuallty the north-western part of Bangladesh is prone to drought. At the same time, no recorded drought events are also found in the project site so no mitigation measures are required for drought.	-	-
Tsunami	• Construction of dike along the proposed project site; The dikes should be designed to prevent flooding during high astronomical tides and during cyclone-generated storm surge too; • Suitable dike height can be selected based on the analysis of last 50 years historical data; • Plantation of selected species at different layer around the proposed project as well as parallel to the coastline in response to storm surges; • Regular monitoring of earthquake and tsunami warning following the Bangladesh Meteorological Department (BMD), United States Geological Survey (USGS) and Pacific Tsunami Warning Center website; • Design, practice, and implementation of evacuation plans;	Contractor	OPDL-2

Risk/Hazards	Mitigation/Enhancement/Management Measures	Responsibility	
		Construction	**Operation**
Tornado	• Consideration of strong wind in the design of the project and associated infrastructures; • Take precautionary measures during pre-monsoon (March-May) and post-monsoon (October-November) seasons for the tornado events; • Prepare and disseminate an emergency plan describing what the workers should to do as a tornado threat; • Drills can be conducted once in a year; • The tornado warning is still unavailable today in Bangladesh, however, people can perceive about the occurrence of tornadoes from their indigeneous knowledge.	Contractor	OPDL-2
Lightning	• Take precautionary measures during pre-monsoon (March-May) and Monsoon (June-September) seasons for the lightning events; • Installation of lightning arrestors in the proposed project site; • Lightning protection devices (lightning rods and grounding) should be installed; • Adequate first aid provision and training the staffs to deal with lightning-related injured victims; • During the lightning, move immediately to the nearest building; • Avoid standing under trees and electricity poles; • Avoid working or standing in upland areas or on the roofs of buildings or open area; • Appropriate firefighting equipment and use must be ensured in the project site; • Avoid using your mobile phone in the open area unless it is absolutely necessary; • Stay away from windows and metal doors.	Contractor	OPDL-2
Flood/Flash Floods	• Prohibiting any fill in floodplain areas, the natural drainage system in the project site; • Ensure adequate stormwater and natural drainage system in the proposed project site; • Construction of dike along the proposed project site; • A detailed drainage study should be required for the proposed project;	Contractor	OPDL-2

Risk/Hazards	Mitigation/Enhancement/Management Measures	Responsibility	
		Construction	Operation
	• Plantation of trees in the proposed project site to reduce the amount of stormwater runoff; • Foundation structure of buildings, machinery, utilities should be elevated considering the base flood elevation to avoid flood/flash flood water or excess rainfall water.		
Climate Change Vulnerability	• Consideration of storm surge height in the design of the project and associated infrastructures; • Construction of dike around the proposed project site. The dikes should be designed to prevent flooding during high astronomical tides and during cyclone-generated storm surge too; • Mangrove afforestation should be given priority to create a green belt; • Social forestry should be promoted involving the participation of local people as the CSR activities; • Emission control is the prevention of climate change and sea level rise; • Control of deforestation and fossil fuel use is essential; • Compressed Natural Gas (CNG) driven vehicle that produced low hydrocarbon, carbon monoxide (CO) and CO_2 shall be encouraged to minimize GHG emission; • Encourage the use of biomass (e.g. biogas), and renewable resources (e.g. windmill, solar photovoltaic); • Planning for future storm surge heights due to sea level rise should be kept in mind.	Contractor	OPDL-2

13.2 Hazard and Risk Assessment

This section deals with various types of hazard analysis and finding a risk assessment in the proposed power plant. The safe working operation of the plant needs to identify the hazards, assess the associated risks and bring the risks to tolerable level on a continuous basis. There are several unsafe conditions and practices in various processes and equipment of the coal fired power plant led to a number of accidents and which can cause loss and injury to human lives, damages the property, interrupt production etc. A risk assessment is an important step in protecting the plant from such conditions. It helps us to focus on the risks that really have the potential to cause harm. The hazard resolution process is to assess the identified hazards in terms of the severity or consequence of the hazard and the probability of occurrence of each type of hazard. Risk classification by severity and probability can be performed by using a risk assessment matrix. Hazard can happen because of the nature of chemicals handled and the nature of process involved. So, for risk analysis the first step is to identify the hazardous chemicals which are to be studied for risk analysis. It involves the identification and assessment of risks at the project site and in the neighboring population who could get exposed to, because of hazards present. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of population etc.

In this EIA report, detailed assessment has been carried out to identify and mitigate the potential hazard associated with construction and operation of the power plant.

13.2.1 RA Study Objective

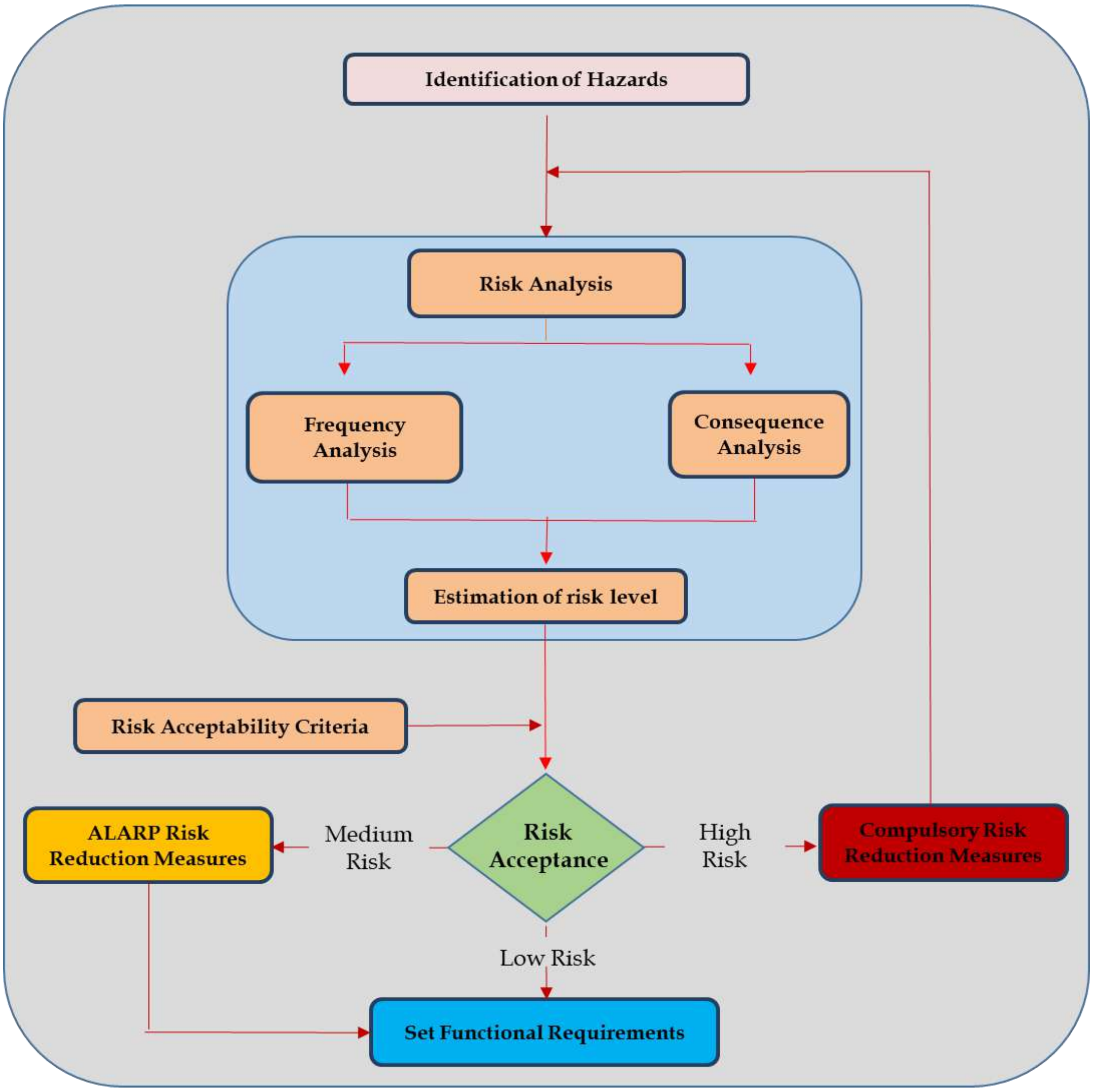
The overall objective of this RA with respect to the proposed project involves identification and evaluation of major risks, prioritizing risks identified based on their hazard consequences and using the outcome to guide and strengthen both onsite and offsite ERP. Hence to ensure effective management of any emergency situations that may arise from failure of various fuel storages. The following specific objectives need to be achieved.

- Identify potential risk scenarios that may arise from storage of volatile fuels in the plant.
- Review existing information and historical databases to arrive at possible likelihood of such risk scenarios.
- Predict the consequences of such potential risks scenarios and if consequences are observed to be high, establish the same through application of quantitative simulation.
- Recommend feasible preventive and risk mitigation measures as well as provide inputs for strengthening of the project Emergency Response Plan (ERP)

13.2.2 Risk Assessment Process

The risk assessment process is primarily based on the likelihood of occurrence of the risks identified and their possible hazard consequences particularly being evaluated through hypothetical accident scenarios. With respect to the proposed project, major risks viz. leak and rupture of storage tanks and pipelines have been assessed and evaluated through a risk matrix generated to combine the risk severity and likelihood factor. The overall approach of risk assessment is summarized in **Figure 13-5**.

Figure 13-5: Risk Assessment Methodology



Risk associated with the power plant operation have been determined semi-quantitatively as the product of likelihood/probability and severity/consequence by using order of magnitude data (risk ranking = severity/consequence factor X likelihood/probability factor). Significance of such project related risks was then established through their classification as high, medium, low, very low depending upon risk ranking.

The risk matrix is a widely accepted and standardized method of quantitative risk assessment and is preferred over purely quantitative methods, given its inherent limitations to define a risk event with certainty. The application of this tool has resulted in the prioritization of the potential risks events resulting from failure of OPDL-2 thus providing the basis for drawing up risk mitigation measures and leading to formulation of plans for risk and emergency management.

13.2.3 Potential Hazard and Risk During Different Stages

Major potential hazard has been identified for the proposed power plant. The potential hazards and risk during pre-construction, construction and operation of the proposed power plant are given in **Table 13-6** and **Table 13-7.**

Table 13-6: Potential Hazards and Risk During Pre-Construction and Construction Phase

Location of hazard	Project Activities	Potential Hazard	Root Causes	Consequences
Pre-construction				
• Machinery and equipment	• Bringing in machines, equipment and vehicles for site clearance activities	• Trips and fails • Cuts and bruises	• Fatigue or prior sickness • Mechanical failure • Lack of safety training • Not abiding to general health and safety and traffic rules	• Health injury • Disability • Life loss
Construction and Erection				
• Construction site	• Construction of building, steel structures and its foundation, cutting, welding, painting works, drilling work etc	• Accidents (burns), electric shocks etc) • Injuries from falls and slips • Cuts and bruises	• Fatigue or prior sickness • Electric failure • Equipment failure • Lack of safety protocols (e.g. not putting up warning signs or enclosing the area to prevent entry of outside people) • Not maintain a designated place for backfilling storage • Not maintaining enough lighting during the night (for those working overtime)	• Physical injury • Disability • Life loss
	• Work at heights	• Accidents • Injuries from falls and slips (e.g. broken bones, fractures, traumas, etc.) • Fatalities	• Fatigue or prior sickness • Lack of safety protocols (e.g. not putting up warning signs or enclosing the area to prevent entry of outside people) • Not maintain a designated place for backfilling storage • Not maintaining enough lighting during the night	• Health injury • Disability • Life loss
	• Vehicles movement	• Noise generation • Accident • Emission from vehicles • Spread of dust and minute particles due to vehicle movement	• Running engine, hydraulic horns, sirens etc. • Mechanical failure • Old engine or engine parts/lack of maintenance	• Injuries • Health problems (e.g. respiratory, hearing and/or cardiac problems) • Fatalities • Disabilities

Location of hazard	Project Activities	Potential Hazard	Root Causes	Consequences
	• Chemical storage area • Handling of hazardous chemical	• Accidental release of chemicals • Acute/chronic toxicity from exposures to chemicals • Fire/explosion	• Lack of safety protocols • Carelessness (e.g. smoking near chemical storage area) • Not proper bounding of chemical storage area • Improper chemical storage (e.g. faulty/leaky containers, improper containers, improper sealing of containers etc.)	• Health injuries (burns, anxiety, depression etc.) • Disabilities • Fatalities • Loss of properties
	• Occupational Hazard	• Cuts, bruises and burns • Falls, slips and tips • Health injuries • Sickness and illness	• Lack of safety awareness • Carelessness in maintaining safety protocols • Use of faulty machineries and equipment • Improper hygiene • Prior sickness or illness • Heavy workload	• Health injuries (burns, anxiety, depression etc.) • Disabilities • Fatalities

Table 13-7: Potential Hazards and Risk During Operation Phase

Location of Hazard	Project Activities	Potential Hazard	Root Causes	Consequences
• Machinery and equipment	• Plant operation	• Mechanical hazard • Fire hazard/explosion • Electrical hazard • Noise generation	• Mechanical failure • Lack of sound buffers	• Health injury • Fatalities • Property damage • Environmental pollution
• Boilers and pressure parts • Compressed air system and pipeline • Live steam line	• Operate pressure valve, switch and control system • Flows live high pressure steam from boiler to distillation unit	• Fire • Release of high-pressure steam • Explosion	• Failure of water pumps • Electric failure • Equipment failure • Mechanical failure of safety valves • Steam pipe crack • Accidental leakage, lack of heat sink for combustion process and non-functional safety and bypass valve.	• Incomplete combustion • Equipment damage • Health injury • Loss of life • Environmental pollution • Disability • Life loss

Location of Hazard	Project Activities	Potential Hazard	Root Causes	Consequences
• Chemical Storage	• Use chemicals for water treatment in different phases of demineralized water, cooling water and potable water	• Toxic accidental releases due to mal function of equipment. • Carelessness of the operator.	• Chemical spillage • Chemical fires • Mishandling and operational error • Toxic release	• Health injury (chronic or acute toxicity) • Disabilities • Loss of life • Environmental pollution
• Tank farm	• Storing fuel oil and LDO	• Explosion • Pool fire • Toxic vapor cloud • Shock wave	• Lack of safety awareness • Carelessness in maintaining safety protocols • Instrumental mal function • Improper maintenance	• Health injuries • Disabilities • Fatalities • Environmental pollution
• Effluent treatment plant	• Waste water treatment	• Toxic chemical release	• Spillage/accidental release • Improper management	• Impact on health • Loss of life • Environmental pollution
• Occupational hazard	• Plant operation	• Cuts, bruises and burns • Falls, slips and tips • Health injuries • Sickness and illness	• Lack of safety awareness • Carelessness in maintaining safety protocols • Use of faulty machineries and equipment • Improper hygiene • Prior sickness or illness • Heavy workload	• Health injuries • Disabilities • Fatalities • Sickness • Anxiety and depression

13.2.4 Hazard Identification

Hazard identification for the purposes of this QRA involves the qualitative review of the project design and operations including relevant information provided by OPDL-2. The major hazards are generally one of three types: flammable, reactive and/or toxic. In this study, only flammable hazards for fuel storage tanks and toxic hazard for Chlorine tonner leakages have been considered. Flammable hazards may manifest as high thermal radiation from fires and overpressures following explosions that may cause direct damage, building collapse, etc. Flammable hazards are present throughout the facility and associated pipelines. Fires may occur if flammable materials are released into the atmosphere and ignition takes place.

Based on the result of this exercise, potential hazards that may arise due to proposed project were identified and a qualitative understanding of their probability and significance were obtained. Taking into account the applicability of different risk aspects, the following hazards have been identified with respect to the proposed project which has been dealt with in detail in the subsequent sections.

- Release of HFO/LDO from failure of loading/unloading line or hose and from storage tank leaks may lead to pool fire and
- Accidental release of HFO/LDO from pipelines leading to pool fires.
- Accidental release of chlorine from tonners leading to toxic vapor cloud dispersion

It must also be noted here that many hazards identified are sometimes interrelated with one hazard often having the ability to trigger another hazard through a domino effect. For example, a large oil spill in most instances is caused by another hazardous incident like a blowout or process leak. This aspect has been considered while drawing up hazard mitigation measures and such linkages (between hazards) has also been given due importance for managing hazards and associated risks in a composite manner through OPDL-2's Health, Safety & Environmental Management System (HSEMS) and through the Emergency Management Plan, if a contingency situation so arises.

13.2.4.1 Hazards from Flammable Liquid Storage

There are a number of hazards that are present at the proposed project site that may result in injury to people or a fatality in more serious cases. This study is only concerned with 'major hazards', which are as follows:

- Hydrocarbon fires associated with tank failures.
- Storage tank fires;
- Flash fires.

Each of these hazards has been described below.

<u>Pool Fires</u>

The principal type of hydrocarbon fire of interest in this study is pool fire. If a liquid release has time to form a pool and is then ignited before the pool evaporates or drains away, then a pool fire results. Because they are less well aerated, pool fires tend to have lower flame temperatures and produce lower levels of thermal radiation than some other types of fire (such as jet fires); however, this means that they will produce more smoke. Although a pool fire can still lead to structural failure of items within the flame, this will take several times longer than in a jet fire. An additional hazard of pool fires is their ability to move.

A burning liquid pool can spread along a horizontal surface or run down a vertical surface to give a running fire. Due to the presence of kerbs, slopes, drains and other obstacles, pool fire areas and directions can be unpredictable.

Flash Fire

Vapour clouds can be formed from the release of flashing liquids of pressurized flammable material as well as from non-flashing liquid releases where vapour clouds can be formed from the evaporation of liquid pools or from an overfilling of storage tanks or vessels. Where ignition of a release does not occur immediately, a vapour cloud is formed and moves away from the point of origin under the action of the wind. This drifting cloud may undergo delayed ignition if an ignition source is reached, resulting in a flash fire if the cloud ignites in an unconfined area or vapour cloud explosion (VCE) if within confined area. Flash fires are considered to be possible as a result of overfilling of storage tanks. Vapour from evaporating pools is not considered to result in flash fires due to slower evaporation rates. The cloud typically stays above the liquid pool and does not disperse significantly out of the bund limits. Should vapour be ignited it will most likely initiate a pool fire of the released pool.

Damage due to Fire

The flammable liquid in a pool will burn with large turbulent diffusion flame. This release heat based on the heat of combustion and the burning rate of the liquid. A part of the heat is radiated while the rest is convicted away by rising hot air and combustion products. The radiation can heat nearby storage or process units to above their ignition temperatures and thus result in spread of fire.

The radiation can also cause severe burns or fatalities to workers or firefighters located within a certain distance. Hence, it will be important to know beforehand the damage potential of flammable liquid pool likely to be created due to leakage or catastrophic failure of storage or process vessel. This will help decide the location of other storage/process vessels, decide the protective clothing the workers/firefighters need, the duration of time for which they can be in the zone, the fire extinguishing measures needed, and the protection methods needed for nearby storage vessels. Effect of thermal radiation on equipment and people is tabulated in **Table 13-8**.

Table 13-8: Effect of Thermal Radiation on Equipment and People

SL. No	Incident Radiation (kW/m^2)	Type of damage caused	
		Damage to Equipment	Damage to People
1	37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10 sec.
2	25.0	Minimum energy required to ignite wood at indefinitely long exposure without a flame	50% Lethality in 1 min. Significant injury in 10 sec.
3	19.0	Maximum thermal radiation intensity allowed on thermally unprotected adjoining equipment	----
4	12.5	Minimum energy to ignite with a flame; melts plastic tubing	1% lethality in 1 min. First degree burns in 10 sec
5	4.5	----	Causes pain if duration is longer than 20 sec, but blistering is un-likely
6	1.6	-----	Causes no discomfort on long exposures

Source: Techniques for Assessing Industrial Hazards, World Bank Technical Paper 55, page 87

13.2.4.2 Hazards from Chlorine

Chlorine is a highly toxic chemical being extremely irritating to the mucous membranes of the eyes and respiratory tract. It combines with moisture to liberate nascent oxygen and form hydrochloric acid. Both these substances, if present in quantity, cause inflammation of the tissues with which they come in contact. If the lung tissues are attacked, pulmonary edema may result.

The current OSHA standard for chlorine is a ceiling level of 1 ppm averaged over a 15-minute period and an IDLH value of 10 ppm. [44] NIOSH has recommended that the permissible exposure limit to be 0.5 ppm measured over a 15-minute period. Overexposure to concentrations moderately above the TLV of1 ppm irritates the eyes and respiratory tract. Chlorine is extremely irritant to the mucous membrane of the eyes at 3ppm and respiratory tract; 15 ppm causes immediate irritation of the throat. Concentrations of 50 ppm are dangerous for even short exposures. Concentrations of about 400 ppm and beyond are generally fatal over 30 minutes, and at 1,000 ppm and above, fatality ensues within only a few minutes.

13.2.5 Frequency Analysis

The frequency analysis of the hazards identified with respect to the proposed project was undertaken to estimate the likelihood of their occurrences during the project life cycle. Hazard frequencies in relation to the proposed project were estimated based on the analysis of historical accident frequency data and professional judgement. Based on the range of probabilities arrived at for different potential hazards that may be encountered with respect HFO storage tank the following frequency categories and criteria have been identified (**Table 13-9**)

Table 13-9: Frequency Categories and Criteria

Likelihood Ranking	Criteria Ranking(cases/year)	Frequency Class
5	Likely to occur often in the life of the project, with a probability greater than 10^{-1}	Frequent
4	Will occur several times in the life of project, with a probability of occurrence less than 10^{-1} but greater than 10^{-2}	Probable
3	Likely to occur sometime in the life of a project with a probability of occurrence less than 10^{-2} but greater than 10^{-3}	Occasional/Rare
2	Unlikely but possible to occur in the life of a project, with a probability of occurrence less than 10^{-3} but greater than 10^{-6}	Remote
1	So unlikely it can be assumed that occurrence may not be experienced, with a probability of occurrence less than 10^{-6}	Improbable

Source: Guidelines for Developing Quantitative Safety Risk Criteria – Centre for Chemical Process and Safety

13.2.5.1 Frequency Analysis- Diesel and HFO Storage Tank

The most credible scenario of a diesel and HFO tank will be pool fire. In order to determine the probability of a pool fire occurring, the failure rate needs to be modified by the probability of the material finding an ignition source. The probability of a pool fire occurring in the event of a release is therefore equal to the product of the failure rate and the probability of ignition. Diesel Tank failure frequency is given in **Table 13-10**.

Table 13-10: Tank Failure Frequency

Sl.	Types of Release	Failure Rate	Frequency
1	Catastrophic tank failure	5.0×10^{-6}	Remote
2	Small bund fire	9.0×10^{-5}	Remote
3	Large bund fire	6.0×10^{-5}	Remote

[44] NIOSH- Occupational Health Guideline for Chlorine

Source: OGP Risk Assessment Data Directory Report No 434 – 3, March 2010, Section-2 – Summery and Recommendation Data

13.2.5.2 Frequency Analysis - Chlorine Storage Tanks

The failure frequency of chlorine tonners is established based on review of the UK HSE Database - Failure Rate and Event Data for use within Risk Assessments. The failure rates for chlorine storages are presented in **Table 13-11**.

Table 13-11: Chlorine Storage - Failure Rates based on Type of Release

Sl.	Type of Release	Failure Rate	Frequency
1	Catastrophic	4.0×10^{-6}	Remote
2	50 mm diameter hole	5.0×10^{-6}	Remote
3	25 mm diameter hole	5.0×10^{-6}	Remote
4	13 mm diameter hole	1.0×10^{-5}	Remote
5	6 mm diameter hole	4.0×10^{-5}	Remote

Source: UK HSE Database

13.2.6 Consequence Analysis

In parallel with the frequency analysis, hazard prediction / consequence analysis exercises were undertaken to assess the likely impact of project related risks on onsite personnel, infrastructure, and environment. In relation to the proposed project, the estimation of the consequences for each possible event has been based either on accident frequency, consequence modeling or professional judgment, as appropriate. Overall, the consequence analysis takes into account the following aspects:

- Nature of impact on environment and community;
- Occupational health and safety;
- Asset and property damage;
- Corporate image
- Timeline for restoration of environmental and property damage
- Restoration cost for environmental and property damage

Table 13-12 represent criteria for consequence rankings during the operation of fuel storage facilities based on life safety, environmental and property damage consequences.

Table 13-12: Severity Categories and Criteria

Consequence	Ranking	Criteria Definition
Catastrophic	5	• Multiple fatalities/Permanent total disability to more than 50 persons • Severe violations of national limits for environmental emission • More than 5 years for natural recovery • Net negative financial impact of >10 crores • Long term impact on ecologically sensitive areas • International media coverage • National stakeholder concern and media coverage
Major	4	• Single fatality/permanent total disability to one or more persons

Consequence	Ranking	Criteria Definition
		• Major violations of national limits for environmental emissions • 2-5 years for natural recovery • Net negative financial impact of 5 -10 crores • Significant impact on endangered and threatened floral and faunal species • Loss of corporate image and reputation
Moderate	3	• Short term hospitalization & rehabilitation leading to recovery • Short term violations of national limits for environmental emissions • 1-2 years for natural recovery • Net negative financial impact of 1-5 crores • Short term impact on protected natural habitats • State wide media coverage
Minor	2	• Medical treatment injuries • 1 year for natural recovery • Net negative financial impact of 0.5 – 1 crore • Temporary environmental impacts which can be mitigated • Local stakeholder concern and public attention
Insignificant	1	• First Aid treatment with no Lost Time Incidents (LTIs) • Natural recovery < year • Net negative financial impact of <0.5 crores. • No significant impact on environmental components • No media coverage

Source: EQMS consequence ranking methodology

13.2.7 Risk Evaluation

Based on ranking of likelihood and frequencies, each identified hazard has been evaluated based on the likelihood of occurrence and the magnitude of consequences. The significance of the risk is expressed as the product of likelihood and the consequence of the risk event, expressed as follows:

Significance = Likelihood X Consequence

Risk calculation matrix is presented in **Table 13-13**

Table 13-13: Risk Matrix

		Likelihood →					
			Frequent	**Probable**	**Remote**	**Not Likely**	**Improbable**
			5	**4**	**3**	**2**	**1**
Consequence	**Catastrophic**	**5**	25	20	15	10	5
	Major	**4**	20	16	12	8	4
	Moderate	**3**	15	12	9	6	3

		Likelihood →					
			Frequent	**Probable**	**Remote**	**Not Likely**	**Improbable**
			5	**4**	**3**	**2**	**1**
	Minor	**2**	10	8	6	4	2
	Insignificant	**1**	5	4	3	2	1

Source: EQMS risk assessment methodology

Table 13-14: Risk Criteria and Action Requirement

Risk Significance	Criteria Definition and Action Requirements
High (16 - 25)	**"Risk requires attention"** Project HSE Management need to ensure that necessary miti gation are adopted to ensure that possible risk remains within acceptable limits.
Medium (10 - 15)	**"Risk is tolerable" -** Project HSE Management needs to adopt necessary measures to prevent any change/modification of existing risk controls and ensure implementation of all practicable controls.
Low (5 -9)	**"Risk is acceptable with mitigation" -** Project related risks are managed by well-established controls and routine processes/procedures. Implementation of additional controls can be considered.
Very Low (1 4)	**"Risk is acceptable" -**All risks are managed by well-established controls and routine processes/procedures. Additional risk controls need not to be considered

Source: EQMS risk assessment methodology

13.2.8 Consequence Analysis of Fuel and Gas

The facilities at the Fuel Dyke area terminal mainly comprise of HFO and Diesel storage tanks. The hazards posed by them are mainly in the form of fire. There is a possibility of pool fire taking place in the event of large spill of hydrocarbons, mainly major failure scenarios were evaluated to assess the effect on people and property inside the plant area as well as outside.

The effect of fire on people and property outside will chiefly manifest itself in the form of thermal radiation. A criterion was selected for deciding the maximum level of thermal radiation to which the outside population can be subjected. Thermal radiation levels from fire scenarios of each tank are worked out at various distances and their effects are evaluated against the set criteria.

The main hazards associated with the storage and handling of fuels are pool fires resulting from the ignition of released material as well as explosions. Hazardous chemicals also can be realized following tank overfilling and leaks/failures in the storage tank and ancillary equipment such as transfer pumps, metering equipment, etc. Fuel oil is a combustible liquid, which will burn if the temperature of the liquid exceeds the flash point and the vapor generated at the liquid surface is ignited. The resultant incident is a pool fire that radiates heat to the surrounding area resulting in a potential equipment damage and/or injury/fatality.

Fuel oil is also a contaminant to the biophysical environment and its release can damage sensitive environmental areas surrounding the storage area in the event a leak occurs and escapes to the environment. Fuel will also float on water and be carried a significant distance from a leak point by a water course.

13.2.8.1 Bulk Storage Tank Scenario

In addition to overfill, the scenarios considered for the HFO and LDO storage tanks may have partial/local failures and cold catastrophic failures. Factors that have been identified as having an effect on the integrity of tanks are related to design, inspection, maintenance, and corrosion. **Table 13-15** represents scenarios for the tanks which are being considered for risk modeling.

Table 13-15: Fuel Tank-Risk Modeling Scenario

Scenario	Tank	Tank Diameter (m)	Tank Height (m)	Tank Volume (m^3)	Accident Scenario
1.	LDO Storage Tank	9	10	500	50 mm leak
2.					100 mm leak
3.					1000 mm leak
1.	HFO Storage Tank	12	16	1500	50 mm leak
2.					100 mm leak
3.					1000 mm leak

The above risk scenarios are modeled using ALOHA[45] and interpreted in terms of Thermal Radiation Level of Concern (LOC). Predominant local meteorological conditions as specified in the baseline chapter have been considered in modeling using ALOHA. Thermal Radiation Level of Concern (LOC) is a threshold level of thermal radiation, usually the level above which a hazard may exist. For each LOC chosen, ALOHA estimates a threat zone where the thermal radiation is predicted to exceed that LOC at some time after a release begins. These zones are displayed on a single Threat Zone plot displayed as red, orange and yellow with red representing the worst hazard. The threat zone displayed by ALOHA represent thermal radiation levels and also indicates the effects on people who are exposed to those thermal radiation levels but are able to seek shelter within one minute. ALOHA uses three threshold values (measured in kilowatts per square meter) to create the default threat zones:

- Red: 10 kW/ (sq m) -- potentially lethal within 60 sec;
- Orange: 5 kW/ (sq m) -- second-degree burns within 60 sec; and
- Yellow: 2 kW/ (sq m) -- pain within 60 sec

For toxic gas release Emergency Response Planning Guidelines (ERPGs) are used as LOCs

13.2.8.1.1 Thermal Radiation Threat Zone-LDO storage

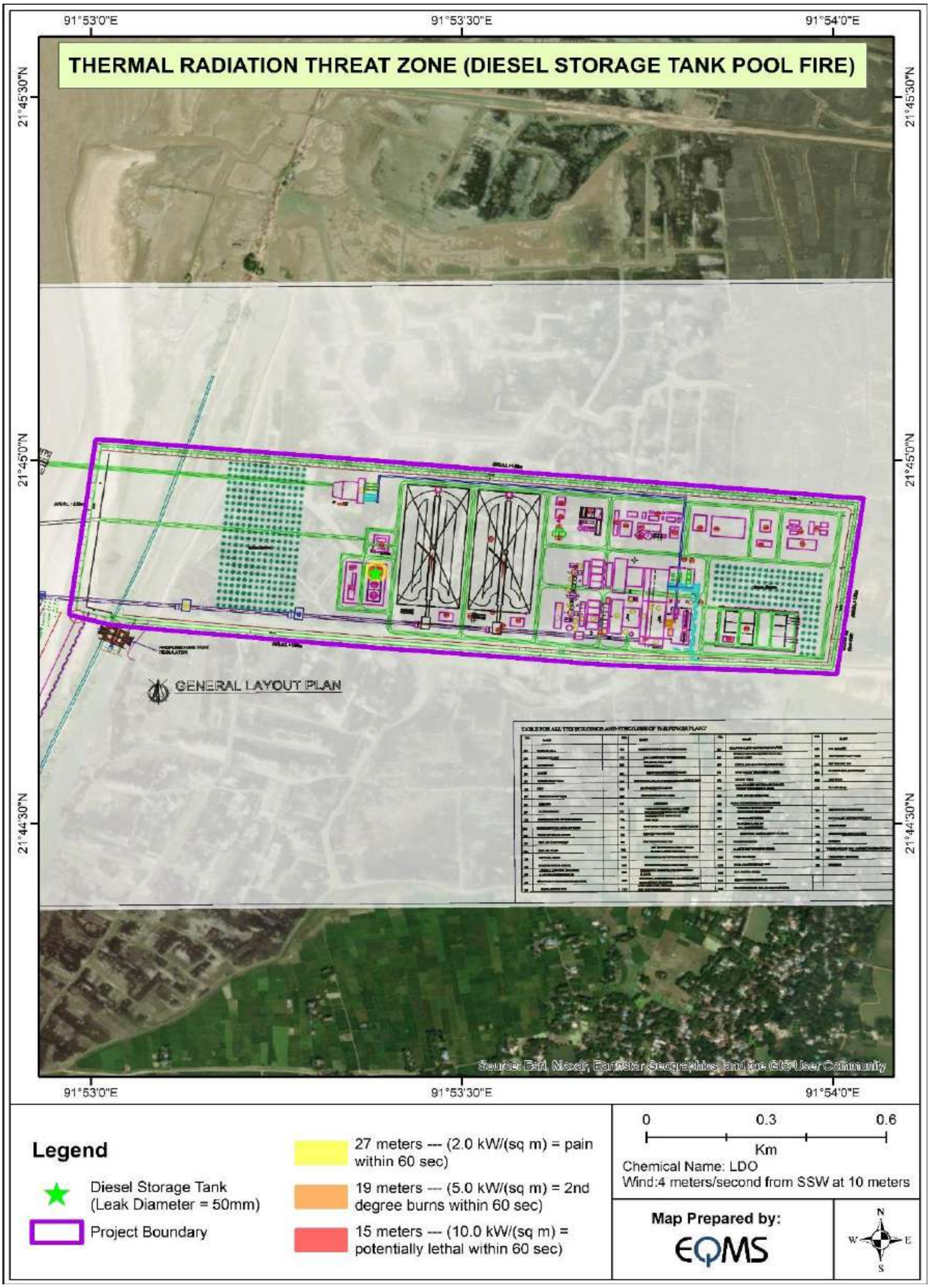
Scenario-1

The pool fire thermal radiation threat zone for 50 mm leak size of the LDO storage tank is presented **Figure 13-6**.

45

ALOHA is a public domain computer code that is part of a system of software that is known as the Computer-Aided Management of Emergency Operations (CAMEO) that was developed by the **United States Environmental Protection Agency (EPA)**, through its Chemical Emergency Preparedness and Prevention Office (CEPPO) to plan for and respond to chemical emergencies

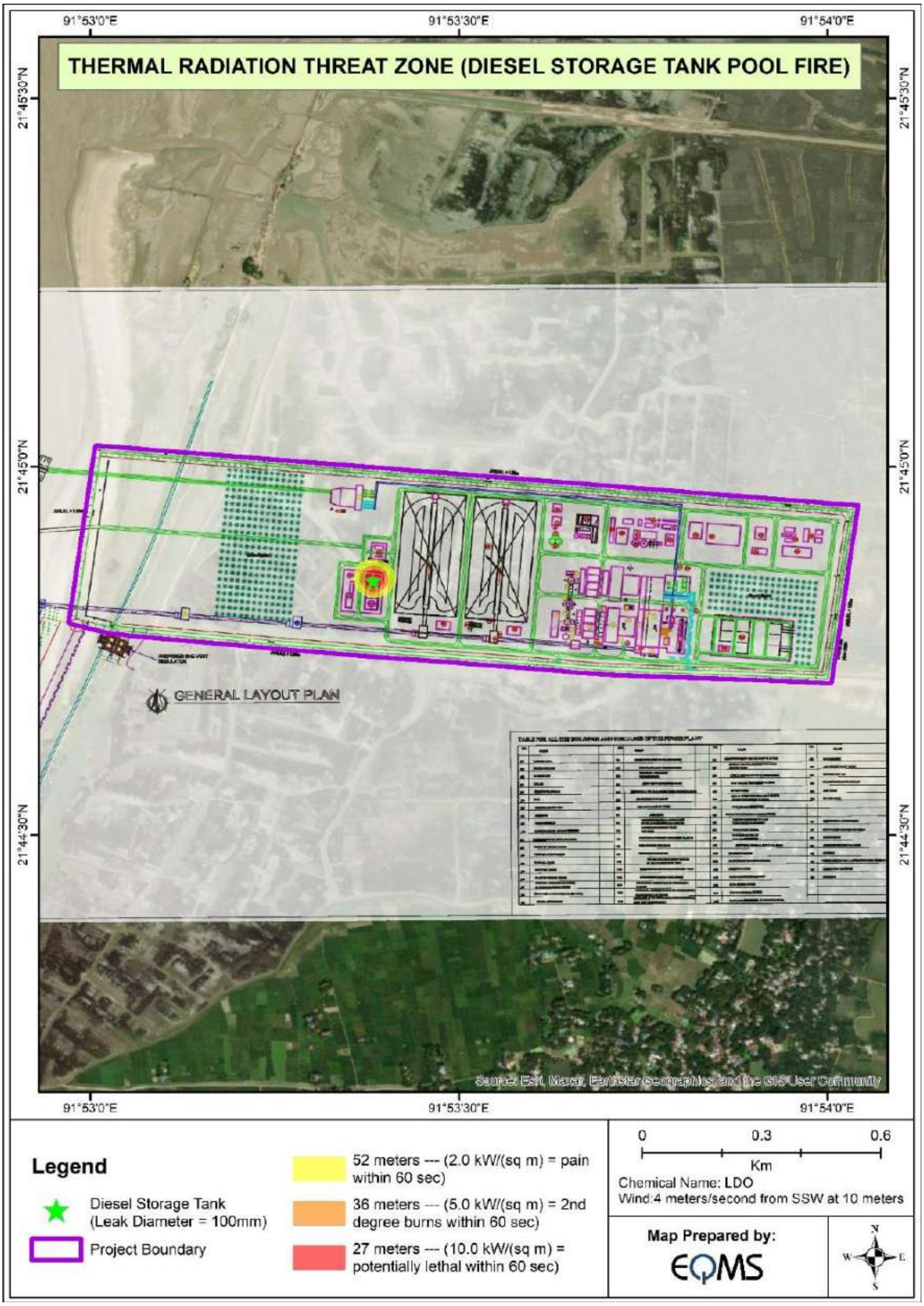
Figure 13-6: Thermal Radiation Threat Zone for 50 mm LDO Storage Tank Leakage



Scenario-2

The pool fire thermal radiation threat zone for 100 mm leak size of the LDO storage tank is presented **Figure 13-7.**

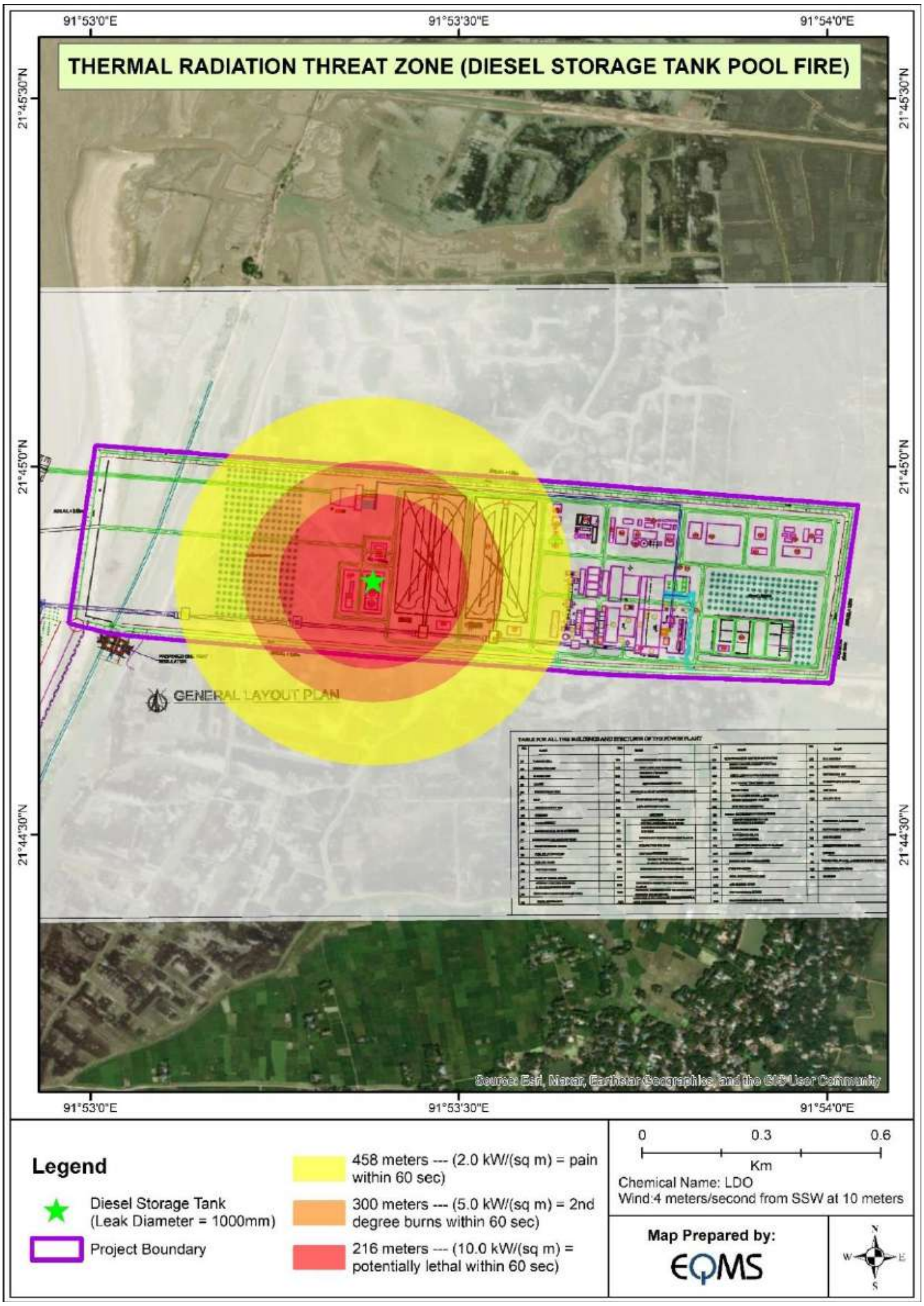
Figure 13-7: Thermal Radiation Threat Zone for 100 mm LDO Storage Tank Leakage



Scenario-3

The pool fire thermal radiation threat zone for 1000 mm leak size of the LDO storage tank is presented **Figure 13-8**.

Figure 13-8: Thermal Radiation Threat Zone for 1000 mm LDO Storage Tank Leakage



13.2.8.1.2 Risk Ranking of LDO Storage Tank

For various hypothetical scenarios considered with respect to LDO storage tank leaks of OPDL-2 the threat zones calculated using ALOHA for defined thermal radiation intensities have been presented in the **Table 13-16**.

Table 13-16: Pool Fire Thermal Radiation Threat Zone (Lethal) for LDO Storage Tank Leakage

Case No	Release Type	Accident Scenario	Thermal Radiation Threat Zone		
			Distance to 10.0 kW/m^2 (m)	Distance to 5.0 kW/m^2 (m)	Distance to 2.0 kW/m^2 (m)
1	Small Bund Fire (9.0 x 10^{-5})	Leak dia=50 mm	15	19	27
2		Leak dia=100 mm	27	36	52
3	Large Bund Fire (6.0 x 10^{-5})	Leak dia=1000 mm	216	300	456

For calculating the risk significance of LDO storage failure, the likelihood ranking is considered to be "2" as the failure probability for such failure is computed to be 6.0 x 10^{-5} per year. With respect to consequence ranking, for the aforesaid incident it has been identified to be as "4" given for a 1000 mm leak scenario lethal effects is likely to be experienced within a maximum radial zone ~216 meters. However, considering that isolated storages will be equipped appropriate state of the art process and fire safety controls in consistent with OISD-117 requirements, the risk is likely to be less significant.

Risk Ranking- LDO Storage Tank Failure (1000 mm Leak Scenario)

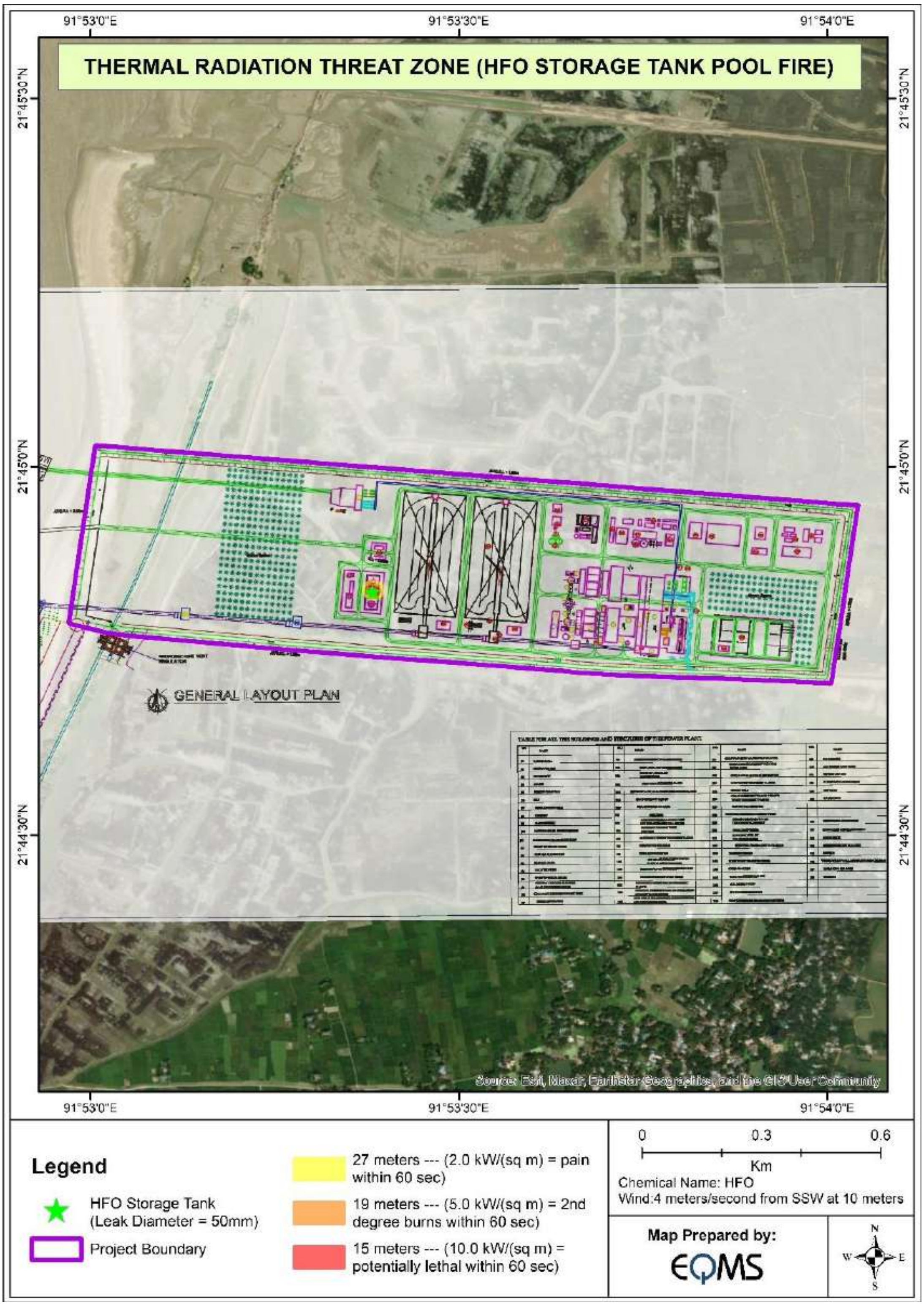
Likelihood Ranking	2	Consequence Ranking	4
Risk Ranking & Significance = 8 i.e. "Low" i.e. Risk is Acceptable with mitigation and can be managed through use of existing controls and evaluation of additional controls.			

13.2.8.1.3 Thermal Radiation Threat Zone-HFO storage

Scenario-1

The pool fire thermal radiation threat zone for 50 mm leak size of the HFO storage tank is presented **Figure 13-9**.

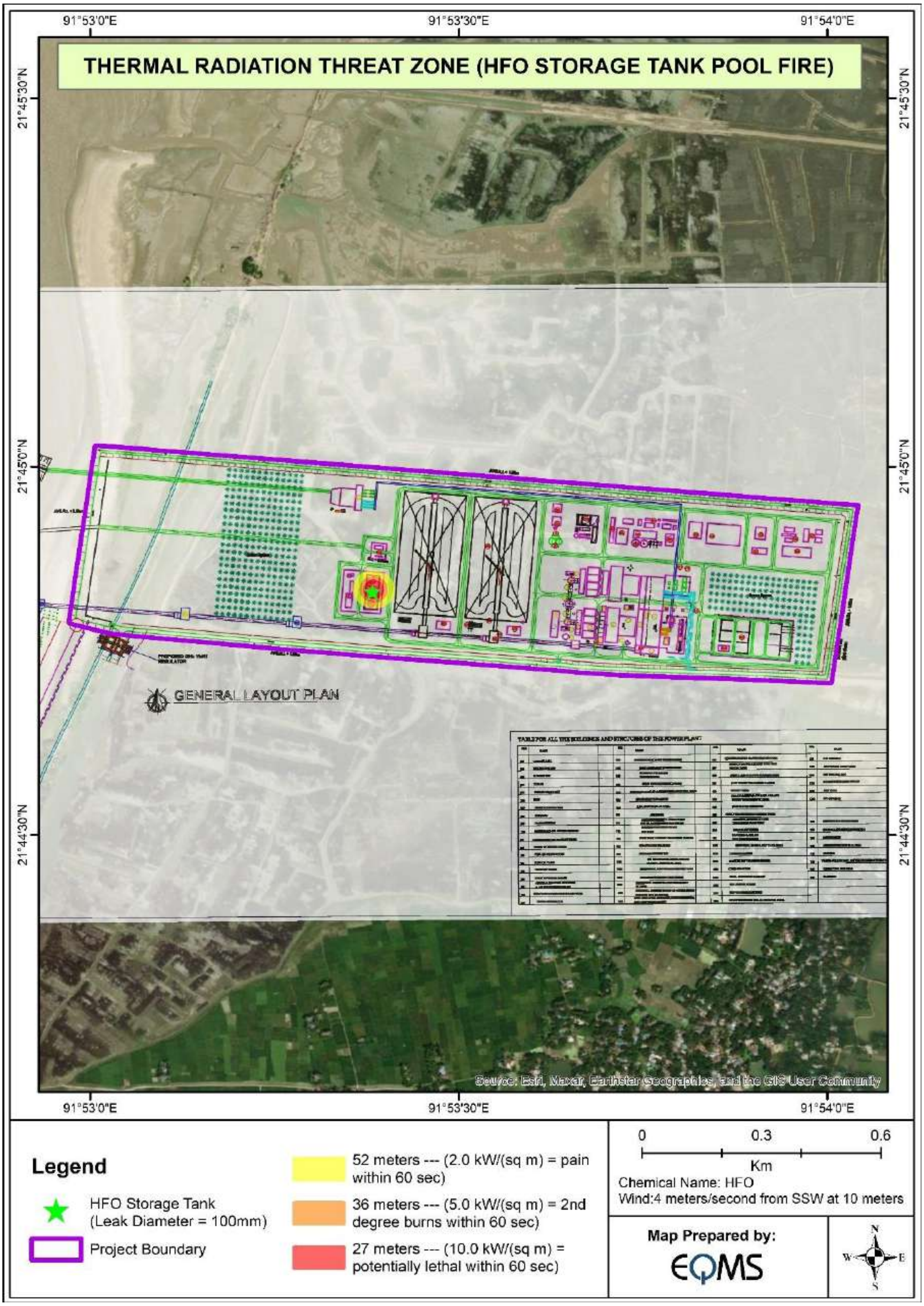
Figure 13-9: Thermal Radiation Threat Zone for 50 mm HFO Storage Tank Leakage



Scenario-2

The pool fire thermal radiation threat zone for 100 mm leak size of the HFO storage tank is presented in **Figure 13-10.**

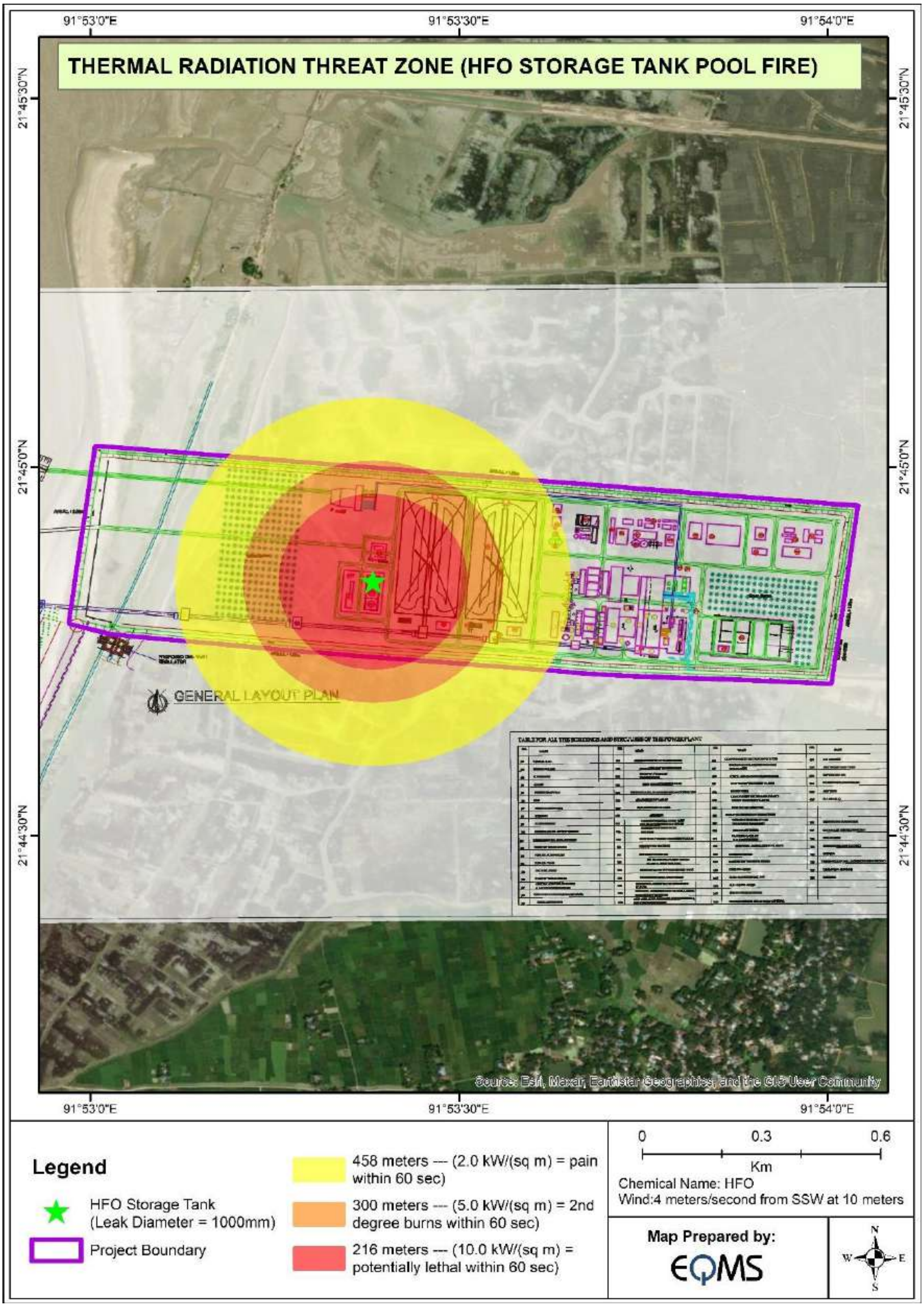
Figure 13-10: Thermal Radiation Threat Zone for 100 mm HFO Storage Tank Leakage



Scenario-3

The pool fire thermal radiation threat zone for 1000 mm leak size of the HFO storage tank is presented **Figure 13-11**.

Figure 13-11: Thermal Radiation Threat Zone for 1000 mm HFO Storage Tank Leakage



13.2.8.1.4 Risk Ranking of HFO Storage Tank

For various hypothetical scenarios considered with respect to HFO storage tank leaks of OPDL-2 the threat zones calculated using ALOHA for defined thermal radiation intensities have been presented in the **Table 13-17**.

Table 13-17: Pool Fire Thermal Radiation Threat Zone (Lethal) for HFO Storage Tank Leakage

Case No	Release Type	Accident Scenario	Thermal Radiation Threat Zone		
			Distance to 10.0 kW/m² (m)	Distance to 5.0 kW/m² (m)	Distance to 2.0 kW/m² (m)
1	Small Bund Fire (9.0×10^{-5})	Leak dia=50 mm	15	19	27
2		Leak dia=100 mm	27	36	52
3	Large Bund Fire (6.0×10^{-5})	Leak dia=1000 mm	216	300	456

For calculating the risk significance of HFO storage failure, the likelihood ranking is considered to be "2" as the failure probability for such failure is computed to be 6.0×10^{-5} per year. With respect to consequence ranking, for the aforesaid incident it has been identified to be as "4" given for a 1000 mm leak scenario lethal effects is likely to be experienced within a maximum radial zone ~216 meters. However, considering that isolated storages will be equipped appropriate state of the art process and fire safety controls in consistent with OISD-117 requirements, the risk is likely to be less significant.

Risk Ranking- HFO Storage Tank Failure (1000 mm Leak Scenario)

Likelihood Ranking	2	Consequence Ranking	4
Risk Ranking & Significance = 8 i.e. "Low" i.e. Risk is Acceptable with mitigation and can be managed through use of existing controls and evaluation of additional controls.			

13.2.8.2 Chlorine Tonner Scenario

The release of chlorine from storage tanks can result due to corrosion, exothermic reaction, exposure to heat, failure of alarm devices/detectors etc. Generally, chlorine is stored as a liquid under pressure in steel containers within a specifically designed enclosure equipped with various detection and safety devices. When a rupture or leak occurs in a liquid chlorine container, the sudden reduction in pressure that occurs causes a portion of the liquid to vaporize as it is released. The remaining liquid chlorine vaporized as it is warmed by the environment. When it becomes a vapor, liquid chlorine expands to 450 times the liquid volume. Consequently, a liquid chlorine release can affect a significantly greater than a chlorine gas release from a vessel or pipe with similar size hole. In all cases (depending upon the release volume), the incident will be a toxic vapor cloud moving downwind. Chlorine released from process could result in significant consequences to the health of personnel within the affected areas due to its highly toxic nature. Taking into account the above tankage failure consequences and frequency analysis the following hypothetical risk scenarios (Refer) have been considered for risk modelling for chlorine release from tanks at the storage yard.

Table 13-18: Chlorine Tonner- Risk Modelling Scenarios

Scenario	Tank	Tank Diameter (m)	Tank Height (m)	Tank Volume (m³)	Accident Scenario
1.	Chlorine Tonner	0.76	2.08	0.94	5mm leak
2.					10 mm leak
3.					Catastrophic Failure

For chlorine release from tonners, the LOC has been interpreted in terms of health effects on general public on exposure to specific concentration of chlorine expressed in terms of part per million (ppm). Based on review of the standard reference documents on chlorine - NIOSH, OSHA and Dangerous

Materials Handbook by Irving Sax, the following threat zones have been considered for risk modelling of chlorine release from tonner using ALOHA.

Red: 20 ppm -Dangerous to Life or Health (EPRG-3).

Orange: 3 ppm - Irritation to the mucous membrane of eye (EPRG-2); and

Yellow: 1 ppm - Permissible Exposure Limit (PEL)/EPRG-1

13.2.8.2.1 Toxic Threat Zone-Chlorine Tonner

<u>Scenario 1: Chlorine Tonner leak (5 mm dia)</u>

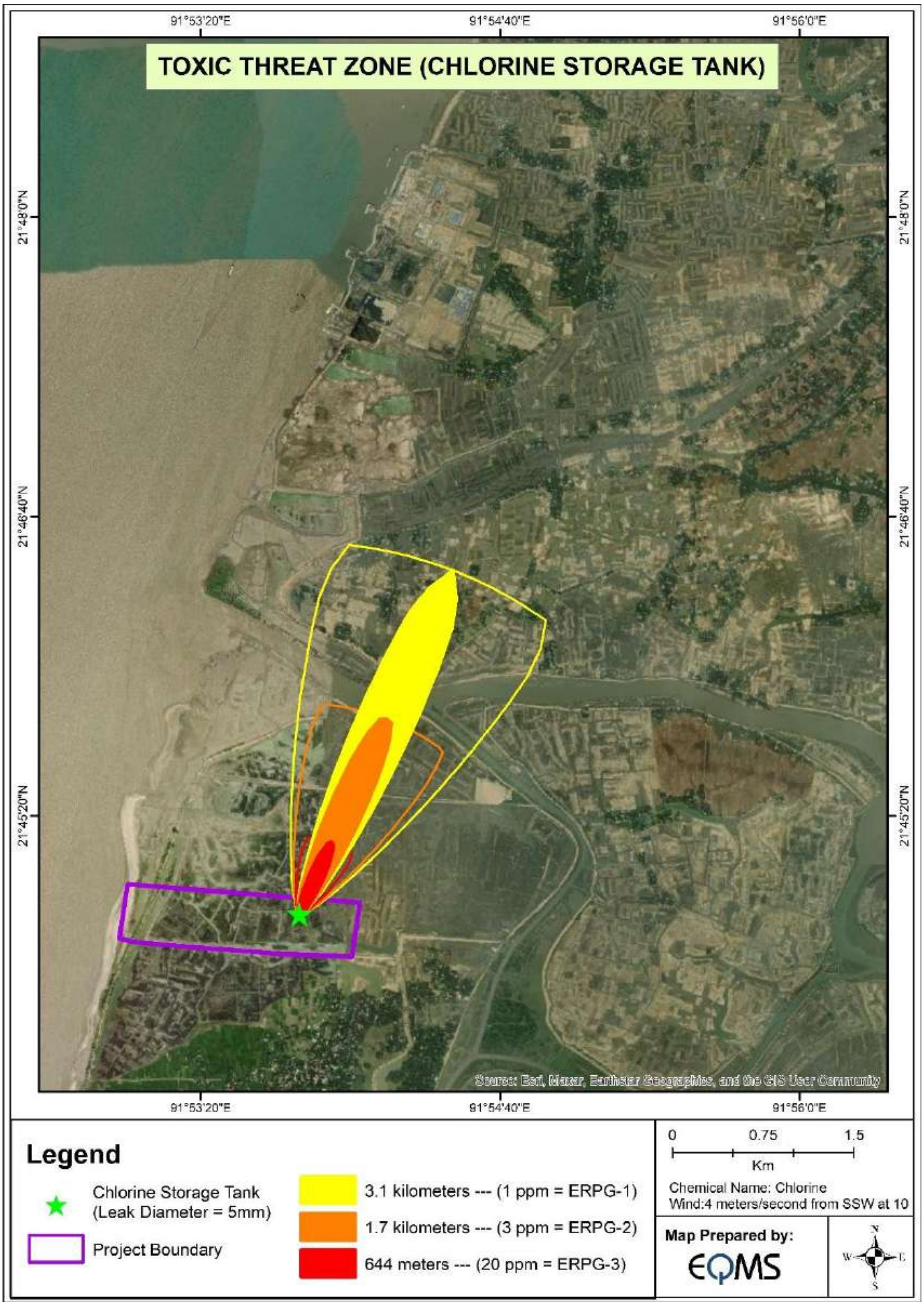
The toxic vapor cloud threat zone plot for release of chlorine gas from leak (5 mm dia) of chlorine tonner is represented in **Figure 13-12**.

Threat Zone

Legend	Diameter	Concentration (ppm)	Remarks
Red	644 m	20	Dangerous to Life or Health, EPRG-3
Orange	1.7 km	3	Irritation to the mucous membrane of eye EPRG-2
Yellow	3.1 km	1	Permissible Exposure Limit (PE L)/ EPRG-I, PEL/EPRG-1

The hazard for release of toxic chlorine Vapor from 5mm leak of a chlorine tonner will be experienced within a radial distance of 3.1 km from Source.

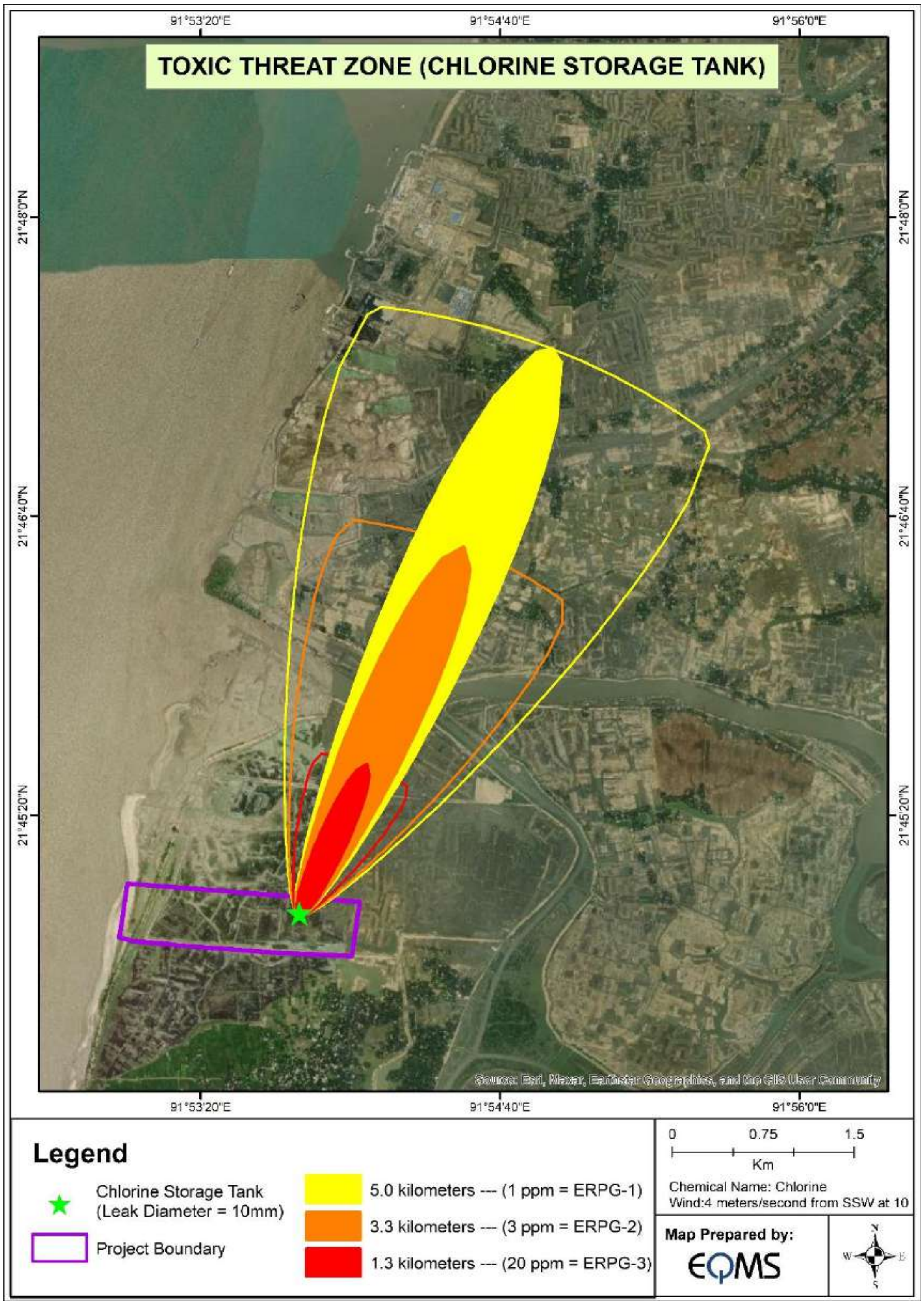
Figure 13-12: Toxic Threat Zone Plot- Chlorine Tonner Leak (5 mm dia)



Scenario 2: Chlorine Tonner leak (10 mm dia)

The toxic vapor cloud threat zone plot for release of chlorine gas from leak (10 mm dia) of chlorine tonner is represented in **Figure 13-13**.

Figure 13-13: Toxic Threat Zone Plot- Chlorine Tonner Leak (10 mm dia)



Threat Zone of 10 mm Leak

Legend	Diameter	Concentration (ppm)	Remarks
Red	1.3 km	20	Dangerous to Life or Health, EPRG-3

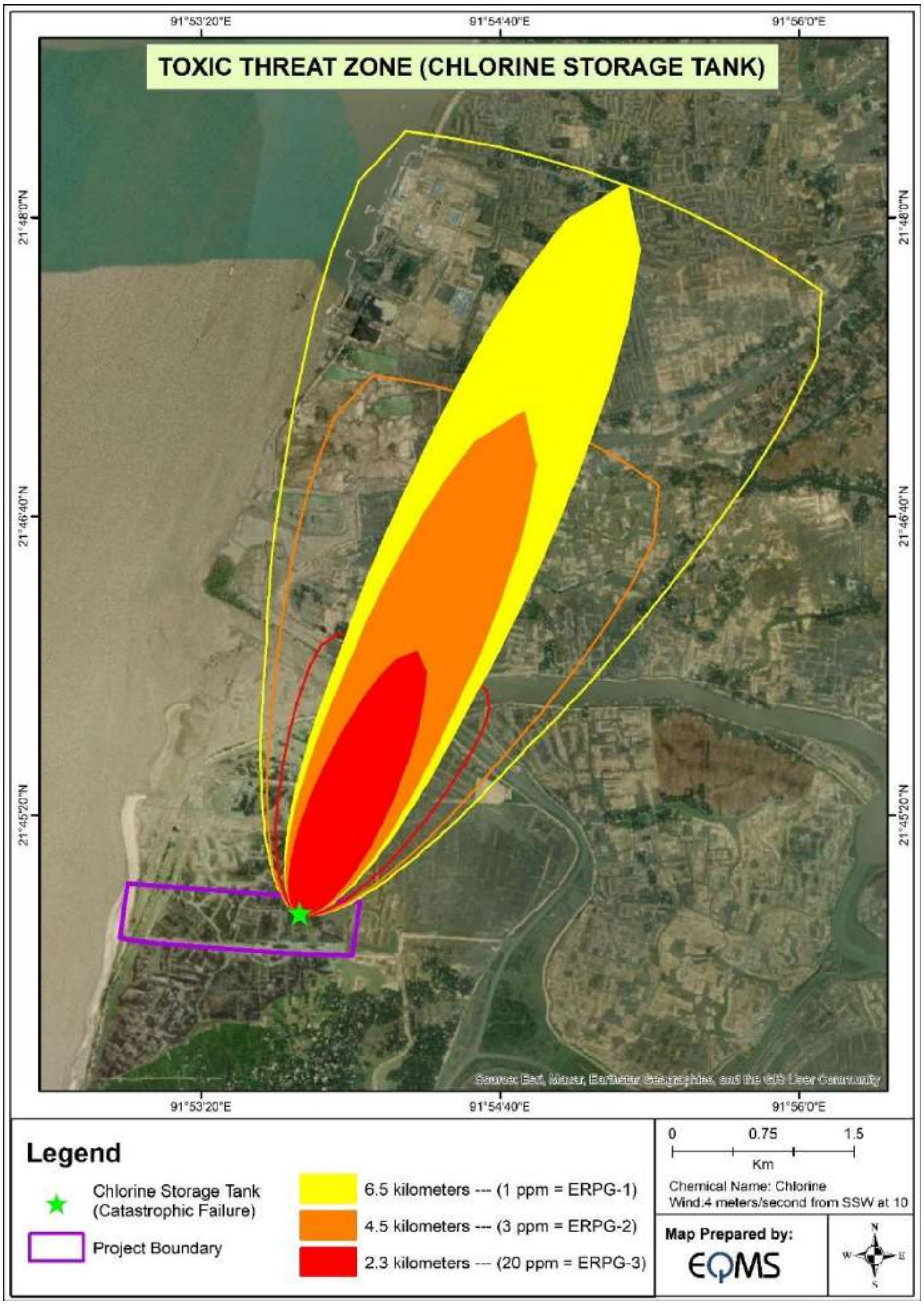
Orange	3.3 km	3	Irritation to the mucous membrane of eye EPRG-2
Yellow	5.0 km	1	Permissible Exposure Limit (PE L)/ EPRG-I, PEL/EPRG-1

The hazard for release of toxic chlorine Vapor from 5mm leak of a chlorine tonner will be experienced within a radial distance of 5.0 km from Source.

Scenario 3: Chlorine Tonner leak (750 mm dia)

The toxic vapor cloud threat zone plot for release of chlorine gas from leak (750 mm dia) of chlorine tonner is represented in **Figure 13-14**.

Figure 13-14: Toxic Threat Zone Plot-Catastrophic Failure of Chlorine Tonner



Threat Zone of 750 mm Leak (Catastrophic)

Legend	Diameter	Concentration (ppm)	Remarks
Red	2.3 km	20	Dangerous to Life or Health, EPRG-3
Orange	4.5 km	3	Irritation to the mucous membrane of eye EPRG-2
Yellow	6.5 km	1	Permissible Exposure Limit (PE L)/ EPRG-I, PEL/EPRG-1

The hazard for release of toxic chlorine Vapor from 5mm leak of a chlorine tonner will be experienced within a radial distance of 6.5 km from Source.

13.2.8.2.2 Risk Ranking of Chlorine Storage Tank

For calculating the risk significance of chlorine tonner failure, the likelihood ranking is "2" as the failure probability for such failure is computed to be ~4 xl0^{-6} per year. As in with respect to consequence ranking, for the aforesaid incident it has been identified to be as "5" given for a worst-case scenario a concentration of 20ppm will be manifested within a zone of 2.3 km from source. However appropriate mitigation measures and controls will be adopted by the site to both prevent and control any major risk associated with chlorine release at source.

Risk Ranking- HFO Storage Tank Failure (1000 mm Leak Scenario)

Likelihood Ranking	**2**	**Consequence Ranking**	**5**
Risk Ranking & Significance = 10 i.e. "Medium" i.e. Risk is Tolerable and can be managed through adoption of necessary controls.			

13.3 Emergency Response Plan

13.3.1 Background

Orion Power Unit-2 Dhaka Limited (herein referred to as "OPDL-2") is in the process of establishing a 635 (Net) MW coal based Thermal Power Plant (herein referred to as "Project"). It is located within Matarbari Union of Maheshkhali Upazila (Sub-district) in the Cox's Bazar district of Bangladesh. Currently, the project site is being used for salt cultivation and shrimp culture. At present, the proposed land elevation is average +1.25m which needs to be raised up to +10.0m.

13.3.2 Purpose

The purpose of the Emergency Preparedness and Response Plan (EPRP) is to establish and maintain procedures to identify potential emergencies and prevent or address potential foreseeable accidents/emergency situation during both construction and operation phases of the project.

13.3.3 Scope

The scope of the EPRP will be applicable to all project activities associated with the construction and operation phases of the 635 MW Coal Based Thermal Power Plant of OPDL-2. The elements of the EPRP will be directly implemented by the contractors and their sub-contractors, with OPDL-2 having overall management and responsibility. OPDL-2 needs to monitor and review the implementation process of EPRP on a regular basis.

13.3.4 Objective

The focus of EPRP is to establish a range of plausible emergencies that can take place and emphasize the tasks required to respond to a particular emergency. The objective of emergency response has been enumerated below:

- Perceiving early inputs of emergency conditions so as to limit impact on personnel, community, assets and environment;
- Define and identify the probable emergency situations for the project specific to its activities, operations, vicinity and geographic location;
- Identify the immediate responses to emergency situations with effective communication network and organized procedures;
- Safeguard personnel to prevent injuries or loss of life by:
    - Protecting personnel from the hazard;
    - Evacuation, whenever necessary;
    - Minimize the impact of the incident/event on the project, community and the environment by:
        - limiting the hazard as far as possible;
        - limiting the potential for escalation; and
        - Localizing the spread of impact.

13.3.5 Risks Associated with Project Activities

Identification of causes and types of emergencies is the primary task for planning of risk assessment. Emergencies can happen because of the nature of chemicals handled and also the nature of process involved during construction and operation phase of the project.

13.3.5.1 Construction Phase

Construction is likely to start after reclamation of the site and will continue for a period of 42 months (three years and six months). Operational Phase of the project will commence thereafter. The life of the project is expected to be twenty-five (25) years.

The construction activities will entail civil works such as site clearance and levelling works along with development of material storage yards, plant structures, boilers, generators, turbines, storage tanks construction of access roads, foundations and erection of boiler units. Following potentially hazardous areas and activities have been identified at the construction site:,

- Fuel storage areas
- Gas Cylinder storage areas
- Kitchen premises in labour camps
- Electrical installations – improper laying of cables
- Scaffolds
- Confined spaces
- Use of heavy vehicles and machinery such as cranes, JCB, trucks etc.

It is likely that during the course of construction phase several emergency situations such as fire and explosion, structural collapse, electrical hazards, chemical hazards, etc. might arise. Such situations will need to be handled in a systematic manner by the OPDL-2 management in order to prevent casualties.

13.3.5.2 Operation Phase

Following potentially hazardous areas and activities have been identified during operation phase of the project, which are likely to lead to emergency situations such as fire, explosion, release of gases, etc.:

1. Plant Sections causing Fire as an emergency- Potential Sources of Fire
   a. Coal Handling Plant and conveyor;
   b. Cable in galleries and cable trays in all plant sections;
   c. Fuel oil handling and oil tanks in main plant;
   d. Leakage of fuel from storage areas;
   e. Ammonia leakage;
   f. Transformer oil;
   g. Burner area in boilers;
   h. Blasting in boilers.
2. Plant Sections causing Explosion as an emergency
   a. Accidental initiation of explosives;
   b. Boiler or Transformer (oil cooled);
   c. Coal dust in mills and boilers
3. Plant Sections causing Bursting Hazards of Pipe lines and Vessels as an emergency
   a. Steam pipes due to high pressure/temperature
   b. Acid and alkali pipelines
4. Plant Sections causing Hazards Due to Release of Gases and Dusts as an emergency
   a. Pulverized coal dust from mills and associated piping and flue gases;
   b. Fly ash and flue gases from stack, ash ponds, ESP hoppers and bottom ash system;
   c. Coal dust generated in transfer points;
   d. Flue gases from the ducts in the plant area.
5. Plant Sections causing Release of Liquids as an emergency
   a. Fuel oil tanks in fuel oil handling section;
   b. Ash dyke (bund failure).

13.3.5.3 External and Meteorological Emergences

Other emergency situations that are likely to occur in the project area thus affecting construction and operational activities of the Project are as listed below:

1. Floods as an emergency
   a. Due to breach of ash dykes
   b. Natural flood as plant is proposed to be constructed on bank of Kutubdia channel and sea.
2. Social Unrest as an emergency
   c. Unsafe and unhealthy working conditions provided to labours;
   d. Non-payment of wages and disrupted terms of employment;
   e. Discrimination between local labour and migrant labour on various grounds (recruitment, benefits, accommodation, equal opportunity etc.);
3. Terrorist Threats/Bomb Threats
   a. Boiler house/chimney

   b. T.G. areal control room etc.,
   c. Residential complex

4. Strike

   a. Any part of the plant or entire plant

5. Earthquake as an emergency

Project site is located in zone 3 having seismic coefficient of 0.28.

13.3.5.4 Release of toxic gases, blasting and explosion and potential sources of fire

Explosion Hazard Areas

a. Turbo Generators
b. Transformer (oil cooled)
c. Boiler
d. Coal dust in Mills and boilers

Bursting of Pipelines & Vessels – Areas

a. Steam pipes due to high pressure / temperature
b. Acid / Alkali and tanks
c. H_2 Gas Cylinders
d. Compressed air header
e. Compressed air receivers

Release of Gases / Dust- Areas

a. Chlorine in Water treatment plant
b. Hydrogen in Turbo Generator area of Main plant and H_2 plant
c. Pulverized Coal dust from mills and associated piping and flue gases
d. Coal dust in transfer points of CHP. Crushers, Water tipplers and Mill area
e. Flue gases from the ducts

Release of Chemicals – Areas

a. Chemical tanks and Chlorine toners in water treatment plant
b. Acid & Alkali storage tanks in WTP
c. HCL tanks at ETP
d. Fuel oil tanks in fuel oil handling section

13.3.5.5 Seismic Vulnerability

A seismic zoning map of Bangladesh has been prepared in 2014 by Bangladesh National Building Code divided into four seismic zone which was accompanied by and outline of a code for earthquake resistant design. As per the Map, the study area occurs in seismic zone III where the suggested Basic Horizontal Seismic co-efficient for this zone is 0.28.

The potential emergencies due to seism tonic activities can be structure failures. All buildings shall be design for earthquake. The coefficient of horizontal acceleration shall be for the appropriate seismic zone as per Bangladesh National Building Code (BNBC). Damping in structures shall be done according to BNBC and Bangladesh standards. All buildings shall be design for earthquake according to National Building Code of Bangladesh, 2020 or later new information in Bangladesh on this issue. The coefficient of horizontal acceleration shall be for the appropriate seismic zone as per BNBC.

13.3.5.6 High Risk Zones and Locations

a. Coal handling plant
b. Main plant (Boiler, Turbo Generator, Oil Tanks)
c. Water Treatment plant
d. Switchyard including sub-station and transformers
e. Cable Galleries
f. Fuel oil handling plant
g. Store where hazardous, flammable and explosive material are stored

13.3.6 Risk Management Plan

This section establishes the general requirement to counter any level of onsite emergency and risks arisen for the proposed project during construction and operation phase.

13.3.6.1 Warning alarm systems

A distinctive and perceivable alarm system for emergency action or safe evacuation will be provided. Specific requirements may apply if the alarm system includes telephones/manual operations, the workplace has 10 or fewer employees, or alarms serve more than one purpose. It is to be ensured that all equipment used for alarm systems is approved and spare components are available.

13.3.6.2 Surveillance

Surveillance programs need to be deployed in the form of mock drills with a definite frequency.

13.3.6.3 Training Programs

Following training are proposed to be imparted to the employees, including members of ERT on periodic basis:

Table 13-19: Training Programme

Sl.	Training	Description	Frequency
1.	Mock Drills	Training on handling fire emergency situations and medical emergencies	Quarterly
2.	Awareness Program for Community	Awareness program for surrounding community on emergency response procedures	Bi-annually

13.3.6.4 Response (Contingencies)

Emergency Classification

Severity of accident and its likely impact area will determine the level of emergency and the management plan required for appropriate handling of the emergency. Emergency levels and the action needed for each level are indicated below:

Level 1 Emergency

A local accident with a likely impact only to immediate surroundings of accident site, such as, local fires and limited release of toxic or inflammable materials. The impact distance may not be more than 250 m from the site of primary accident and may require evacuation of the building/area where accident occurred and utmost the adjacent buildings. At the proposed power plant, minor fires and minor release of chlorine may cause Level 1 Emergency.

Level 2 Emergency

A plant level accident with impact distance upto 1000 m for potential threats to life and property requiring the evacuation of all plant personnel except the emergency response personnel. The demarcated limited area outside the plant may also have to be evacuated. Larger fires, release of large quantities of inflammable or hazardous materials may belong to emergency Level 2. At the proposed power plant, minor release of chlorine for long time and pool fire in HFO/LDO tanks dykes can be considered as Level 2 Emergency.

Level 3 Emergency

An accident involving a very serious hazardous situation and with likely impact extending well beyond the plant boundary limit, such as, major fire, very large release of hazardous or inflammable material and explosion of large quantity of explosive materials. Major fires will usually have the triggering effect resulting in the propagation of explosion. In a Level 3 emergency, evacuation of surrounding population around the plant periphery up to a distance of 1000 m may sometime become necessary.

13.3.6.5 Support (Logistics and Manpower)

A range of support services like adequate number of first aid kits, ambulance van should be present at the site. All fire fighters and first aiders should be identified prior to the start of operation of the plant and details to be presented in table below.

Table 13-20: Details of Fire Fighters and First Aiders

SL.	Name of Employee	Photograph	Designation	Working Location	Contact Details

13.3.6.6 Personal Protective Equipment

The workplace will be assessed for hazards that are present or likely to be present. Select and ensure the use of PPE based on the workplace assessment. It should be verified that each affected employee has received and understood the required training through a written certification. Employees/workers must demonstrate the ability to use PPE prior to performing work requiring its use.

13.3.6.7 Chain of Commands

- Verify status of all items in "First on Scene" checklist;
- Notify appropriate organizations and personnel, as per requirements;
- Assemble job personnel and count heads. Share basic information about incident with job personnel;
- Avoid speculation regarding cause of accident and commence the work with a Safety meeting;
- Direct media inquiries to be directed to the corporate spokesperson;
- Gather/verify available information - What happened? Where? Who was involved? How did it occur?
- Document incident in writing and with digital camera;
- E-Mail to Project and Corporate Office.

13.3.6.8 Reporting System

Reporting system for implementation of emergency response plan has been depicted in **Figure 13-15** and has been explained in section 13.3.7- Organizational Set Up.

13.3.6.9 Evacuation

Construction of exit Routes: The number of exit routes should be adequate based on the number of employees, the size of the building, its occupancy, and the arrangement of the workplace. The width of exit routes must be sufficient to accommodate the maximum permitted occupant load.

Medical services and first aid: It will be ensured by the project management that medical personnel are ready and available for advice and consultation on the overall employee safety and health condition in the workplace. Trained personnel and adequate first aid supplies will be provided to render first aid when a medical facility is not in near proximity to the workplace. In case of likely exposure to injurious or corrosive materials, suitable facilities for immediate emergency use will be provided.

13.3.6.10 Fire/ Hazard Fighting

Portable fire extinguishers: Portable fire extinguishers based on the class, size, and degree of workplace fire hazards will be selected and distributed. The extinguishers will be mounted, located, and identified so that they are readily accessible in an emergency and employees are not subjected to potential injury.

1. Emergency Contact Numbers: An Emergency Contact List (the closest ambulance service, hospital or other source of medical attention, police, fire department, and emergency squad (if any) including reporting instructions to be conspicuously posted to facilitate prompt communication.
2. Emergency Action Plans: Specific emergency action plans needs to be prepared for each identified emergency. At a minimum, the plan must include:
    - Escape procedures and escape routes;
    - Procedures for those who remain to conduct critical operations prior to evacuation;
    - Procedures to account for employees after evacuation;
    - The rescue and medical duties of employees;
    - The fire and emergency reporting procedures, and
    - Who to contact for further information or explanation about the plan.

The Emergency Action Plans will be communicated to all workers and systematically reviewed but not less than every 6 months.

13.3.6.11 Ammonia Leakage

Ammonia dosing will be required to condensate system, wherein leakage of ammonia can occur. The following measures to be taken to avoid any kind of leakage:

- Ensure that all containers, piping, valves, and fittings contacting ammonia are constructed of iron, steel or other ammonia-compatible materials, as ammonia is corrosive to even trace amounts of copper, zinc silver, and many of their alloys.
- Check that the ammonia contains at least 0.2% water to prevent stress corrosion of the recommended compatible materials;
- Install tank pressure gauges and safety valves on ammonia gas storage tanks for pressure relief. Install leak detectors if facilities are unstaffed for periods of time;
- Ensure that adequate training is provided to all facility employees concerning the safe handling, storage, and use of ammonia; and

- Ensure that the proper protective equipment is easily accessible in case ammonia is released. Train employees in the proper use of the equipment.

13.3.6.12 Emergency Response during Coal Transportation

It will be the responsibility of the Supervisor to check and contact all people under their control and relay to them the following information as briefly as possible:

- The nature of the emergency;
- The route to be travelled to the designated emergency evacuation assembly area;
- All the persons to be provided with appropriate PPEs like shoes to avoid slipping, mask and goggles to avoid coal dust;
- All the personnel will be provided with duty cards bearing work instructions on it and emergency contact numbers;
- A checklist is to be duly filled before and after completion of coal transportation.
- All shipping and loading operations will cease in the event of a tropical cyclone or other adverse weather conditions;
- All barges and ships will be fitted with global positioning system (GPS), radar, and/or other electronic navigation systems to minimize the potential for grounding or collisions;
- All ships will carry appropriate spill containment and treatment equipment; and
- All ships will be subject to a regular maintenance program to ensure proper functioning of steering and navigation systems, and to preserve the structural integrity of the hull, fuel tanks, etc. Proper maintenance will reduce the potential for grounding, collisions, and fuel and oil leaks.

13.3.6.13 Communication Network

A hazard communication program should be developed and implemented. It is to be ensured that material safety data sheets for each hazardous chemical used and the hazard communication program are available to workers in the workplace.

13.3.6.14 Verification of Activities

Activities should be verified before its commencement to avoid any kind of emergency. The various check points have been presented in table below.

Table 13-21: Check Points for Emergency Preparedness

Sl.	Check Points	Yes/No
1.	Whether mock fire / emergency response drills are held	
2.	If yes, periodicity of emergency response drills	
3.	Mock drills cover all types of probable emergencies	
4.	Details of water storage available with Mutual Aid member including District Fire Service and mechanism to utilize the same in the said location well documented in the On-Site emergency Plan.	
5.	Periodicity of safety training for officers, staff, contractor workers, and security personnel mentioned in the On-Site emergency Plan.	
6.	Whether all unsafe developments and likely risks are deliberated in the meetings and appropriate steps are recommended for eliminating such risks.	
7.	Whether performance and shortcomings observed during recent mock disaster drills form part of the discussions in safety committee meetings	
8.	Whether Work Permit System has been implemented	
9.	Whether work permits are issued for hot work, cold work, electrical work and vessel entry jobs	
10.	Whether work permits are duly closed at completion of the stipulated jobs, duly certified by the supervising officer.	

13.3.7 Organizational Set up

13.3.7.1 Emergency Response Team (ERT)

This section provides the organizational framework suggested to handle different levels of emergencies and identifies the key personnel that will be responsible for managing any emergency situation. An Emergency Response Team (ERT) will be set up initially for construction phase and the same will be revised for commencement of plant operations. The Emergency Response Team (ERT) at the operating site under its control will have the following role:

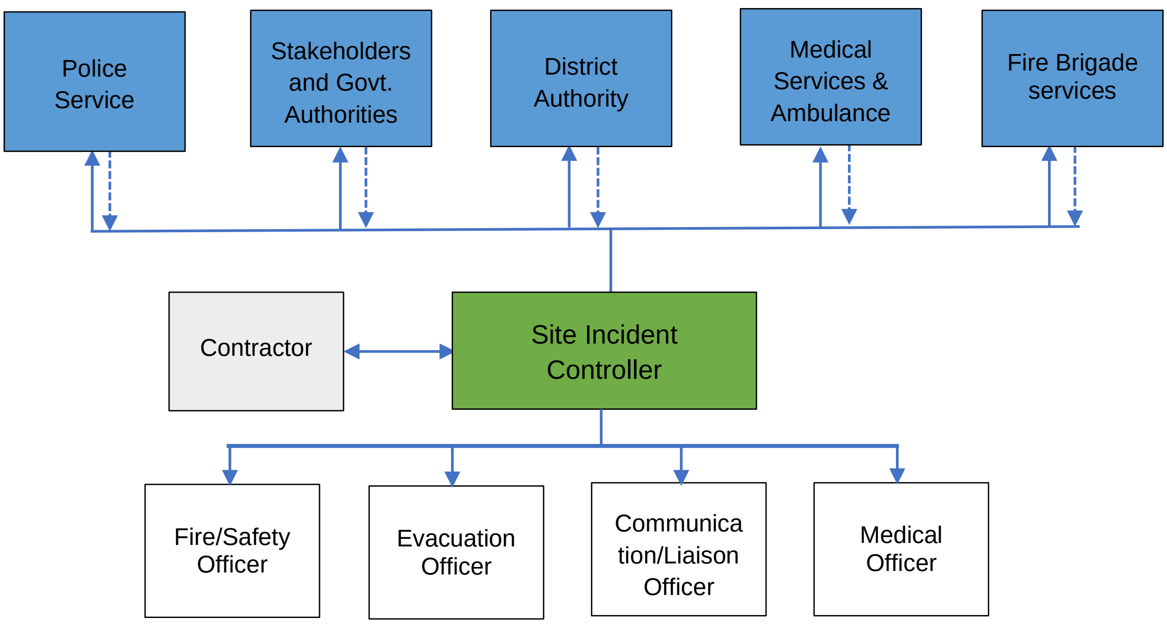
- Control the emergency and render the site safe by the application of local resources; and
- Support the local response effort by co-ordinating additional equipment, personnel, and other external resources for the direct response effort.

The ERT will be headed by a Site Incident Controller and will comprise of following personnel:

- Fire/ Safety Officer;
- Evacuation Officer;
- Communication/Liaison Officer and;
- Medical Officer.

The organogram for emergency response plan is presented in **Figure 13-15**.

Figure 13-15: Organogram for Emergency Response Plan



13.3.7.2 Roles and Responsibilities of ERT

The role of the members of Emergency Response Team (ERT) is as detailed below:

13.3.7.2.1 Site Incident Controller (SIC)

The Site In charge of Coal Site Team will act as Site Incident controller who will supervise the members of Emergency Response Team. The responsibilities of SIC are enumerated below:

- Set up Emergency Control Centre (ECC) to direct emergency operations with the help of other team members;
- Determine the severity of an emergency; declare appropriate emergency level and changing the emergency level, if considered essential;

- Marking of Safe Assembly Zones (SAZs) within the site in consultation with Evacuation Officer and informing all the employees present at the site;
- Determine most probable course of events by continuously reviewing and assessing the developments;
- Direct the safe shutting down of the plant in consultation with other officers, if necessary;
- Ensure proper evacuation and treatment to injured personnel;
- Liaison with District Administrative Authorities, Police, Fire Brigade and other agencies, if
- necessary;
- Look after safe operation of the plant and rehabilitation of affected persons; and
- Declare all clear situations after the emergency is over.

13.3.7.2.2 Fire/ Safety Officer

- Reports to Site Incident Controller and assist him in all matters;
- Arrange first aid to the casualties and other emergency equipments;
- In post-accident condition to gather information on the material /equipment involved in the accident and its danger potential, its effect on humans and environment;
- Assist Site Incident Controller in maintaining the emergency equipment and in conducting /evaluating mock drills; and
- All the fire fighters shall work under his guidance at the time of emergency.

13.3.7.2.3 Evacuation Officer

- Proceed to emergency area and report to Site Incident Controller and acts as per the instructions;
- Consult the Safety Officer of the site for evacuation of the employees;
- Advice all the employees expect emergency response team to assemble at SAZ;
- To perform head count at SAZ and shall record names;
- Proceed to the emergency area and report to Site Incident controller the after getting the information regarding emergency through telephone or through messengers;
- He handles all the transmission to the emergency control center and dispatched from it, including those to outside agencies and technical information source;
- As per the Site Incident Controller's instructions, he will pass information to other members, if required.

13.3.7.2.4 Communication/Liaison Officer

- As soon as he receives the information, he should proceed to the Emergency Control Center and report to the Site Incident Controller;
- Co-ordinate with all the outside agencies who offer assistance to an emergency response supporting team;
- Keep information on the various agency representatives and where and how to contact them;
- Ensure that casualties received adequate attention and the alternate transport, when in need;
- When emergency is prolonged, he shall co-ordinate with evacuation officer to arrange for the relief of rescue or firefighting personnel and organize refreshments or catering facilities;
- Responsible for evacuation of the nearby village people, if situation warrants.

13.3.7.2.5 Medical Officer

- On receipt of information keep him ready and alert his staff to attend serious and urgent cases;
- Responsible for providing first aid to those injured/ rescued and making that they are promptly transported for further treatment, if required;
- Arrange for medical supplies at the site;
- Familiar with antidotes for specified materials.

13.3.7.2.6 Role of Contractors

Under an emergency situation, the contractor's supervisor will take steps to:

- Notify the Site Safety Officer immediately;
- Protect the lives/health of employees;
- Safeguard information and company assets (equipment, tools);
- Communicate and delegate the first two priorities in a controlled manner that reduces confusion, and
- Commence an appropriate response to the emergency event as directed by Site Incident Controller

13.3.8 Control Structure

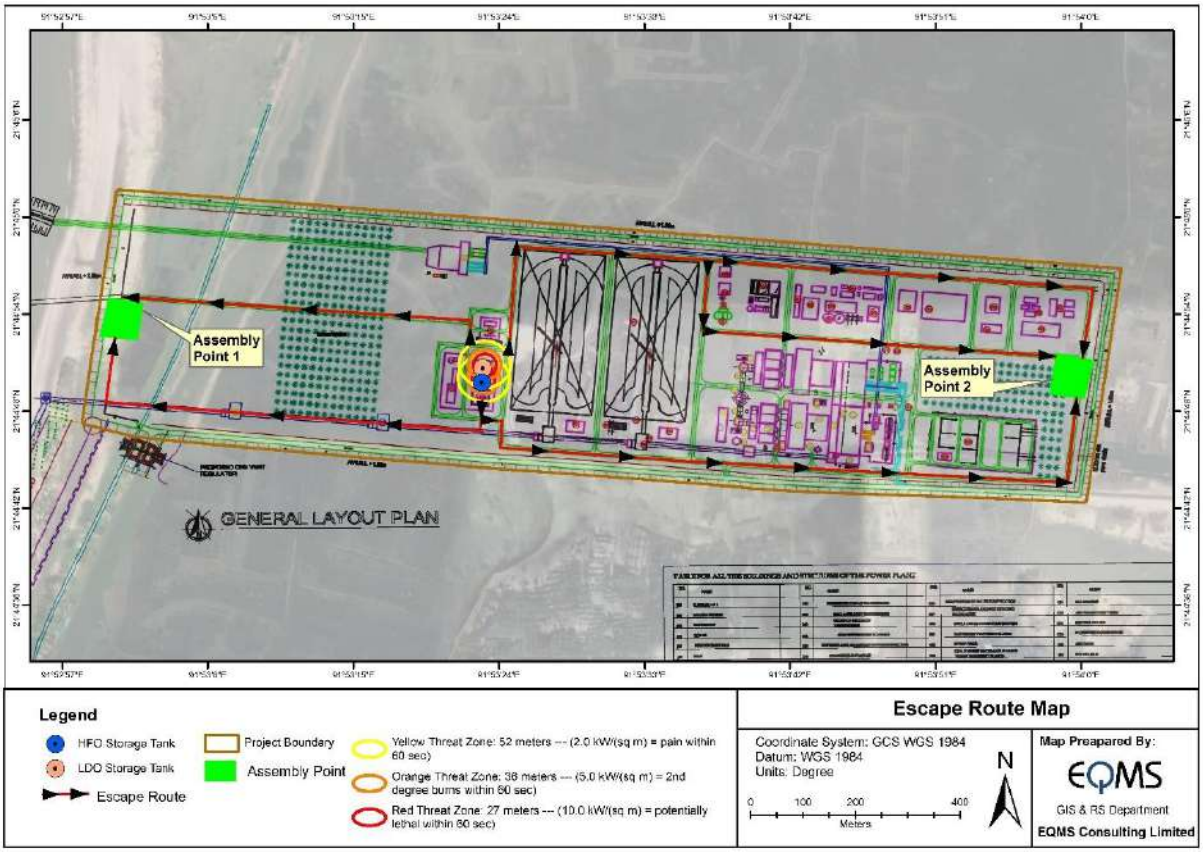
Emergency Control Centre is the point from which the Site Incident Controller directs the movements of Personnel and Equipment during an Emergency. Contents of Emergency Control Centre:

a. External telephone line and a list of relevant telephone numbers.
b. Internal telephone and telephone list of Emergency Assembly Points.
c. List of Emergency Control Team, who must be called showing addresses and telephone numbers.
d. Emergency Controller's Red & White Helmet.
e. A list of all persons (by title) responsible for groups of employees.
f. Logs and Emergency Controller's checklist.
g. Emergency lighting.
h. Copy of the emergency plan.
i. List of persons trained in First Aid & Fire Fighting.
j. List of safety cabinets and their contents & locations.
k. Battery operated torches.
l. Detailed site plan.
m. First aid equipment including stretchers (in surgery).

13.3.9 Assembly Point

The escape route from the plant should be clearly marked. The escape route will be the shortest route to reach out of the plant area to open area, which leads to assembly point. This route should be indicated on the layout plan attached to the Emergency Plan. The emergency escape route and assembly point are presented in **Figure 13-16**.

Figure 13-16: Emergency Escape Route and Assembly Point



13.3.10 External Communication

It will be done by Site Incident Controller. The following persons and offices may be given updated information as necessary and ask for necessary help.

a. SDO
b. Police
c. Fire Brigade
d. Nearby Hospital
e. Factory Inspector
f. Local Media
g. District Magistrate

13.3.11 Responsibility Matrix

The responsibilities assigned to the various persons have been presented in table below.

Sl.	Key Person	Responsibilities
1.	Site Incident Controller	• Set up Emergency Control Centre (ECC); • Determine the severity of an emergency; • Marking of Safe Assembly Zones (SAZs); • Direct the safe shutting down of the plant in consultation with other officers, if necessary; • Liaison with District Administrative Authorities, Police, Fire Brigade and other agencies, if necessary; and

Sl.	Key Person	Responsibilities
		• Declare all clear situations after the emergency is over.
2.	Fire/ Safety Officer	• Arrange first aid to the casualties and other emergency equipments; • Assist Site Incident Controller in maintaining the emergency equipment and in conducting /evaluating mock drills; and • All the fire fighters shall work under his guidance at the time of emergency.
3.	Evacuation Officer	• Proceed to emergency area and report to Site Incident Controller and acts as per the instructions; • Advice all the employees expect emergency response team to assemble at SAZ; • He handles all the transmission to the emergency control center and dispatched from it, including those to outside agencies and technical information source;
4.	Communication and Liaison Officer	• As soon as he receives the information he should proceed to the Emergency Control Centre and report to the Site Incident Controller; • Co-ordinate with all the outside agencies who offer assistance to an emergency response supporting team; • Keep information on the various agency representatives and where and how to contact them;
5.	Medical Officer	• On receipt of information keep him ready and alert his staff to attend serious and urgent cases; • Responsible for providing first aid to those injured/rescued and making that they are promptly transported for further treatment, if required; • Arrange for medical supplies at the site;
6.	Contractors	• Commence an appropriate response to the emergency event as directed by Site Incident Controller; • Under an emergency situation, the contractor's supervisor will take steps to: ○ Notify the Site Safety Officer immediately; ○ Protect the lives/health of employees

13.3.12 Onsite Emergency Response Initiation

In case of all emergencies, the Emergency Response Team will swing into immediate action without losing time in order to save human life, to mitigate the impact on the environment and to safeguard commercial consideration of the project and the community. The response to an emergency situation will be as per the following five phases:

- **Discovery and Notification:** An event with an imminent threat of turning into an accident must first be discovered and notified the same to the Site Incident Controller, who will eventually inform Safety Officer.
- **Evaluation and Initiation of Accident Control:** Based on the evaluation of available information, the Safety Officer will make a rapid assessment of the severity of the accident and initiate the best course of action.

- **Suppression and Counter Measures:** Action will first be taken to contain and control the accident by eliminating the causes which may lead to the spread of accident. Workers/personnel will be advised to remain on the scene until help arrives. If not, safe evacuation of area will be done.
- **Clean-up and Disposal:** After the accident is effectively contained and controlled, the cleanup of the site of the accident and safe disposal of waste generated due to the accident will be undertaken.
- **Documentation:** All aspects of accidents must be documented for subsequent analysis of accident for prevention in future, damage estimation, insurance recovery and compensation payment (if made).

13.3.13 Reporting Hierarchy within Organization and liaison with Authority

Reporting hierarchy within organization has been explained section 10.15 HSE Management Organization Structure of the report.

13.3.14 Physical Barrier, Alarm System and Access Controls

OPDL-2 to ensure the implementation of following provisions.

- Provide a distinctive and perceivable alarm system for emergency action or safe evacuation.
- Specific requirements may apply if the alarm system includes telephones/manual operations, the workplace has 10 or fewer employees, or alarms serve more than one purpose.
- Ensure that all equipment used for alarm systems is approved and spare components are available.
- Provide rescuers access to all permit spaces from which rescue may be necessary, so that appropriate rescue plans are developed, and rescue operations practiced.

13.3.15 Public Safety and Education Programme

Information is to be made available to the public on a periodic basis on how they will be notified and what their initial actions should be in an emergency (e.g., listening to a local broadcast station and remaining indoors), the principal points of contact with the news media for dissemination of information during an emergency (including the physical location or locations) are established in advance, and procedures for coordinated dissemination of information to the public are to be established.

13.3.16 Support required for external porting and areas

All the people identified in organogram for implementation of emergency response plan will be responsible for Laisioning with the relevant port authority and BITWA for any emergency during transportation of coal during operation phase.

13.3.17 External Events Perceived

a. Unsafe and unhealthy working conditions provided to labours;
b. Non-payment of wages and disrupted terms of employment;
c. Discrimination between local labour and migrant labour on various grounds (recruitment, benefits, accommodation, equal opportunity etc.);
d. Threats due to Bomb and Terrorists

13.3.18 Rehearsal

Drills should present a variety of Emergency scenarios and designed to challenge each segment of the organisation. Limited scale drills are useful and should be used by Site Incident Controller to train his own team and other employees of the plant. Plans should be made to have periodic mass casualty exercises. These exercises should attempt to simulate as closely as \possible a fire, explosion, or toxic agent release and comparison of the prescribed timelines and the actual received. Each Mock Drill should be recorded with observations and deficiencies to be rectified within 24 hours. To have better results it is suggested to involve all sections within the industry, nearby industries, fire services, medical, police personals etc.

13.3.19 Safety training

In order to reduce the risks associated with accidents, internal and external threats, and natural disaster a safety training program is essential for workers in plant operation. There should be a regular training program on safety for the workers to increase their awareness and also to reduce the risks. Provision of yearly professional training for health and safety would enhance the effectiveness of safety. Safety training should be planned for the local people living around the project area so that they can be aware of the risk possessed by the power plant and can take appropriate preparedness. The suggested training schedule has been shown in **Table 13-22**.

Table 13-22: Present the Training Schedule that should be Adopted for Safety

Target Trainee	Training Schedule
Worker	Four training per year
Professional	Two training per year
Local People	Two training per year
Drivers	Four training per year
Safety Professional	Two training per year

In addition, there could be a discussion and awareness session for increasing awareness of safety in each kind of meeting. The employee should regularly practice toolbox meeting and job safety analysis.

13.3.20 Risk Mitigation Measure

13.3.20.1 Auxiliary Fuel System

Protective systems with high reliability and availability will be designed to ensure that these physical conditions are maintained.

- Dyke would be provided for LDO and HFO storage tanks.
- Co-ordination with local authorities such as fire, police, ambulance, district administration & nearby industries would be ensured to manage / control meet any eventuality.
- To prevent the hazard of static electricity, the fill and recirculation lines to the storage tanks shall discharged below the liquid level.
- One independent high-level alarm and trip off liquid inlet-line.
- One low level alarm with trip off device.
- Provision of auto deluge water sprinkler system for each bulk storage tank. The auto deluge water sprinkler would be set to start working at a temperature of 66^0 C.
- In case of any tank on fire or fire in the vicinity, the cooling of adjoining tank should be resorted promptly in addition to tank on fire so that the neighboring tanks does not give away.
- The night vision wind stocking be mounted on top of administrative building, main plant building and storage tanks is preferred so that people can move in upwind directions in the event of massive spillage or tank on fire.
- No machinery of vital importance like firefighting pump house, hydrant and fuel oil pump house should be placed out of at radiation contours of 37.5 kW/m^2 heat intensity.
- Maintenance plays a vital role in proper upkeep of plant. One important function is the monitoring of equipment health, pipelines and machines. Adoption of system like thickness

survey (including supports) maintenance practices will improve plant performance and safety. Normally, failure rates of equipment and pipes are influenced by maintenance practices especially when plant starts aging.

- The proposed site is located under zone-III. Analysis and design of structures to resist the seismic forces are to be carried out as per the provisions of standard.
- It is recommended that strict adherence to standards and accepted maintenance and operation of the plant plays a vital role in proper up keep of the plant. The monitoring of the health of equipment, pipeline and machines, thickness survey will improve plant performance and safety.

13.3.20.2 Chlorine Tonners

- Chlorine from pressure relief devices will go to an expansion tank or to gas absorption system. Complete chlorination plant shall be located indoor.
- Chlorine leak absorption system shall be provided for chlorination plant to neutralize chlorine leakage.
- To prevent the large release of chlorine to atmosphere, monitoring and feedback facilities for early detection leaks and emergency shutdown shall be provided.
- There will be facilities in the form of water curtain for absorption of chlorine released during an emergency as chlorine is highly soluble in water.
- Flow control valves at key points will be installed to prevent excess chlorine flow from the tonner with multiple level safety per line.
- Chlorination plant shall be provided with adequate nos. of chlorine tone containers, instrumentation, panels, chlorine leak detectors etc.
- Immediate actions will be taken for evacuation of all personnel in case of accidental release of chlorine.
- Eye wash stations and emergency shower stations will be provided at appropriate locations especially in the vicinity of Chlorine storage and dosing facilities.
- The standby chlorine tonners shall be kept / stored at isolated covered warehouse at safe distance. It shall be provided with sufficient high (about 6 m) roof ventilation, chlorine detection and water spray system inside storage facility.
- Conduct awareness programs on regular basis in order to educate villagers around the project about the consequences of possible health hazards and their precautionary measures during accidental conditions.

13.3.20.3 General Control Measures

Fire is one of the major hazards, which can result from auxiliary fuel (LDO & HFO) storage tanks. Fire prevention and relevant code enforcement is one of the major responsibilities of project proponent. The fire service facility will be equipped with:

- Smoke and fire detection alarm system, Water supply, Fire hydrant and nozzle installation, Foam system, Water fog and sprinkler system, Mobile Firefighting equipment, First aid appliances
- Smoke and fire detection, fire hydrant & nozzle installation etc. as indicated above shall be included as part of all major units at the proposed project.
- Periodic maintenance of all protective and safety equipment.
- Wind socks/wind cock should be installed at suitable height and with proper visibility to check the prevailing wind direction at the time of accident.
- Periodical training/awareness will be given to work force at the project to as refresh courses handle any emergency situation.

- Periodic mock drills will be conducted so as to check the alertness and efficiency of the DMP and EMP and corresponding records will be maintained.
- Signboards including emergency phone numbers and no smoking signs will be installed at all appropriate locations.
- Plant shall have adequate communication system.
- All major units/equipment shall be provided with smoke/fire detection and alarm system.
- All electrical equipment shall be provided with proper earthing.
- Emergency lighting shall be available at all critical locations including the operator's room to carry out safe shut down of the plant, ready identification of firefighting facilities such as fire water pumps, fire alarm stations, etc.
- In addition to normal lighting each installation shall be equipped with emergency (AC) and critical (DC) lighting.
- All electrical equipment shall be free from carbon dust, oil deposits, grease, etc.
- Cable routing shall be planned away from heat sources, gas, water, oil, drain piping, air conditioning ducts, etc.
- Cable route markers shall be provided in the permanent way at the location of changes in the direction of cables at the intervals not more than 30 m and at cable joint locations.

13.3.20.4 Other Safety Measures

OPDL-2 will provide appropriate training to the workers and staff in environmental, safety, and health aspects and will provide necessary protective measures for workers to minimize safety risks.

Electric and Magnetic Field

Occupational EMF exposure will be prevented or minimized through the preparation and implementation of an EMF safety program including:

- Training of workers in the identification of occupational EMF levels and hazards;
- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers;
- Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the Institute of Electrical and Electronics Engineers (IEEE);
- Personal exposure monitoring equipment to be set to warn of exposure levels that are below occupational exposure reference levels (e.g., 50 percent);
- Action plans to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or
- The Project is to ensure that use of pesticides and insecticides is taken up by personnel only after proper training and use of personal protective equipment.

Heat Exposure

Prevention and control measures to address heat exposure at thermal power plants will include:

- Regular inspection and maintenance of pressure vessels and piping;
- Provision of adequate ventilation in work areas to reduce heat and humidity;
- Reduction of the time required for work in elevated temperature environments and ensuring access to drinking water;
- Shielding of surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc.;
- Use of warning signs near high-temperature surfaces and personal protective equipment (PPE) as appropriate, including insulated gloves and shoes.

Occupational Noise

Additional mitigation measures for occupational noise include:

- Provision of sound-insulated control rooms with noise levels below 60 dB(A);
- Design of generator to meet applicable occupational noise levels;
- Identification and marking of high noise areas and areas that require that personal noise protecting gear is used all the time when working in such areas, typically areas with noise levels >85 dB(A).

Electrical Hazard

Measures to prevent minimize, and control electrical hazards at thermal power plants include:

- Installation of hazard warning lights inside electrical equipment enclosures to warn of inadvertent energization;
- Use of voltage sensors prior to and during workers entrance into enclosures containing electrical components;
- Deactivation and proper grounding of live power equipment and distribution lines according to applicable legislation and guidelines whenever possible before work is performed on or proximal to them;
- Provision of specialized electrical safety training to those workers working with or around exposed components of electric circuits. This training will include, but not be limited to, training in basic electrical theory, proper safe work procedures, hazard awareness and identification, proper use of PPE, proper lockout/tagout procedures, first aid including CPR, and proper rescue procedures;
- Provisions will be made for periodic retraining as necessary.

Physical Hazard

Measures to prevent minimize, and control physical hazards from fire and explosion at thermal power plants include:

- Use of automated combustion and safety controls;
- Proper maintenance of boiler safety controls;
- Implementation of startup and shutdown procedures to minimize the risk of suspending hot coal particles (e.g., in the pulverizer, mill, and cyclone) during startup;
- Regular cleaning of the facility to prevent accumulation of coal dust (e.g., on floors, ledges, beams, and equipment);
- Removal of hot spots from the coal stockpile (caused by spontaneous combustion) and spread until cooled, never loading hot coal into the pulverized fuel system;
- Use of automated systems such as temperature gauges or carbon monoxide sensors to survey solid fuel storage areas to detect fires caused by self-ignition and to identify risk points;
- Measures to prevent minimize, and control physical hazards from chemical hazards at thermal power plants use of sodium hypochlorite in place of gaseous chlorine may be opted. Measures to prevent minimize, and control occupational exposure to dust in thermal power plants include:
- Use of dust controls (e.g., exhaust ventilation) to keep dust below applicable guidelines or wherever free silica levels in airborne dust exceed 1 percent.

CHAPTER 14

Conclusion and Recommendations

14 CONCLUSION AND RECOMMENDATIONS

14.1 Conclusion

Now a days the acute crisis of Oil & Gas due to the effect of the Russia-Ukraine war, many developed countries are changing their strategies for generating electricity. Many developed countries re-open their coal-based power plant to meet their electricity demand. Government of Bangladesh also has taken several alternative plans to meet the electricity crisis. Government of Bangladesh has given high emphasis on implementing the proposed 635 MW Coal-based power plant i.e., Orion Power Unit-2 Dhaka Limited at Matarbari, Maheshkhali. Previously the power plant was planned to set up in Gazaria, Munshiganj. BPDB has suggested to shift the location to more suitable location at Matarbari. The proposed power plant will be set up on 225 acres land owned by Coal Power Generation Company Bangladesh Limited (CPGCBL) to ensure the best utilization of this land as well as most reliable operation of this project i.e., OPDL-2. The major benefits of this area are Matarbari deep seaport is only within 5 km, availability of water and no transshipment will be required. The navigation channel is 350 meters (1,150 ft) in length with a maximum permissible draught of 16 meters (52 ft). Ships with a capacity of 70,000 DWT can dock here. A 4.7 km coal conveyer belt will be built to transfer the coal from port to the coal yard. Coal will be imported from Australia and Indonesia. Annual coal requirement has been estimated to be 1.47 million tons. The generated electricity will be evacuated through Maheshkhali-Modunaghat-Vulta 765kv transmission line (Initially charged 400 kv). From the socio-economic and power energy security point of view the project is very important.

The project entails various impacts on the study area, some negative and some positive. This EIA study finds out the significant environmental and social impact during pre-construction, construction, and operation phase. The project site is located on the left bank of Kutubdia channel and near to the Matamuhuri-Kohelia and Kutubdia channel confluence. The Project is not located near any ecologically sensitive protected areas. No archaeological or protected monuments are located in the project vicinity. Project site is land already acquired by GoB and currently salt and shrimp are being cultivated. All landowners got the proper compensation as per government law. There is no titled housing structure within the project site. Only nine squatters are living beside the embankment within the project site whereas twelve squatters are living within the 20 meters proposed coal corridor. Approximately 204 salt pan workers and 20 shrimp cultivators will lose their livelihood. During pre-construction/land development stage there will be some environmental impact such as water pollution due to river dredging, noise and air pollution during the land filling and vehicle as well as equipment operations. The artificial and natural drainage of the project site will be changed.

During the construction phase of the project, the key environmental issues are noise and dust generation. There is also a risk of contamination of soil, groundwater and the Kutubdia channel water from accidental spills and leaks of hazardous materials (e.g. oil) during handling, transportation, and storage at the site. The other major impact during the construction stage is workers health and safety issue due to degradation of environmental quality and accidental injury. Solid waste and liquid waste not properly managed will impact on the surrounding environment. Terrestrial ecology will be impacted due to the noise generation and dust emission whereas aquatic ecology will be impacted due to the wastewater discharge, underwater noise and accidental release of oil. The major positive impact during construction stage is local people will get job opportunity and local business will be enriched. During the construction phase, the impact will be short term, localized in nature and reversible. Subsequent mitigation measures are proposed in the EMP to mitigate the impact in desire level.

During the construction phase there will be impact from migration of labour into the Project area, construction activities and increased movement of traffic. The range of impacts identified include conflicts with the local community, health and safety issues inconvenience due to vehicle movements, waste disposal and unhygienic conditions and risk of spread of communicable and sexually transmitted diseases. The magnitude and significance of most of these impacts would be limited to the construction period, with limited spill over to the operation phase. As the project intends to have a construction camp at the facility, the interaction between the community and migrant workers would be limited. Furthermore, by implementing the recommended mitigation measures the Project will minimise the identified risks whereas on-going consultation and engagement will support the maintenance of a harmonious relation with the local community. Community health and safety related impacts will be managed at source to reduce the footprint. By adopting the mitigation measures as suggested in the EMP.

The major impacts during operation phase are air pollution due to coal burning, noise pollution from operation of power plant, surface water pollution due to thermal water discharge and accidental oil spill, ground water pollution from ash yard and improper liquid waste disposal, sediment pollution from wastewater discharge. Terrestrial ecology will be impacted due to heavy noise, dust generation and light. Aquatic ecology will be impacted due to hot water discharge, light on the coast, accidental spillage and wastewater discharge to the river. Air pollution, noise generation, and traffic movement are the major source of community health impact.

The main impact is associated with the generation of SO_2, NO_2, and Particulate matter from power generation processes and their impact on the nearby areas. However, with mitigation measures like ESP's, use of coal with low sulphur content and FGD, these will be reduced to have minimum impact in the study area. The effluent generated during the operational phase will be treated to meet the permissible norms and will be utilized for green belt development and other industrial purposes within the plant. The fly ash from the plant is proposed to be collected 99.99% through dry ash extraction systems. Thus, the changes in the air, water environment with the implementation of proper mitigation measures would allow compliance with appropriate standards and confine negative impacts within acceptable limits. Thermal water will be discharged within the prescribed limit of ECR 2023. A surface water quality monitoring program, along with quarterly monitoring of aquatic ecology and fisheries has been formulated to further understand the extent of impact, if any, and to alert OPDL-2 to take additional mitigation measures. Noise barrier and silencer will be used in the high noise generating location and equipment. In the project, there will be ETP, STP and Oil water separator to meet the wastewater standard. There are also very significant positive impacts during construction and operation phase like local people job opportunities and increase business opportunities. Local people showed interest in the project considering the needs for national development.

The effective implementation of the ESMP and adherence with the GOB standard will assist in minimising the environmental impacts to acceptable levels. A detailed monitoring plan has been prepared as part of the EMP. The focus areas of monitoring cover air, surface water quality, groundwater quality, noise, soil and groundwater contamination, ecological monitoring, occupational health and safety as well as community health and safety. The reporting requirements along with the follow-up actions in case of deviation from the norms have been detailed in the EMP. The frequency has also been set in consideration of the likely impacts.

Based on the analysis conducted in this environmental and social assessment, it is concluded that overall, the Project will result in positive socio-economic benefits and the negative environmental impacts that have been identified are mostly short-term and localised in nature, and can be minimized adequately through good design, appropriate application of mitigation measures, monitoring and regular supervision of implementation.

14.2 Recommendations

The following recommendations are made based on EIA study that should be considered for achieving the goal of optimum minimum environmental and social impact and optimum benefits:

- Findings and suggestion of EIA study in project planning, design and operation should be considered and implement with strong monitoring;

- People those who are living within the project boundary as squatter should be compensated and created scope for alternative livelihoods;
- A drainage study including detailed survey must be conducted by the project proponent to avoid the waterlogging in the proposed project surrounding area;
- Ensure Matarbari beach is accessible of the local people during both construction and operation stages;
- Income and employment opportunities for the local community and strengthen the CSR activities for the local community;
- All activities (pre-construction, construction and post-construction stage) should be implemented according to EMP;
- Environmental Management Plan and, Hazard and Safety Management Plan should be implemented at every suggested step of plant construction and operation;
- Establishing Institutional arrangement with proper logistics and training for Environment, Health and Safety in Project Management Unit during pre-construction, construction and operation phases of the project;
- Conduct fish and turtle survey in Kutubdia channel during construction and operation phase of the proposed project;
- Cooling water discharge temperature must be within 5°C than ambient water temperature;
- The intakes for the water pumps in the main pump-house will meet the IFC guidelines, including recommended intake velocity less than 0.30 m/s and a mesh size of 9.5 mm;
- Obtain the Clearance Certificate from WARPO for taking make up water from underground and Kutubdia channel during construction and operation stages;
- Relevant national laws, NOSCOP and IMO conventions signed by the GOB should be enforced properly by the relevant authorities (Port Authority, DG Shipping, BIWTA, etc.); accordingly, the Coal Transportation Agency should oblige the relevant laws and conventions;
- The plant should be operated ensuring all pollution abatement measures, e.g. ESP, FGD, Low NOx burner, effluent treatment plant, etc. are in order, and regular monitoring has to be done to evaluate their performance;
- Prepare a health impact assessment prior to commencement of the construction work;
- Environmental monitoring plan stipulated in the EIA study should be followed at every stage of the proposed power plant.