

Environmental & Social Impact Assessment (ESIA)

Sonagazi 220 MW (AC) Solar Power Plant Project by EGCB Ltd

June 2025

Prepared For

Electricity Generation Company of Bangladesh (EGCB)

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ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
ADT	Average Daily Traffic
AEZ	Agro-Ecological Zones
AIGAs	Alternative Income Generating Activities
ANSI	American National Standard Institute
BBS	Bangladesh Bureau of Statistics
BBS	Behavior Based Safety
BERC	Bangladesh Energy Regulatory Commission
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BOD	Biochemical Oxygen Demand
BWDB	Bangladesh Water Development Board
CAAQMMS	Continuous Ambient Air Quality Micro-Monitoring Station
CDD	Community Driven Development
CE	Critically Endangered
CEGIS	Center For Environmental and Geographic Information Services
CESAP	Construction Environmental and Social Action Plan
CHSP	Community Health and Safety Plan
CoC	Code Of Conduct
COD	Chemical Oxygen Demand
CSR	Corporate Social Responsibilities
CTFB	Chattogram Tripura Fold Belt
DEPC	Department Of Environmental Pollution Control
DoE	Department Of Environment
DRIP	Disaster And Climate Risk Information Platform
ECA	Environment Conservation Act
ECC	Environmental Clearance Certificate
EECMP	Energy Efficiency and Conservation Master Plan
EGCB	Electricity Generation Company of Bangladesh
EHS	Environment, Health and Safety
EHSGs	Environmental Health and Safety Guidelines
EMoP	Environment Monitoring Plan
EN	Endangered
EP	Equator Principles
EPFI	Equator Principle Financial Institution
EPRP	Emergency Preparedness and Response Plan
EPRP	Emergency Preparedness and Response Plan
ESCOPs	Environmental And Social Code of Practices
ESF	Environmental And Social Framework
ESIA	Environmental And Social Impact Assessment
ESMF	Environmental And Social Management Framework

ESMoP	Environmental And Social Monitoring Plan
ESMP	Environmental And Social Management Plans
ESMS	Environmental And Social Management System
ESS	Environmental And Social Standard
FGDs	Focus Group Discussion
FI	Financial Intermediary
GBV	Gender-Based Violence
GBV	Gender Based Violence
GIIP	Good International Industry Practice
GoB	Government Of Bangladesh
GPN	Good Practice Note
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GSMP	Gas Sector Master Plan
HFL	Highest Flood Level
HRACs	Hazard Risks Assessment Codes
IAs	Implementing Agencies
IsDB	Islamic Development Bank
IEE	Initial Environmental Examination
IEPMP	Integrated Energy and Power Master Plan
IESCs	Important Environmental and Social Components
IFC	International Finance Corporation
IGD	Informal Group Discussions
ILO	International Labour Organization
IMDMCC	Inter-Ministerial Disaster Management Coordination Committee
IRR	Internal Rate of Return
IUCN	International Union for Conservation Of Nature
JHA	Job Hazard Analysis
KBA	Key Biodiversity Areas
KIIs	Key Informant Interviews.
KPIs	Key Performance Indicators
LCOE	Lowest Levelized Cost of Electricity
LCRM	Local Grievance Redress Committee
LGRC	Local Grievance Redress Mechanism
LIF	Livelihood Improvement Framework
LLPs	Low Lift Pumps
LMP	Labour Management Procedures
LO	Likelihood Of Occurrence
LTIFR	Lost Time Injury Frequency Rate
MoEFCC	Ministry Of Environment, Forest and Climate Change
MSDS	Material Safety Data Sheets
NBSAP	National Biodiversity Strategy and Action Plan Of Bangladesh
NCS	National Conservation Strategy
NDMC	National Disaster Management Council
NEMAP	National Environment Management Action Plan
NEP	National Energy Policy
NEQS	National Environmental Quality Standards
NEXI	Nippon Export and Investment Insurance

NWMP	National Water Management Plan
OHS	Occupational Health & Safety
PAPs	Project Affected Persons
PCM	Public Consultation Meeting
PCU	Passenger Car Units
PDM	Public Disclosure Meeting
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
RAP	Resettlement Action Plan
RE	Renewable Energy
RRAs	Rapid Rural Appraisal
SCC	Site Clearance Certificate
SDG	Sustainable Development Goals
SEA	Sexual Exploitation & Abuse
SIS	Small Indigenous Species
SOPs	Standard Operating Procedures
SoWs	Scope Of Works
SPS	Safeguard Policy Statement
SRDI	Soil Resource Development Institute
SST	Sea Surface Temperature
STDs	Sexually Transmitted Diseases
STP	Sewage Treatment Plant
SWA	Stop Work Authority
TL	Transmission Line
TRIR	Total Recordable Injury Rate
UN	United Nation
UNO	Upazila Nirbahi Officer
VIP	Ventilated Improved Latrine
WB	World Bank

EXECUTIVE SUMMARY

The Government of Bangladesh (GoB) aims to transform the nation's economy to match the level of developed countries by 2041 through industrialization, urbanization, and mechanized agriculture. To achieve this goal and meet the future energy demand-supply gap, it is essential to develop clean and renewable energy (RE) infrastructure alongside conventional fuel-based systems. Power demand continues to rise steadily, and the Government has set a target of generating at least 40% of electricity from clean energy sources by 2041 while addressing the existing power demand-supply challenges. Projections estimate a power demand of approximately 96,767 MW by 2050 (IEPMP 2023, PP2041 Case Scenario), including 18,000 MW from solar energy. The primary aim of the project is to establish a 220 MWAC Grid-Tied Solar Power Plant to boost power generation from renewable sources, thereby strengthening the national grid and supporting the Government's vision for rapid urbanization, industrial growth, and overall development by 2041. This initiative will also ensure a reliable and high-quality power supply for consumers.

According to the national environmental legislation of Bangladesh, all development projects are governed by some legal and institutional requirements. Project proponents or developers need to evaluate relevant legal provisions, policies, strategies, and institutional considerations before implementing any plan or program. Developers are required to understand and comply with these regulations as applicable. Before initiating any development project, obtaining environmental clearance from the Department of Environment (DoE) is mandatory. The Environmental Conservation Rules (ECR), 2023 outline the process for securing an Environmental Clearance Certificate (ECC). According to this rule, solar projects exceeding 50 MW capacity are classified under the 'ORANGE Category,' which necessitates an Initial Environmental Examination (IEE) to secure Site Clearance. Additionally, to meet lender requirements, a comprehensive Environmental and Social Impact Assessment (ESIA) study has been conducted to prepare a bankable report.

The proposed Power Plant site is situated on the left bank of the Feni River and the North side of the Shabazpur Channel, located at Sonagazi, Feni. The proposed plant area is adjacent to the 75 MW newly constructed EGCB's Power Plant. The proponent would take 700 acres of land which has already been acquired by EGCB. The proposed Project will be constructed geographically at the Latitude 22.79°N; Longitude: 91.39°E; and administratively, it is in Purba Baradhali Mouza under Char Chandia Union of Sonagazi Upazila of Feni District.

Baseline study was conducted in the area with the objective of keeping proper documentation of the present condition of all the environmental and social components of the study area. The Baseline chapter represents the existing situation of the environmental and social context for the proposed 220 MWac Solar Power Plant and its surrounding areas. In broad sense environmental and social condition for baseline study comprises outlining the physical environment (e.g., including meteorological, hydrological, geological components and processes), biological environment (e.g., including flora, fauna, and ecosystems), land use pattern, agricultural practices, culture and capture fisheries, and social environment (cultural activities, economic status, livelihoods and hazard) of the

Study area. Under this project, primary and secondary data have been used to analyze the baseline condition of the study area.

Any development activity may have positive or negative effects on the physical, biological, and socio-economic environment. These impacts can be temporary, reversible, or permanent and may occur during various project phases, such as pre-construction, construction, or operation. The potential impacts and corresponding mitigation measures for each phase of the power plant project have been provided in the Impact and Mitigation chapter.

Stakeholder consultation, which is a two-way flow of information and exchange of opinion, or simply consultation, is conducted in the project area, to collect people's perception about the project implementation in the area. The main goals are to improve efficiency, transparency and public involvement in this project. The details of consultation meeting outputs are presented in Chapter 6.

Project Management has created a system to respond to project-related questions and complaints, as well as to resolve any inconsistencies in the execution of the standards specified for environmental protection impact assessment and mitigation. The complaints related to plant operation that may create inconveniences to agency/individual should be addressed based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly without resorting to expensive, time-consuming legal actions. To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRC will record the details of the complaints and the reasons that led to the acceptance or rejection of particular cases. The GRC will keep records of all resolved and unresolved complaints and grievances and make them available for review as and when asked for by appropriate authorities and any organizations known to be working with urban development issues. However, it should be noted that the GRC process will not pre-empt an aggrieved person's right to seek redress in the courts of law.

An EMP will be used to execute environmental mitigation measures and environmental monitoring requirements. Environmental consequences, mitigation strategies, environmental monitoring standards, and environmental supervisory obligations are explained in detail in the EMP. The EMP is prepared for the site preparation stage, Pannel configuration stage, operation stage and decommissioning stage. The EMP would act as a guided document for contractor to ensure that they can implement the project in an environmentally sound manner where project planners and design agencies, contractors, relevant government departments and stakeholders of concern understand the potential impacts arising out of the proposed Project and take appropriate actions to manage them properly.

The project is expected to have a minimal impact on the environment. The planned activities under the project are unlikely to cause any significant harm to the surroundings as a well-defined execution timeline and modern construction methods will be employed. The proposed mitigation measures comply with established standards and best practices for the project's construction and operation.

The following Project will be implemented with the financing of Islamic Development Bank (IsDB). A Draft report was shared with IsDB for review, comments and Suggestions. After reviewing, IsDB shared comments on the draft report, which was then incorporated, and this report has been prepared addressing the necessary inputs of IsDB."

1 INTRODUCTION

1.1 Background

The Government of Bangladesh (GoB) aims to elevate the country's economy to the level of developed nations by 2041 through industrialization, urbanization, and mechanized cultivation. Achieving this objective and addressing the future demand-supply gap necessitates developing clean or renewable energy (RE) infrastructures, which will complement conventional fuel-based infrastructures. Despite the satisfactory progress in power infrastructure development, the incorporation of renewables into the sector lags significantly. Recognizing solar power as Bangladesh's most suitable renewable energy source, the GoB plans to establish renewable energy-based power plants in alignment with the recommendations outlined in the Integrated Energy and Power Master Plan (IEPMP) 2023.

According to the Environment Conservation Rules, 2023 (ECR,23), the proposed solar project is categorized as 'ORANGE' [Item Number 08 of Orange Category list (Capacity exceeding 50 MW) in ECR, 23], requiring only an Initial Environmental Examination (IEE) for obtaining the Site Clearance Certificate (SCC) and subsequently the Environmental Clearance Certificate (ECC). However, the following document has been prepared to comply with the funding agency's Environmental and Social guidelines/requirements and a comprehensive Environmental and Social Impact Assessment (ESIA) Study for this project has been conducted instead of Initial Environmental Examination (IEE).

1.2 Project rational

The power demand is continuously growing with each passing day. Moreover, the Government targets generating at least 40% of power from clean energy sources by 2041 and reducing the present power demand-supply gap. The government predicts a power demand of about 96,767 MW (IEPMP 2023, PP2041 Case Scenario) by 2050 including a power generation of 18,000 MW from solar system by 2050.

The proposed project once completed will add about 220 MWAC of clean electricity to Bangladesh's national power grid. Additionally, it will create employment opportunities for the local people and improve the road transportation system in the project area, which will ultimately play an important role in poverty reduction and develop social safety net conditions. Moreover, this Solar Power Plant will thereby play an important role in producing electricity in an environmentally friendly manner, which will surely have a very low impact on the environment compared to the other conventional fuel-based power infrastructures.

1.3 Objective

1.3.1 Project objective

The overall objective of the Project is to construct a 220 MWAC Grid Tied Solar Power Plant to enhance the country's power generation through clean energy to strengthen the national

power grid capacity towards achieving the Government's target of fast-growing urbanization, increased industrialization and other development activities for 2041, and to ensure reliable and quality power supply to the consumer level.

1.3.2 Study Objectives

The overall objective of the Environmental and Social Impact Assessment (ESIA) study is to meet the environmental regulations of Bangladesh by conducting the assessment of the environmental and social consequences associated with the design, construction, and operation of the proposed Project and to obtain necessary approvals from the Department of Environment (DoE) by following the applicable statutory requirements. The project is expected to be funded by the Islamic Development Bank (IsDB) so, it was also ensured that the report meets all the compliance with the Environmental and social standards of Islamic Development Bank (IsDB) and other Multilateral funding organizations. The specific objectives of the study are as follows:

- To identify and evaluate the potential impacts that the project may have on the environment, such as air and water quality, biodiversity, ecosystems, and natural resources. This assessment helps in understanding the magnitude and significance of the potential impacts.
- Improve and assess the potential social impacts of the Project on local communities and stakeholders. This includes a set of social factors, such as, landscape alteration, livelihoods, cultural heritage, involuntary resettlement¹, indigenous people, community health and safety, and social cohesion.
- To review the existing national policy, legislation, guidelines, relevant international documents IsDB's Environmental and Social Safeguard Policy 2020 including relevant other funding agencies.
- To recommend appropriate mitigation and management measures to minimize or eliminate potential adverse environmental and social impacts. These measures may include implementing Environmental and Social Management Plans (ESMP), Good International Industry Practice (GIIP), monitoring programs and incorporating sustainable practices throughout the project lifecycle.
- To assist in obtaining the Site and Environmental Clearance Certificates (SCC and ECC) along with No Objection Certificates (NOCs) from the relevant authorities; and
- To obtain approval of the report from the DoE.

1.4 Scope of Works

As per the Project Terms of Reference (ToR), the following are the scope of works (SoWs) envisaged to be carried out under the ESIA Study:

¹ Subject to the availability of RP Study Report, a complete assessment of potential social impact related to involuntary resettlement and indigenous peoples would be conducted. Otherwise, as per general practice, ESIA Study would be accomplished with a low level of information.

- Delineating project design and description considering ESIA study extracting from the feasibility study report addressing phase- wise project activities, alternative analysis, implementation plan.
- Reviewing relevant literatures and existing documents (e.g. Environmental and Social Impact Assessment (ESIA) Report Under Feasibility Study for Development of Utility Scale Solar PV & Wind Projects in Bangladesh) of the proposed Project.
- Reviewing country legislations for describing the statutory requirements and standards of Islamic Development Bank (IsDB) and other funding agency.
- Investigating site accessibility and transportation of raw materials for the Power Plant.
- Preparing a detailed environmental and socio-economic baseline of the study area covering all relevant aspects of physical environment [i.e., environmental quality (air, water, noise & soil), climate change, water resources, and land resources; biological environment (i.e., ecosystem and biodiversity, fisheries resources, and agricultural resources; and socio-economic environment (i.e., demographic profile, lifestyle, utilities, gender, etc.) by integrating primary and secondary data;
- Identifying the Important Environmental and Social Components (IESCs) which would be impacted by the project.
- Identifying the potential hazards and risks along with natural events.
- Engaging local stakeholders to conduct informal consultations like KIIs, FGDs, RRAs and formal consultations like PCM and PDM.
- Conducting a comprehensive environmental and social impact assessment (both adverse and beneficial) for project interventions and activities.
- Preparing an Environmental and Social Management Plan (ESMP) in detail in compliance with national regulations and IFC Performance Standards on Environmental and Social Sustainability, IFC general EHS guidelines, IFC EHS guidelines for Transmission and Distribution, the Equator Principles, World Bank Group EHS Guidelines with applicable measures and a tentative ESMP implementation budget.
- Preparing an Environmental and Social Monitoring Plan (ESMoP) including the budget.
- Preparing an ESIA Report which shall cover the basis (IEE) of the site clearance certificate/Environmental Clearance Certificate from the DoE as well as for fulfilling the lenders' requirements.

1.5 Approach and Methodology

The Environmental and Social Impact Assessment (ESIA) process is a way to identify, predict and assess the type and scale of potential environmental and social impacts, and opportunities to benefit conservation, associated with any business activities or Projects.

The approach and methodology that will be followed to conduct this study has been outlined below:

1.5.1 Reviewing Policies and Legal Issues

The national policies, acts, regulations and guidelines as well as development partner's/project financier's policies that have been reviewed and investigated under this study have been detailed out in in **Chapter -2**

1.5.2 Project Conceptualization

The project has been conceptualized through a kick-off meeting held at PGCB head office. A field visit has also been conducted for relevant data collection and public consultation. A schematic framework of the ESIA study has been shown in Figure 1.1

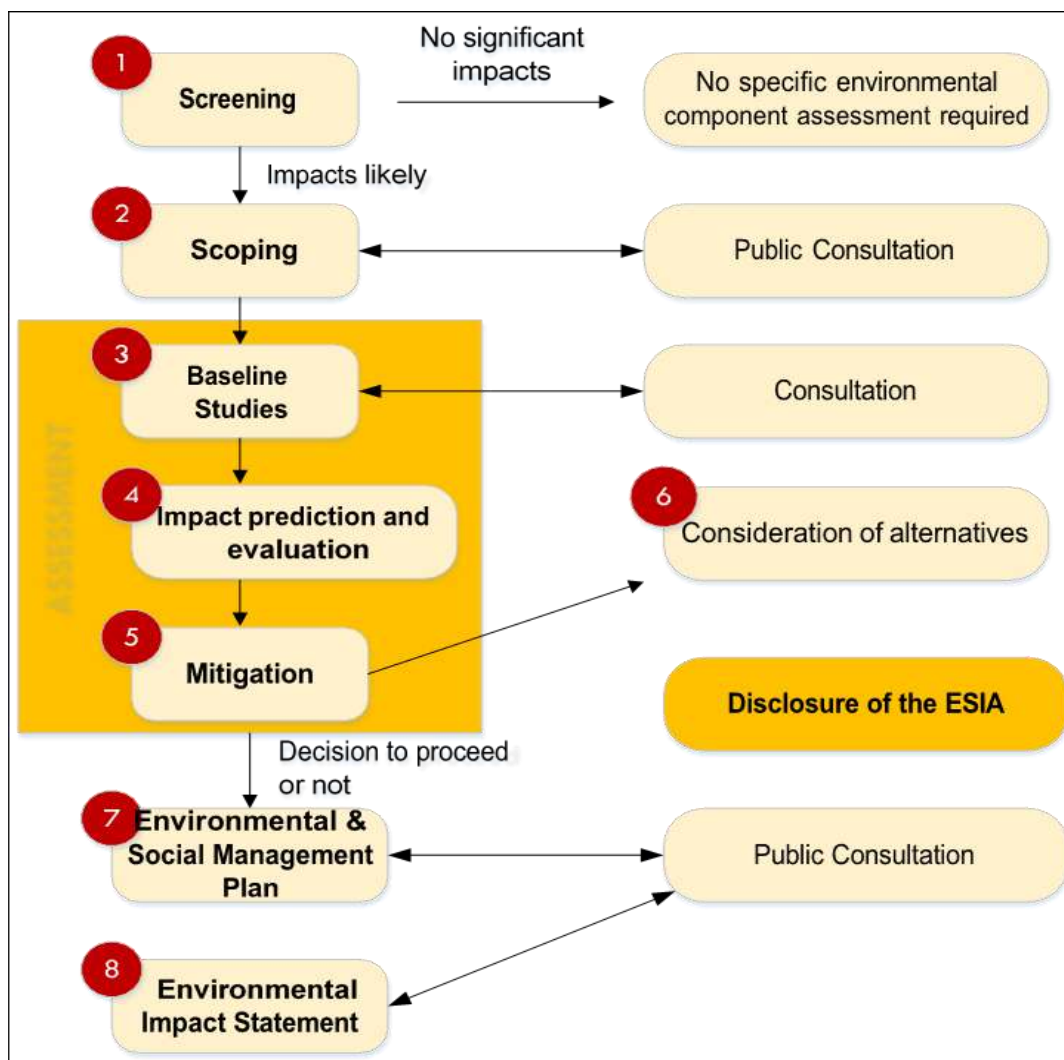


Figure 1.1: Environmental and Social Impact Assessment Process

1.5.3 Screening

Screening is the initial stage of the environmental assessment for the project intervention. This process is generally based on preliminary information including determination of legal and other requirements based on applicability. The output of this process is emphasized to

determine the potential positive and negative impacts on environment and socioeconomic issues. The site-specific regulatory obligation has been figured out at the very beginning for sustainable performance.

1.5.4 Scoping

The scoping of the Project has considered the following four major tasks:

- Study boundary delineation
- Identify key issues for decision making
- Identify area of significant impacts
- Identify area of significant risk (natural/ project based/ man-made hazards)

At the initial level of scoping, a boundary has been set to define the work area for the selected study in respect of time, space and subject matter (nature and characteristics of the environment that may be affected by the Project).

1.5.5 Study Area Delineation

The study area for conducting the ESIA study has been delineated considering: (i) nearest settlement area including important social features likely to be impacted by the Project; (ii) the probable extent of the reflection of light from the PV panel; (iii) habitation of dependent livelihood; (iv) accessibility; (v) wildlife habitat, (vi) source of water, etc. After finalization of the study area, it has been bounded and visualized in a map using GIS tools and RS technology. This section has been detailed out in **Chapter 3**

1.5.6 Project Description and Project Options

1.5.6.1 Project Description

A detailed Chapter (Chapter 3) has been prepared narrating the description of the project and associated components for this report based on the data collected from the reconnaissance field visit, baseline survey, and secondary data from the literature review, Feasibility Report and other documents that has been shared by the client.

1.5.6.2 Alternative Analysis

Initially, the selections from alternatives were done by following the findings of the feasibility study report provided by the Client. The project site associated facilities and technologies were evaluated in respect to environmental and social point of views. The justification of selecting the best option for the project has been done considering the Project site, associated facilities, technologies etc. which has been evaluated in respect to environmental and social point of views. The alternative evaluation includes comparative analysis of – i) No action alternative ii) Technology alternative, iii) Site alternative, etc.

The evaluation process has followed the aspects given below:

- Examination of the ‘No Action Alternative’;
- A comparison of the environmental and technical performance potential and other relevant variables would be included.
- A discussion on the status of any ongoing analysis, including a discussion of the options not chosen and the rationale for their exclusion.

- Contingency plans if major project components or methods prove infeasible or do not perform as expected; and
- The implications of a delay in proceeding with the Project, or any stage of the Project

1.5.7 Existing Detail Environmental and Social Condition (Baseline Condition)

The baseline information has been delineated within the study area based on both primary and secondary data analysis and expert judgement. The assessment of potential risks and impacts for the project greatly relies on this data, hence, it has been ensured that sufficient data has been collected and analyzed to enable a robust assessment. The contemporary and world-standardized tools and techniques have been used in investigating the physical, biological and social environment of the study area. The physical environment has covered the existing condition of the environmental quality including air, water, noise, and soil; hydrological analysis including water level and discharge of the nearest water level station, assessment of erosion prediction of the river bank, and ground water analysis (water level only); climate meteorology; topography; seismicity and geological settings; and resources including land class, type, use, and cover; and hazard analysis including natural and manmade. Biological environment has covered agricultural resources, ecological resources, and fisheries resources; and Socio-economic environment has covered the demographic profile, utilities, ethnicity, archaeological sites etc.

The environmental parameter selection has been finalized after the reconnaissance field visit based on which environmental quality would be checked. Some of the parameters have been tested in-situ and some samples have been collected for laboratory testing. These data have been analyzed and presented in ways that are consistent with applicable environmental standards, norms and requirements of both national (i.e., ECR 2023) and international (i.e., IFC/ the WB guidelines). Secondary data will be used to comprehend precisely for the study area.

1.5.7.1 Physical Environment

Meteorological and Climatic Condition: Meteorological data such as rainfall, temperature, sunshine hours, humidity, wind speed, wind direction, solar radiation and history of tornadoes have been collected from Feni Station of Bangladesh Meteorological Department (BMD) and analyzed for 30 years period for assessing local climate that are directly related to the Project.

Land use/Cover: The most recent and available high resolution multispectral satellite images have been used to extract the present uses of land of the project site and study area and to quantify the area of land cover. The land use features have been identified and extracted from the satellite images through onscreen digitization techniques using ArcGIS software and compiling those land use features to generate data and prepare a land use map that has been used in field investigation. Ground truthing techniques have also been applied in case of any haziness in identifying the land uses from the image. See Table 1.1 for details.

Landscape, Geomorphology and Morphology: The landscape and geomorphological condition of the study area have been delineated in this section focusing the existing multiple land uses, topography, soil and geology, aesthetic values by consulting the reference documents like Upazila Gazette, Bangladesh National Building Code (BNBC), Topography Report, etc. Besides Morphological behavior of the rivers within the study area especially close to the plant site have been analyzed based on the time series satellite imagery, and field investigation.

Hydrological Investigation: The hydrological scenario of the site has been delineated by giving special emphasis on storm water run-off, drainage patterns, river/ Channel flow, etc. based on the information collected from the Feasibility Study Report. Furthermore, this section has been updated by filling data that has been collected from Bangladesh Water Development Board (BWDB) and other available secondary data sources. Besides water salinity data has been collected from the available secondary sources and through salinity testing of collected sample from field. In addition, a ground water availability assessment would be conducted through an empirical method prescribed by National Water Management Plan (NWMP) 2001 as groundwater will be required for panel washing and potable purposes. Furthermore, information on the morphological aspect of the site particularly the erosion potential, has also been collected from the Feasibility Study Report that has been provided by the Client. Analysis of the potential impacts of dyke construction will be conducted as well. This section has also covered the paleontological, architectural, archaeological and cultural features.

1.5.7.1.1 Environmental Quality

1.5.7.1.1.1 Air quality

Ambient air quality of the criteria pollutants ($PM_{2.5}$, PM_{10} , CO, SO₂, NO_x, SPM) have been measured continuously 24 hours of a day except CO (8 hr.) at the six (06) locations based on the location of the sensitive receptors and the direction of wind. AirSENCE (Model: AS400P-1021C6B440224, CANADA) have been used for air quality monitoring which is an advanced, accurate, and affordable Continuous Ambient Air Quality Micro-Monitoring Station (CAAQMMS).

1.5.7.1.1.2 Noise level

The ambient noise levels have been monitored at twelve (12) locations in and around the proposed Project site considering the sensitivity of the receptors. Noise levels have been measured continuously for 15 minutes both for day and night period in order to get the ambient noise level status of the study area. For survey purposes, ANSI Type II (KANOMAX) noise level meter has been used. Depending on the site condition and acoustic environment, the noise meter has been set up and calibrated each time prior monitoring.

1.5.7.1.1.3 Vibration Level Monitoring

The vibration level (mm/s) has been measured by Kanomax Vibration meter (Model 4200) an electronic device at six (06) locations on the basis of the site sensitivities.

1.5.7.1.1.4 Water Quality (Surface and Ground Water)

To check the water quality during the Dry Season of the study area, both surface (2 nos.) and ground (2 nos.) water samples have been collected from the study area. For surface water quality testing, water samples from rivers, ponds or nearby canals; and ground water samples from the nearby wells, deep tube wells within study area have been collected, assessed and described accordingly in this report. While selecting the sample collection locations were magnitude, extent, timing, duration, significance and seasonal variation. Water quality parameters have been selected depending on the ambient water use and potential polluting agents from the project. See Table 1.1 for details.

1.5.7.1.1.5 Soil Quality

Soil quality information has been collected from the Soil Resource Development Institute (SRDI), Bangladesh (secondary data source). However, for checking existing soil quality within the study area, soil samples from four (04) locations have been collected during the reconnaissance field visit and checked the mentioned parameters as per Table 1.1. below.

Land Resources: Using the SOLARIS tools of SRDI the soil and land resources data have been extracted. The SOLARIS stores all the data related to land and soil management for agricultural purposes which include soil quality, texture, land type, deposition type, flooding depth, drainage, moisture content, etc.

1.5.7.1.1.6 Analysis of Natural Disaster

Being in the coastal region, the study area is prone to cyclones with storm surge, sea level rise and heavy rainfall. Other natural events such as: floods, seismic events, salinity intrusion, and soil erosion etc. have been analyzed for this Project. The basic hazard related information and its causes and consequences have been analyzed based on field information, available literature review, and available secondary meteorological and hydrological data analysis (data sources: BWDB, NWRD database of WARPO, GSB). In addition, Disaster and Climate Risk Information Platform (DRIP) portal (<http://drip.plancomm.gov.bd/>), prepared by the Planning Commission, has also been used to gather natural hazard-based information (as available) for this project. Details of Climate Risk Assessment Methodology is elaborated in Section A.

1.5.7.1.1.7 Land Resources

Using the SOLARIS tools of SRDI the soil and land resources data have been extracted. The SOLARIS stores all the data related to land and soil management for agricultural purposes which include soil quality, texture, land type, deposition type, flooding depth, drainage, moisture content, etc.

1.5.7.1.1.8 Analysis of Natural Disaster

Being in the coastal region, the study area is prone to cyclones with storm surge, sea level rise and heavy rainfall. Other natural events such as: floods, seismic events, salinity

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1.5.7.2 Biological Environment

A detailed description of the flora and fauna (terrestrial and aquatic) of the area, with special emphasis on rare, endemic, protected or endangered species, has been presented in this report. Migratory species have also been considered in this regard.

Information on existing vegetation, proposed vegetation loss and resulting loss and/or fragmentation of habitat for fauna have been presented. Generally, species dependence, niche specificity, community structure and diversity are also outlined in the section.

The presence of bats has also been determined. A description has been given of:

- Different ecosystem types including cave and sinkholes and their species, if present.
- Nocturnal species within the project site.
- Flight and behavioral patterns of bat species
- Habitat of flora.
- Biological diversity is the importance of the area.
- Invasive and economically important species.
- Mitigation measures to avoid or minimize negative impacts on wildlife, wildlife habitat and vegetation communities/ecosystems; and
- Anticipated changes to wildlife and vegetation within the study area have also been examined and documented.

A map(s) illustrating the location of all ecosystem types has also been included.

Secondary data related to bio-ecological zones have been collected from IUCN. Ecological data and relevant information have been collected through field surveys and review of different secondary sources. Overall perceptions of the local people about biodiversity and ecosystem have been gathered from transect survey, public consultation meetings (PCM), KII, FGD and RRA methods. Wildlife habitat types, roosting habitat wetland and shoreline birds along with migratory species and other threatened species have been identified through field investigation and secondary information. Breeding habitat and migratory routes of the threatened wildlife species have been identified through public consultation, physical investigation and secondary information. The ecological survey method is presented Figure 1.2.

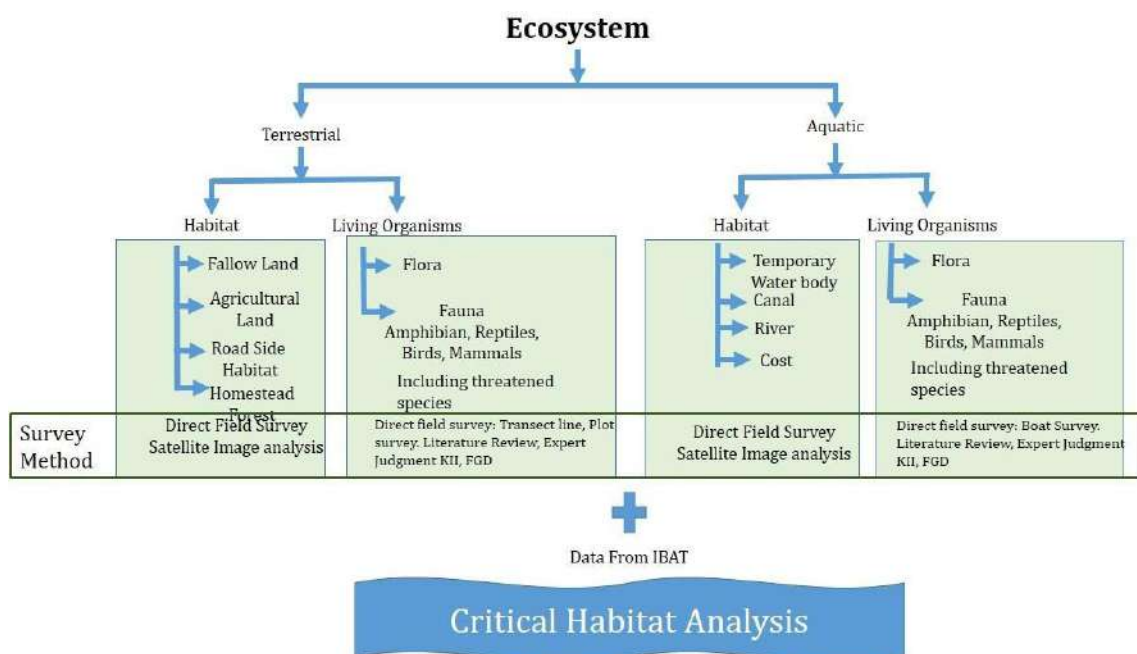


Figure 1.2: Ecosystem Survey Process

1.5.7.2.1 Benthos Plankton

Two strategic sampling sites have been selected at the most probable impact locations: one near the project site canal and another within the project area canal. These sites have been used to establish a baseline for the plankton and benthos communities, enabling an assessment of the project's impact on these ecosystems.

Plankton samples have been collected from the upper layer of the Canal Water and benthic samples have been collected from the bottom soft soil. Collected samples have been taken in plastic containers. The collected samples have been immediately preserved in 5% buffered formaldehyde and transferred to the laboratory for analysis.

For the Plankton survey, 40 liters of water have been filtered successively through 64µm mesh nylon nets (Millipore corp., Bedford, USA), and 70 ml of the concentrate have been collected initially as a crude measure of plankton. For the qualitative and quantitative study, samples have been observed under a compound microscope in an S-R (Sedgewick- Rafter cell, U.K.) cell (Photoplate 12.1) following published methods (Welch, 1948). Briefly, 1 ml samples of 5% buffer formalin-fixed plankton have been pipetted on to a clean S-R (Sedgewick-Rafter cell) cell and observed at 10 X 10 magnification, using a (KRUSS, MBL 2100, Germany) compound microscope (Photoplate 12.2).

Benthic faunal communities have been sampled by taking sediments from each sampling point. They have been sieved in a sieve plate and preserved in 5% buffered formaldehyde in a plastic container. Afterward, Containers were labelled indicating the site code, the sample code, the sampling date etc.

The number of plankton estimated per ml has been calculated by adopting the following formula (Welch, 1948):

$$N = \frac{A \times C}{L}$$

Here,

N = Number of plankton/L

A = Total concentrate number of plankton (ml).

C = Number of plankton counted in 1 ml sample

L = Amount of water (In litre) passed through plankton net (minimum 40 litre).

For benthos calculation various indices have been calculated using the results of the final count of organisms. Calculations are project specific and include, total number of organisms, total number of taxa, percent dominant taxa, and statistical analysis.

1.5.7.2.2 Fisheries Assessment

Resources have been assessed based on the primary and secondary data. The primary data have been collected from the field by selecting representative sites considering capture and culture fishery. In this regard, the potential site categories will be as: (i) Inland capture fishery; and (ii) Culture fishery. The major sets of primary data include physical condition of different fish habitats, connectivity, migratory route, catch status, fish species diversity, composition, fishermen and fisher's status, fish price, fish seed and input information, landing centers etc.

The spatial extent and area of fish habitats have been obtained from the land use that has been generated by analyzing image and water resources database. Habitat quality has been assessed based on the measured water quality data. Fish yield and production for individual capture and culture fisheries habitats have been estimated using primary and secondary data. Impact on fisheries for the proposed project have been assessed in different angles like direct loss of habitat, possible changes of habitat quality based on the emission and discharge of effluent from the plant and EMP has been provided accordingly.

1.5.7.2.3 Agriculture and Livestock Assessment

To prepare the baseline information on agriculture, various agricultural parameters such as farming practices, existing major cropping patterns, cropped area, yield rate, crop production, crop damage and various inputs used (availability of irrigation water, fertilizers, pesticides, seeds, labour etc.) have been collected from both primary and secondary sources.

Information on existing cropping patterns and cropping intensity have been collected from secondary sources (UAE Office) and from primary sources through field level survey in consultation with concerned farmers through FGD, dealers of fertilizer and pesticides, officials of DAE and BADC etc. The average yield value (ton/ha) of different crops in the study area has been calculated based on this information. High resolution recent images have been used for computation of NCA. The total existing crop production has been estimated using the formula: Total crop production = damaged free area × normal yield + damaged area × damaged yield.

Present statistics of livestock (Cow/Bullock, Buffalo, Goat and Sheep) and poultry (Duck and Chicken) including their numbers and information on grazing land, fodder availability and disease infestation status of the study area have been evaluated during field level survey in

consultation with the local people through PRA, RRA and KII. Livestock resources data have also been collected from secondary sources i.e. from District/ Upazila Livestock office.

Table 1-1: Baseline Data Sources for Environmental Data and Collection Methods

Area of Studies	Indicators	Secondary Sources	Primary Data Acquisition Process
Physical Environment			
Land Use	Land classification and land type determination	Historical Image from google earth of April 2021	Image Analysis (0.3m World View 3, March and April 2023)
Climate and meteorology	Wind speed, wind direction, humidity, precipitation, pressure, cloud cover, mixing height, upper atmospheric data, sunshine hour	BMD (station-Feni for the years 1993-2023), NWRD of WARPO, CEGIS (if needed)	-
Hydrology	Water level, discharge (Extreme value return period analysis), Aerial extent of River and other water bodies, Rainfall runoff, Flooding.	BWDB (Station: SW-182 & SW-87), BIWTA, NWRD of WARPO (if needed)	BWDB, NWRD, Field survey and satellite Imagery analysis with remote sensing and GIS technology
Morphology	Bankline shifting, erosion and accretion	Satellite Images from CEGIS Archive	CEGIS Archive
Agriculture	AEZ zone data, cropping pattern, cropping intensity, crop varieties and crop production	NWRD of WARPO, DAE, BARI, BARC	RS, GIS, FGD
Water Quality (Surface)	TSS, chloride, sulphate, nitrate, Ni, Mn, Cr+6, Fe, Cu, BOD ₅ , COD, total hardness, total alkalinity, sodium, potassium, total nitrogen, total phosphorus, phenol, heavy metals (As, Cd, Hg, Pb, Zn), total coliform and faecal coliform	DoE, CEGIS, BWDB	Field sampling & Lab Analysis at CEGIS Lab, DPHE and BCSIR

1.5.7.3 Socio-Economic and Cultural Environment

A comprehensive socio-economic baseline survey has been conducted to discern the social economic and cultural ways of life of people. It has derived information on current composition that has been used for comparative analysis. Furthermore, an analysis of the social acceptability of the proposed project has been carried out with a view to understanding the level of acceptance by the local people and stakeholders. Several tools and techniques for such analysis have been adopted. To gain such consensus, the analysis have been performed on the basis of the following three main conditions:

- Status of land ownership and livelihoods
- Economy, employment and labour market, health and cultural status of the study area
- Presence of archaeological sites, cultural heritages and aboriginal people

Social surveys have been conducted in administrative units (Mauza, Ward, and Union) which fall within the 5 km radius area from the project boundary. Such a radius area of 5 km around the project boundary would be considered for assessing the community health, safety and

security assessment. Secondary data on socio-economic issues have been collected from 5km buffer area from the project boundary.

A detailed socio-economic survey technique has been applied to figure out the precise concurrent social and economic situation of the study area. Data from Bangladesh Bureau of Statistics (BBS), local and regional government and non-government organization will be collected for better understanding about the social settings, economic power, gender dimension, social safety nets, seasonal livelihood and migration status of the study area. KII with direct or indirect stakeholders and PRA with the local communities will be conducted. Tools of PRA like transect walk, FGD, social and resources mapping, mobility mapping will be applied to extract information on social issues like land acquisition and compensation, resettlement plan, livelihood shifting, cultural attitude, labour recruitment system, impacts during construction, benefit sharing, impacts during operation, fire hazard, health risk etc.

Household Survey: The following formula (Cochran1953) is usually used for sample size determination.

$$n = p(1 - p) \left(\frac{Z}{E} \right)^2$$

n = Sample size,

P= Proportion of beneficiaries = 0.5

Z=1.96 (at 95% confidence level)

E = Standard error = 0.01 (or 1% is considered as standard margin of error)]

Then the sample size is 384 for the unknown population size whereas increasing the standard error up to 10% in the above-mentioned formula, the sample size is 95. However, there are a small number of households residing within the 5 km radius of the center point of the project area. In this regard, 5% of the population (not more than 100) have been surveyed purposively in this demarcated study area.

The focus of the household survey is to identify the Socio-Economic condition of the people residing within and close vicinity of the project area who might be directly affected by the proposed project and triggered as Project Affected Persons (PAPs). PAPs affected by the livelihood have additional attention in the survey questionnaire for developing its effective restoration plan.

A structured questionnaire has been prepared to conduct the survey. Online-based surveys have been carried out considering the short-time frame of the Project. For this, Kobo Toolbox has been used for facilitating the survey.

1.5.7.3.1 Traffic Survey

Information has been collected on traffic volume for road and river connecting the project site by conducting traffic volume monitoring at three locations (Feni to Sonagazi Road, Olama Bazar Road, Sonagazi to Dhan Gobeshona). The traffic volume counts have been recorded in three different time segments (8 am to 9am, 11 am to 12 pm, 04 pm to 05 pm) considering the peak and off- peak time to assess the existing total daily traffic, peak hour traffic and traffic composition.

The Site-specific baseline data sources and collection method for socio-economic condition is given in Table 1.2.

Table 1-2: Site Specific Socio-Economic Baseline Data Sources and Collection Methods

Environmental Sectors	Data Type	Data Sources	Tools and Approach
Socio-Economic Resources			
Socio economic	i. Demographic Profile ▪ Households and population ▪ Sex ration, ▪ Age structure, ▪ Dependency ratio ii. Living of standard ▪ Housing structure, ▪ Housing tenancy, ▪ Vulnerability and disasters, ▪ Displacement or migration iii. Poverty and livelihood asset ▪ Gender based Occupation and employment, ▪ Labour market, ▪ Household income and expenditure, ▪ Land ownership and price, ▪ Poverty status iv. Ethnicity v. Cultural heritage and others ▪ Archeological sites vi. Social Facilities/ Utility Services ▪ Electricity coverage, ▪ Sanitation, ▪ Drinking water, ▪ Communication facilities, ▪ Access to health facilities vii. Literacy status (Gender based educational qualification) viii. Traffic Volume	i. BBS 2011, 2022 ii. Agricultural Census 2019 iii. Field Survey	i. Questionnaire survey ii. KII, RRI, FGD
Stakeholder Consultation	Suggestions/ Consent from the local people, officials from GOs and NGOs, other stakeholders	Field Survey and Consultation	Stakeholder engagement using the following social tools and techniques: i. FGD, KII, RRA, etc. ii. Public Consultation Meeting (PCM) and Public Disclosure Meeting (PDM))

1.5.8 Stakeholder Consultations

Stakeholder's/public consultation meetings have been organized to assess possible environmental and social impacts. This has addressed the key issues on:

- Communication with local people and stakeholders about the proposed project.
- Provide information on the project activities and involvement of the stakeholders,
- Collection of opinions of the local people and stakeholders, in particular, attitudes to the proposed industrial activities, interest in employment opportunities and local economic development and importance of energy independence etc.
- Involvement of the stakeholders during installation and operation stages of the project.
- The aspects of the project design that could be influenced by the stakeholders; and
- Representation of different stakeholders' interests

Stakeholder consultations have been conducted by following the bottom-up approach and aligning with the ECR 2023 and WBG Guidelines. The stakeholders have been engaged in the following modes:

- Focus Group Discussion (FGD): A few FGDs with stakeholders will be carried out.
- Key Informant Interview (KII): Knowledgeable and/or key officials will be interviewed on the need based.
- Public Consultation/Disclosure Meeting (PCM/PDM): Large scale formal public consultation and disclosure meetings will be carried out as per ECR 2023.

1.5.9 Identification of Important Environmental and Social Components

Important Environmental and Social Components (IESCs) have been identified in ESIA. Significant IESCs have been identified scrutinizing the natural and social environment and with the help of public opinions through reconnaissance field visit. Selected IESCs have been recapitulated at the preliminary field visits and the finalization of IESCs have been done after the participatory sessions with stakeholder. The proposed IESCs have been verified in the participatory sessions.

1.5.10 Detail Environmental Impacts and Mitigation Measures

Impact identification and assessment starts with scoping of project intervention(s) and associated activities. This section assessed potential impacts in a way the Project interacts with the elements of the physical, biological, socio-cultural or human environment to render impacts to resources/receptors. The feasibility study, field surveys including environmental quality baseline monitoring, ecological and fisheries surveys, social surveys and stakeholder consultations have assisted in assessing impacts. The steps of impact assessment are summarized in **Figure 1.3** and comprises of:

Impact prediction: to determine what could potentially happen to resources/receptors because of the Project and its associated activities.

Impact evaluation: to evaluate 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: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.

Residual impact evaluation: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures

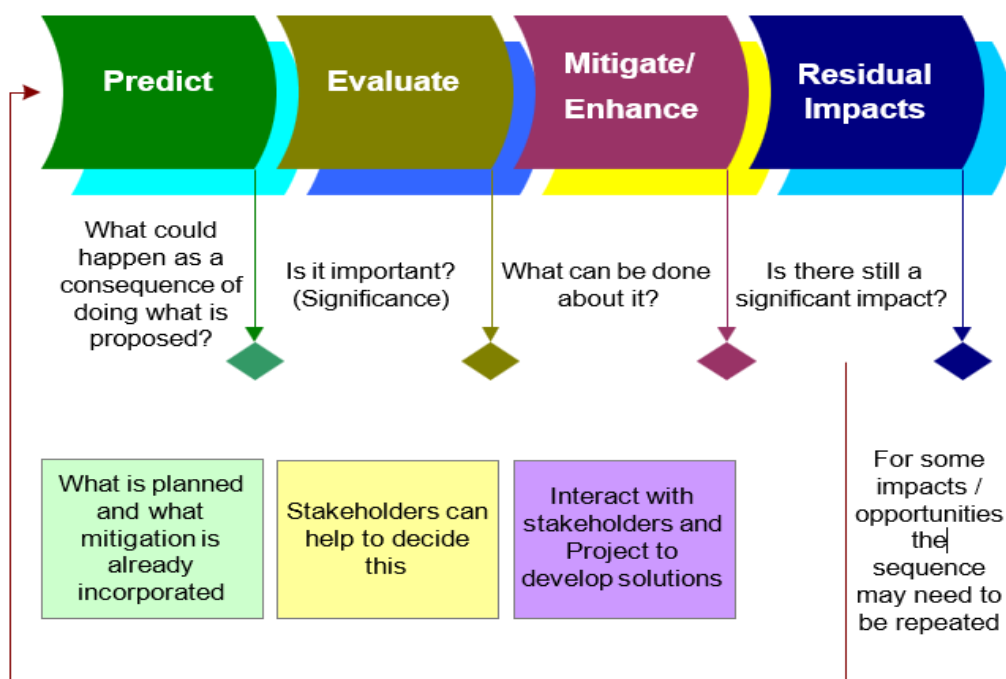


Figure 1.3: Environmental and Social Impact Assessment Process

The significance of potential impacts has been assessed using the criteria and methodology given below:

Project Activities: The project activities are defined for which the impacts on the receptors are assessed. The study has considered the activities to be involved in the construction of power plant in three phases, i.e., Pre-construction that is feasibility and design, project construction/implementation, and operation and maintenance.

Receptors: The "medium" (e.g. soil/air/water) or organism (e.g. wildlife/fish/bird) affected by the pollutant or contaminant or noise emitted or generated from an activity of the Project is called a receptor. In ESIA study, the receptor related information is expected in the baseline information.

Sensitivity of Receptor: The sensitivity of a receptor for each impact has been assessed based on the capacity or features (including proximity/numbers/vulnerability etc.) of the receptors to handle or tackle an impact. A four-level qualitative scale defining the sensitivity as "low", "moderate", "substantial" and "high" is developed to assess the sensitivity. The definitions of the sensitivity classes are outlined in Table 1.3. In case of biodiversity risk assessment, the sensitivity has been defined following the ESS6 considering critical habitats

or a species triggering CH criteria would have high sensitivity and the moderate habitat would have lower sensitivity.

Table 1-3: Definitions of the Sensitivity Classes

Sensitivity Class	Definition
High (H)	Vulnerable receptor with no capacity to absorb proposed changes or minimal opportunities for mitigation.
	Biodiversity Risk Assessment: If the receptor (species, or biodiversity feature or habitat) is triggering Critical Habitat Criteria
Substantial (S)	Vulnerable receptor with little capacity to absorb proposed changes or limited opportunities for mitigation.
	Biodiversity Risk Assessment: If the receptor (habitat) is categorized as a natural habitat and provides supports to vulnerable species (EN and CR)
Moderate (M)	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
	Natural or modified habitats with anthropogenic pressure and decreasing trend of habitats (or population) with biodiversity value
Low (L)	Vulnerable receptor with good capacity to absorb proposed changes and/or good opportunities for mitigation
	Modified habitats with the occurrence of no important species

Impact/Vulnerability Prediction: Prediction of impacts have been carried out with an objective to determine what is likely to happen to the resources/receptors of the environment as a consequence of the Project and its associated activities. From the potentially significant interactions identified in Scoping, the impacts on the various resources/receptors were elaborated and evaluated.

Impact Magnitude: The potential impacts of the project have been categorized as major, moderate, minor, or nominal based on consideration of parameters such as: i) duration of the impact; ii) spatial extent of the impact; iii) reversibility; iv) likelihood; and v) compliance to Legal Standards before Mitigation Measures.

A ‘Likert Scale’ is developed (Table 1.4) to assess the degree of each parameter. The scale has a maximum score “4” which is labelled as “High” and minimum score “1” which is labelled as “Low”. A word scenario was also developed to guide quantification of each parameter. Once the assessment of each parameter is complete for an impact, a composite score for each impact is calculated summing scores of all five parameters. Depending on the composite score, the magnitude of the impact is assessed following the scale provided in Table 1.5.

Table 1-4: Definition and Scaling of Designations

Parameter	Qualitative Scale to Quantify the Parameter (corresponding score is in parenthesis)			
	High (4)	Substantial (3)	Moderate (2)	Low (1)
Duration of potential impact	Long term (more than 15 years)	Medium Term (5 to 15 years)	Short Term limited to construction period	Temporary with no detectable potential impact

Parameter	Qualitative Scale to Quantify the Parameter (corresponding score is in parenthesis)			
	High (4)	Substantial (3)	Moderate (2)	Low (1)
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Potential impact requires a year or so to recover with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains almost constant
Compliance to Legal Standards before Mitigation Measures	Breaches national standards and or international guidelines/ obligations	Comply with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Certain	Likely	Occasional	Unlikely to occur

Table 1-5: Scoring Criteria for Magnitude Assessment

Magnitude of Impact	Composite score to define magnitude of an impact
High (H)	16 – 20
Substantial (S)	11 – 15
Moderate (M)	6 – 10
Low (L)	0 – 5

Once impact characteristics are defined, each impact has been assigned a ‘magnitude’. Magnitude is typically a function of a combination (depending on the resource/receptor in question) of the following impact characteristics, such as extent, duration, scale and frequency considering the embedded control measures.

In case of unplanned events only, magnitude incorporates the ‘likelihood’ factor discussed above.

Embedded Control Measures: The abatement measures that are already considered in the implementation of a Project and dealt in the Project design and description are termed as embedded control measures. The control measures may be a device, or set of devices, that manages, commands, directs or regulates the behavior or functions of other devices or systems. It is important to note that impact prediction and evaluation considers any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the Impact Assessment Process).

Impact Significance: Once magnitude of impact and sensitivity/ vulnerability/ importance of resource/ receptor have been characterized, the significance has been assigned for each impact. Impact significance is designated using the matrix shown in Table 1.6. A word description of the significance has also been described in Table 1.7

Table 1-6: Impact and Risk Matrix of Significance

Magnitude of Impact	Sensitivity of Receptors			
	High (H)	Substantial (S)	Moderate (M)	Low (L)
High (H)	High (H)	Substantial (S)	Substantial (S)	Moderate (M)
Substantial (S)	High (H)	Substantial (S)	Moderate (M)	Low (L)
Moderate (M)	Substantial (S)	Moderate (M)	Moderate (M)	Low (L)
Low (L)	Moderate (M)	Low (L)	Low (L)	Low (L)

Table 1-7: Significance of the Impact

Significance Class	Word Description
High (H)	The resource/receptor are highly sensitive to the impacts/risk and would likely experience a high magnitude impact that would endure for a long time, extend over a large area, exceed national/international standards, endanger public health and safety, threaten a species or habitat of national or international significance, and/or exceeds a community's resilience and ability to adapt to change. The Project may have difficulty in complying with the applicable ESF requirement, and significant mitigation would likely be required.
Substantial (S)	The resource/receptor would experience a clear change from baseline conditions and would approach but not exceed applicable standards. The Project would comply with the applicable ESF requirement, but mitigation would be required.
Moderate (M)	The resource/receptor would experience a noticeable effect, but the magnitude of the impact is sufficiently small (with or without mitigation) that the overall effect would remain well within applicable standards. The Project would comply with the applicable ESF requirement, but mitigation may be required.
Low (L)	The resource/receptor would experience a noticeable effect, but the magnitude of the impact is sufficiently small (with or without mitigation) that the overall effect would remain well within applicable standards. The Project would comply with the applicable ESF requirement, but mitigation may be required.

1.5.11 Natural and Technical Risk Assessment and Emergency Response

The purpose of the Risk Assessment Study is to provide the following information on the nature and extent of risk impacts arising from the construction and operation of the Projects. The objectives of the risk assessment will include the following:

- Identification of all hazardous scenarios associated with transport, storage and processing of dangerous goods (DG) taking equipment failures and human faults into account.
- Comparison of individual and societal risks with Government Risk Guidelines and comment on the acceptability of the assessed risk.
- Identification of the risk management strategies required to render the risks acceptable; and

- Identification and assessment of practicable and cost-effective risk mitigation measures

The risk and hazard analysis will have three major components:

Natural Hazards and Risk Assessment: Hazards associated risks due to natural disasters such as cyclones, tornadoes, droughts, floods, earthquakes, road accidents, etc. have been identified and assessed based on literature review, field survey, and secondary data analysis. Following the analysis disaster management plan and risk reduction measures and plan have been prescribed in ESIA report.

Hazard Risk Associated with the Project (Technical/ Manmade): Hazard and associated risk with the construction and implementation of the proposed power plant have been identified using risk matrix. Besides, Vehicle Collisions, Struck-By/ Caught-In/ Caught-Between, Falls, Confined Spaces, High Pressure Lines and Equipment, Electrical and Other Hazard, Machine Hazards will be assessed during the ESIA stage considering the magnitude of the hazards and the associated consequences.

Occupational Hazard and Safety Assessment: In the ESIA, hazard assessments have been carried out to identify the potential hazards and to identify possible measures to avoid the hazards along with the safety plan for minimizing the risk. Incorporating these measures and safety plan in design, planning and operational procedure of the proposed Project, the potential hazard points have been eliminated. Steps to be followed include identification of potential hazard points, hazard cause identification, consequences of exposure, risk management and safety plan.

Emergency Response: Emergency Response Plans have been developed to address a range of plausible hazard scenarios that are unplanned and emphasize the tasks required to respond to a physical event. The emergency response plan typically included the following aspects shown in Figure 1.5.

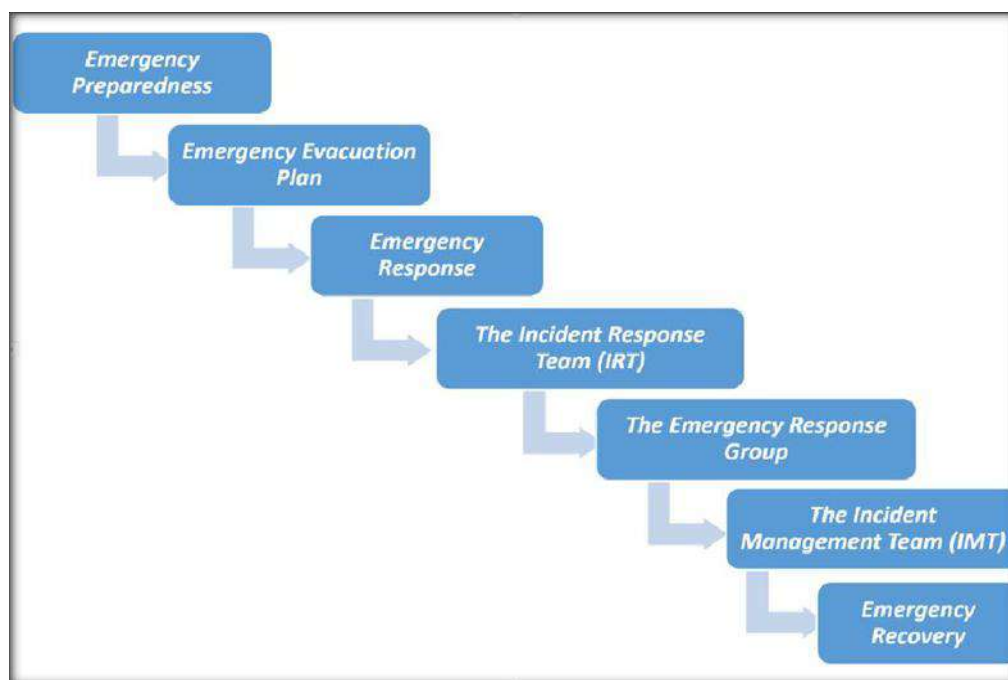


Figure 1.4: Components of Emergency Response Plan

1.5.12 Formulation of Environmental and Social Management Plan

In this section the set of mitigation and management measures that have been adopted to avoid, reduce, mitigate, or compensate for adverse environmental impacts (in that order of priority) have been discussed. It includes multiple management plans, sub plans and actions which have covered impact specific EMP (i.e., EMP for air quality, noise level, water quality etc.), site specific EMP (i.e. for construction site, special location, important, etc.) and special ESMP (i.e., grievance redress mechanism, stakeholder engagement plan, ecosystem management plan, green belt management plan etc.) as well as Environmental Code of Practice. Mitigation measures have also been outlined considering different phases of the Project cycle (pre-construction, land development and operation). The ESMP has been formulated in a manner so that the implementing agency can easily follow it as well as can reduce the collective environmental and social issues of the study area. The details of the water quality management plan, air quality management plan, noise level management plan, demolition plan for the end of the project life span, green belt development plan etc. will be elaborated in the ESIA report as per best practices.

The contents that have been addressed in the ESMP in general have been discussed below:

- Identify and summarize anticipated significant adverse environmental impacts and risks.
- describe each mitigation measure with technical details, including the type of impact to which it relates and the conditions under which it is required (for instance, continuously or in the event of contingencies), as well as implementing agencies.
- Provide links to any other mitigation plans (for example, for involuntary resettlement) required for the Project.

1.5.13 Formulation of Environmental Monitoring Plan

A practicable environmental monitoring plan will be suggested at the end of the study for future monitoring. The monitoring parameters will be carefully selected depending on the Project activities in coherence with the monitoring procedure of IFC Guidelines.

- Monitoring: Under monitoring the ESMP will:
 - Describe monitoring measures with technical details, including parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits and definition of thresholds that will signal the need for corrective actions; and
 - Describe monitoring and reporting procedures to ensure early detection of conditions that necessitate mitigation measures and document the progress and results of mitigation.
- Implementation arrangements: Under the implementation arrangements the ESMP will:
 - Specify the implementation schedule showing phasing and coordination with overall Project implementation.
 - Describe institutional or organizational arrangements, namely, who is responsible for carrying out the mitigation and monitoring measures, which may include one or more of the following additional topics to strengthen

- environmental management capability: technical assistance programs, training programs, procurement of equipment and supplies related to environmental management and monitoring, and organizational changes; and
- Estimate capital and recurrent costs and describe sources of funds for implementing the environmental and social management plan.
 - Performance monitoring indicators: Here the desired outcomes as measurable events will be described to the extent possible, such as performance indicators, targets, or acceptance criteria that can be tracked over defined time periods.

1.5.14 Preparing ESIA and ESMP Report

Finally, a draft ESIA Report has been prepared following the DoE guideline and submitted to the Client for their feedback. Complying with the feedback and comments, the ESIA Report will be submitted to the Project Director in association with the ToR of the ESIA Study for the proposed Project.

Some plans, evaluation as well as assessments have also been provided in the appendix of ESIA report. Those are outlined below:

A. Methodology for Climate Resilience and Disaster Risk Assessment

This section covered Climate Resilience and Disaster Risk Assessment. This assessment is linked to the decision of the National Disaster Management Council. The detailed methodology has been outlined below:

Hazard Identification and Risk Assessment Process

The hazard assessment has been carried out to identify the potential hazard associated with or inherent in the design process and to identify possible measures to avoid the hazard along with the safety plan for minimizing the risk. Incorporating these measures and safety plans in the proposed project's design, planning and operational procedure would eliminate/mitigate the potential hazard impacts. The assessment process involves the following steps

- Identification of potential hazard
- Identification of causes and consequences
- Risk management

The study area is highly prone to the flooding and drainage congestion. The basic hazard-related information and its causes and consequences have been collected from the field visit. Based on information from the field and Feasibility Study, the possible impacts of natural disasters on the proposed project and appropriate risk reduction measures have been identified and presented in Table 1.8.

Table 1-8: Baseline Data Sources for Environmental Data and Collection Methods

Sl. No.	Natural Disaster	Potential Impact	Disaster Risk Reduction/management	Implementation Agency
1				
2				

In this regard, the hazard and risk-related information for the major disasters in the area has been collected and utilized from the Disaster and Climate Risk Information Platform (DRIP) prepared by the Planning Commission.

Climate Change risk analysis

The climate change risk analysis for the study has been carried out following several activities, which are:

i. Trend analysis of recent climate

Meteorological or microclimatic data of the study area have been collected from the nearest station (Feni, Comilla and Sandwip) of BMD. Historical records of meteorological parameters, i.e. precipitation, temperature etc. have been collected from the respective agencies. Besides, water level has been analyzed based on data availability from BWDB stations at Companyganj (SW182), Malipur (SW257), Sonapur (SW87), Sandwip (SW122) and Hatiya (SW321). Based on the data, the trend of recent climate has been analysed for understanding the pattern of climate in the study area.

ii. Future climate projection

The future climatic condition for the study area has been assessed based on IPCC Sixth Assessment Report (IPCC, 2021). The IPCC Sixth Assessment Report (AR6) has updated future climate projections with new shared socio-economic pathway (SSP) scenarios based on five narratives describing climate change impacts including broad socioeconomic trends. To capture the complete variation of future climate as presented in the AR6, SSP1-2.6 and SSP5-8.5 scenarios have been considered for this analysis. The AR6 based future climate projection have been included following the National Adaptation Plan of Bangladesh (MoEFCC, 2022). In this respect, Temperature and Rainfall projections for the study area for 2030s and 2050s have been analyzed.

iii. Potential impacts of climate change:

The various impacts of climate change on the study area and the proposed project activities will be analyzed based on available secondary data and DRIP website. The major impacts on Flood, Inundation and erosion will be assessed for the study area based on the relevant information from the technical study and other secondary information from available literature.

B. Methodology for Livelihood Improvement Framework

The Livelihood Improvement Framework (LIF), a component of the Environmental and Social Impact Study, establishes a framework for improving livelihoods to mitigate potential long-term negative impact and impoverishment among households affected by the Project. This initiative aligns with relevant national and international legislation, such as the Acquisition

and Requisition of Immovable Property Act 2017, as well as international best practices. This framework aims to prevent severe physical and economic displacement of affected households by ensuring their livelihoods are either improved or restored.



Figure 1.5: Livelihood Improvement Framework

Assessing the Present Livelihood Scenario

Present socio-economic status of PAPs including landowner and land dependent have been assessed through FGD and socio-economic census survey of PAPs during preparation of this livelihood improvement framework.

Findings from Different levels of Group Discussion

FGDs, RRAs, Informal Group Discussions, KIs and Formal Consultations have been undertaken during site visits to gather information related to the project activity and associated impacts, local community, and social fabric of the project area.

Result from Socio-economic Sample Survey

Findings from socio-economic sample survey have been carried out to gather data of the individual PAPs to understand the number of households impacted due to the project activities, their familial and cultural background, area being impacted upon including other facilities and available infrastructure, educational and occupational pattern, poverty level, compensation negotiation, migration, training need for livelihood improvement and grievance redress mechanism. Vulnerable groups amongst the affected PAPs have been identified during the survey as some of the PAPs might require additional restoration and development assistance.

Guideline Entitlement Matrix

Based on data gathered from socio-economic surveys and FGDs, an entitlement matrix related guideline has been prepared so that all PAPs covered under legitimate compensation amounts.

Guideline for Grievance Redress Mechanism

A guideline for Grievance Redress Mechanism has been developed to receive, respond to and address any complaints related to the project activities.

Guideline for Improving Livelihood Options

A guideline for improving livelihood options has been developed based on findings from entitlement matrix and solutions from grievance redress mechanism. Subsequently,

specific opportunity options for livelihood improvement have been described in this framework.

C. Critical Habitat Assessment

In this proposed project critical habitat has been assessed through the Critical Habitat Criteria provided by ADB.

The criteria for critical habitat defined by ADB (2009) are as follows:

Criterion 1: The area includes habitat required for the survival of critically endangered (CR) or endangered (EN) species.

Criterion 2: The area has special significance for endemic or restricted range species.

Criterion 3: The area represents a site that is critical for the survival of migratory species; or supports globally significant concentrations or numbers of individuals of congregator species.

Criterion 4: The area includes unique assemblages of species that are associated with key evolutionary processes or provide key ecosystem services.

Criterion 5: The area holds biodiversity of significant social, economic, or cultural importance to local communities.

Criterion 6: The area is either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's World Natural Heritage sites. IFC Performance Standard 6 (IFC, 2012b) adds an additional criterion:

Criterion 7- (Criterion 4 in IFC Performance Standard 6): Highly threatened and/or unique ecosystems. Highly threatened or unique ecosystems are those (i) that are at risk of significantly decreasing in area or quality; (ii) with a small spatial extent; and/or (iii) containing unique assemblages of species including assemblages or concentrations of biome-restricted species. IFC does not limit the definition of critical habitat to these criteria. Other recognized high biodiversity values might support a critical habitat designation, but these are either considered duplicative of the criteria (i.e. new species discovered during surveys were precautionary classified as endemic) or not relevant (e.g. refuge sites for drought, fire or floods or climate change, erosion control, presence of keystone species).

Methodology of Determining Critical Habitat

The approach to critical habitat assessment has been started with screening ADB SPSS (2009) to preliminarily assess whether these criteria would be applicable or not. Thereafter, a species list has been obtained from the IBAT dataset of species for 50km radius of the project AOI. The list of species has been further updated with the data from IUCN Red List of Bangladesh (IUCN Bangladesh 2015). While determining the conservation status, priority has been given to the national red list ratings over and global IUCN Red list status.

Species have been screened through excluding the species which are relevant to the BAA defined for biodiversity assessment and which are unlikely to occur within the BAA and its vicinity. The BAA included natural habitats. The modified habitats occurring within the BAA

have also been included. Thereafter the relevance of critical habitat has been assessed for each species based on expert judgment. The assessment of “significant importance” of the habitat have been made through applying the following guidelines developed for ADB (2009):

- Key Biodiversity Areas (KBA) including IBA and AZE sites, other protected areas and reasons for designation are important CH indicators but require appropriate justification against the ADB (2009) critical habitat criteria.
- ADB (2009) Criterion (a) requires an assessment against both global (IUCN) and national red list ratings. ADB (2009) footnote 13 states that where the threatened status of a species is listed differently between the two lists, assessment of the impact of net reduction should be based on the national/regional population. This is interpreted as a requirement to follow a precautionary approach and apply assessment of species reduction (project impact) to the smaller species population.
- CR species face an extremely high risk of extinction, and their survival is in a critical state. Therefore, if present in the BAA, consideration should be given towards ADB (2009) Criterion (a) being achieved, unless there are appropriate arguments for its exclusion.
- Where a significant proportion ($\pm 1\%$) of the national or global population of a CR or EN species has a likely presence within the BAA, critical habitat can be achieved under ADB (2009) Criterion (a).
- ADB (2009) Criterion (b) can additionally be achieved for restricted range species where
- the BAA overlaps with a significant proportion ($\pm 1\%$) of a species’ distribution range.
- ADB (2009) Criterion (c) can be achieved for migratory and congregatory species where a significant proportion ($\pm 1\%$) of a species’ national or global population is exposed to the BAA of impact.
- ADB (2009) Criteria (d) and (e) are to be assessed on a case-by-case basis using reliable data sources and expert opinion, with consideration given to legally protected areas, KBAs, IBAs, AZE sites, Ramsar Sites, World Heritage Sites, other conservation initiatives and the reasons for which they are designated.

Determination of Critical Habitat Occurrence

A list of CR and EN species relevant to the BAA have been presented in a table. The screening assessment is based on the national database of Bangladesh's biodiversity, habitat preference of this species, and the Likelihood of Occurrence (LOO) of each species (within the BAA). The species that had not been recorded previously in the BAA, and which were unlikely to occur have been excluded from the list. After the screening, the assessment has been made to determine Critical Habitat Occurrence within the BAA as per the ADB (2009) criteria, and expert judgment on “habitat of Significant Importance” and “Significant Concentration of migratory species”.

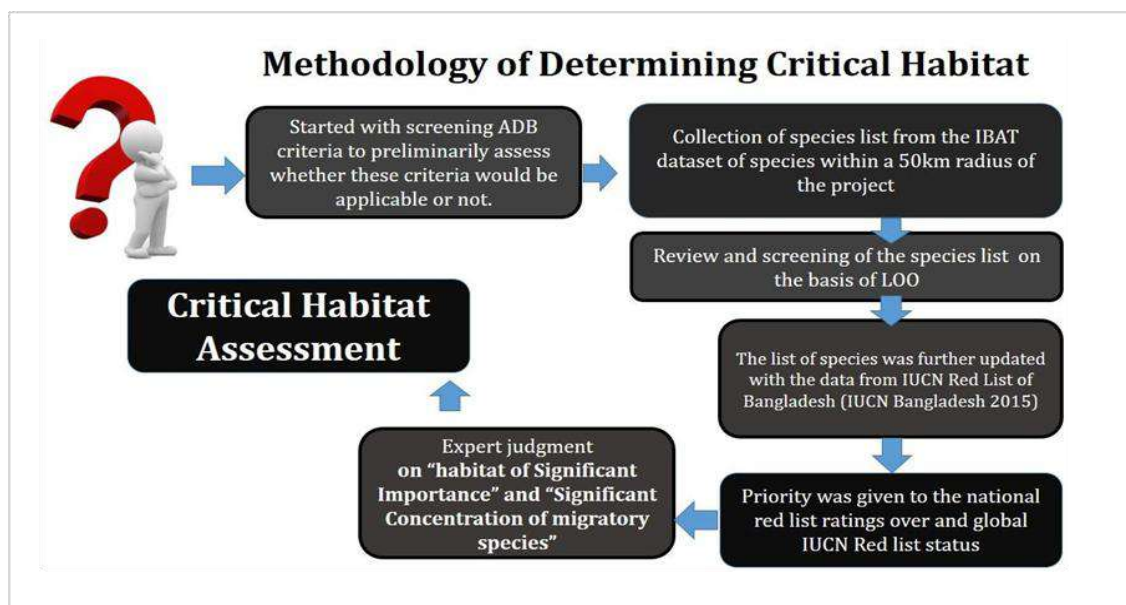


Figure 1.6: Methodology of Determining Critical Habitat

1.6 Limitations

Due to its stipulated time frame the study is conducted considering the baseline condition. Seasonal variations may increase additional weight to the study findings. However, environmental monitoring data during project implementation phase may be useful for enrichment of the study report.

1.7 Study Team

Primarily, the environmental and social study has been conducted by the CEGIS under the contract with EGCB. However, according to the study requirement the analysis of data and report structure has been updated by Infrastructure Investment Facilitation Company (IIFC)'s multi-disciplinary Team. The team members with their positions are presented in **Table 1.9.**

Table 1-9: Team Composition for ESIA and ESMP Study

Sl. No.	Name of the Professionals	Assigned Position
1	MD Shafiqur Rahman	Team Leader/Senior Environmental Specialist
2	Munsi Shahid Anis	Survey Specialist
3	Mamun Ar Rashid	Social Development Specialist
4	Madhu Sudan Das	GIS Expert
5	Mehedi	Project Coordinator
6	Md. Mashiur Rahman	Ecologist
7	Saiful Islam Imran	Resettlement Expert
8	Rajib Roy	Mid-Level Environmental Specialist & GIS Expert
9	Md. Nurul Absar	Civil Engineer
10	Mohammad Zahidul Islam	Jr. Social Specialist

2 LEGISLATIVE, REGULATION AND POLICY

2.1 Introduction

This chapter of the ESIA focuses an overview of the institutional context, major national and international policies, laws, rules and international commitments that are ratified by Government of Bangladesh and playing a vital role for governing environmental protection including environmental assessment of development projects in the country.

According to the national environmental legislation of Bangladesh, all development projects are governed by some legal and institutional requirements. As such, assessment of relevant legal provisions, policies, strategies and institutional issues are very important for any project proponent or developer before execution of a program or plan. The proponent has to 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 (DoE). The procedure for obtaining Environmental Clearance Certificate (ECC) has been detailed in the Environmental Conservation Rule (ECR) 2023. As per this rule, the proposed solar project (more than 50 MW) falls under the 'ORANGE Category', which requires an Initial Environmental Examination (IEE) to obtain the Site Clearance. However, for the requirement of the project funding agency, the following ESIA report has been prepared by conducting a comprehensive Environmental and Social Impact Assessment (ESIA) Study.

2.2 Organizations Related to Enforcement of Environmental Standards

Roles and responsibilities of various Ministries and Departments involved in the enforcement of environmental requirements are described below:

2.2.1 Ministry of Environment, Forest and Climate Change

The Ministry of Environment, Forest and Climate Change (MoEFCC) is the key Government institution in Bangladesh for all matters relating to national environmental policy and regulatory issues. Realizing the ever-increasing importance of environmental issues, the MoEFCC replaced the Ministry of Agriculture and Forest in 1989 and is at present a permanent member of the Executive Committee of the National Economic Council. This is the major decision-making body for economic policy issues and is also responsible for approving all public investment projects. The MoEFCC oversees the activities of the following technical and implementing agencies.

2.2.1.1 Department of Environment (DoE)

In order to expand the scope of environmental management and to strengthen the power for achieving it, the Government adopted the Environmental Pollution Control Ordinance in 1977. The ordinance provided the opportunity for the establishment of an Environmental Pollution Control Board, which was assigned with the responsibility of formulating policies

and proposing measures for their implementation. In 1982, the Board was renamed as the Department of Environmental Pollution Control (DEPC). Six divisional offices were established in Dhaka, Chattogram, Khulna, Barishal, Sylhet and Rajshahi. A special presidential order renamed the DEPC as the Department of Environment (DoE) and placed it under the newly formed MoEFCC in 1989.

The DoE is a Department of the MoEFCC and is headed by a DG. The power of the DG, as given under the Act, may be outlined as follows:

- DG has the power to close activities considered harmful to human life or the environment. The operator has the right to appeal, and procedures are in place for this. However, if the incident is considered an emergency, there is no opportunity for any appeal.
- The DG has the power to declare an area affected by pollution as an ecologically critical area. The DoE governs the type of work or process which can take place in such an area.
- Before undertaking any new development project, the project proponent must take Environmental Clearance Certificate (ECC) from the DoE. The procedures to take such clearance are in place.
- Failure to comply with any part of the Environment Conservation Act (ECA1), 1995, with subsequent amendments, may result in punishment by imprisonment or a fine of or both.

2.2.1.2 Forest Department

This department under the MoEFCC is responsible for the protection and management of all reserve forests in the country. Department personnel extend down to the union level in areas where there are reserve forests. The department has recently started some agroforestry programs, and its officers are also responsible for the protection of wildlife in the forests.

2.2.1.3 Other Related Organizations

There are several other organizations which have certain social and environmental functions. These organizations include:

- Ministry of Land: Land Reform and Land Acquisition Directorate
- Ministry of Water Resources: Bangladesh Water Development Board
- Ministry of Fisheries and Livestock: Directorate of Fisheries
- Ministry of Labor and Employment

2.3 Review and Applicability of Relevant National and International Policies and Legislations

Based on the activities of the Project there are the relevancy of National and international Policy and Legislative for Environmental, natural resources and energy sectors. The relevant national and international policy, legislation and framework along with their applicability to this proposed project have been discussed below:

Table 2-1: Relevant National and International Policy and Legislative Framework

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
The Environment Court Act, 2000	The Act provides the jurisdictions of environment court, penalty for violating court's order, trial procedure in special magistrate's court, power of entry and search, procedure for investigation, procedure and power of environment court, authority of environment court to inspect, appeal procedure and formation of environment appeal court.	The Act is triggered as the Project in some ways might be responsible for affecting the local environment. Any unregulated event that happens due to negligence of the Proponent is liable to penalize as per the Act.
The Bangladesh Environmental Conservation Act of 1995 (ECA, 1995) and (Amendments 2000, 2002, 2007, 2010)	This Act is the key legislation in relation to environment protection in Bangladesh. It is promulgated for environment conservation, standards, development, pollution control, and abatement. It has repealed the Environment Pollution Control Ordinance of 1977. The Act has been amended in 2000, 2002, 2007 and 2010.	The Act is triggered as the Project may have the potential of violating the environmental quality standards and in contrast to this pollution control undertaking mitigation measures is the compelling job for the FISPCL. Otherwise, punitive measures are provisioned for environmental, hazardous pollution as well as automobiles under this Act.
Environment Conservation Rules ECR-2023	This provides categorization of industries and projects and identified types of environmental assessments needed against respective categories of industries or projects. Moreover, this rule sets (i) national environmental quality standards for water and various types' of effluent (ii) requirement and procedure to obtain environmental clearance and (iii) the requirement for IEE and EIAs according to interventions and how to prepare a report.	ECR is triggered under this project as the project falls under "Orange Category" according to the categorization of ECR, 2023. Moreover, it stipulated environmental quality standards and other relevant requirements which needs to be complied during Project life cycle.
National Environment Management Action Plan, 1995;	NEMAP is a wide ranging and multi faced plan, which builds on and extends the statements set out in the national environmental policy. It set out the framework within which the recommendations of the National Conservation Strategy (NCS) are to be implemented. NEMAP has 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 and built environment. • Conservation of habitats and biodiversity.	It is applicable as it is related to the conservation of biodiversity and their habitat including environmental management and quality of life.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
	- Promotion of sustainable development; and - Improvement in the quality of life of the people One of the key issues in NEMAP regarding the energy sector is “energy conservation awareness is generally low throughout the country”. However, the policy focuses on the precaution for control of environmental degradation and conservation of the biodiversity.	
National Environment Policy, 2018	The National Environment Policy envisaged environment conservation, pollution control, biodiversity conservation, and mitigation of the adverse effect of climate change to ensure sustainable development. It provides detailed directives to ensure sustainable development without compromising the environmental protection for different sectors along with implementation plan. It also mentions the implementation agencies that will address all these above-mentioned issues of the following sector. such as: - Land Resources Management - Other Pollution Control - Water Resources Management - Environment Friendly Economic Development, Production and Consumption - Air Pollution Control - Safe Food and Water - Agriculture - Public Health and Health Services - Accommodation, Housing and Urbanization - Education and Mass Awareness - Forest and Wildlife - Biodiversity, Ecosystem Conservation and Biosafety - Hill Ecosystems - Fisheries and Livestock (Coastal and Marine Ecosystem - Ecotourism - Industrial Development - Energy and Mineral Resources - Communication and Transportation	It is triggered because all the construction and operation activities under the prosed project will be conducted following all the prescribed guidelines mentioned in this policy to ensure protection of the environment and sustainable development.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
	- Human Resources Management - Climate Change Preparedness - Disaster Management (Science, Research, Information and Communication Technologies - Management of Chemical Substances	
Bangladesh Water Rules 2018	The Water Rules 2018 has been promulgated based on the National Water Act 2013. It directs integrated development of ground and surface water; ensure sustainable extraction of groundwater, distribution, usage, protection, declaration of water shortage area and their management system and conservation of water resources in Bangladesh. Without prior permission issued by the Executive Committee of WARPO, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor will they be allowed to build any permanent structure or project that impede the natural flow of rivers and canals. Abstraction of ground water from the aquifers is restricted and the Executive Committee can give protection order, if the aquifer condition is degrading.	The Rule is triggered by the Project, as the Project has the provision of withdrawing of ground water for panel cleaning. In this regard, according to this rule, the proponent is required to collect necessary approval/ certificate from the WARPO.
National Energy Policy 2004	The objectives of the National Energy Policy (NEP) are outlined as follows: - Provides detail guidelines for utilization of energy for sustainable economic growth and environmentally sounds sustainable energy development programs. The Policy highlights the importance of protecting the environment by requiring an EIA for any new energy development project, introduction of economically viable and environment friendly technology. One of the seven objectives (Section 1.2) addresses the environment and states, "(vi) to ensure environmentally sound sustainable energy development Programs causing minimum damage to the environment". Seven specific policy recommendations are listed under Chapter 1.9. The following three of those objectives are relevant to the present project: - Environmental impact assessment should be made mandatory and should constitute an integral part of any new energy development project. - Use of economically viable environment friendly technology is to be promoted; and - Public awareness is to be promoted regarding environmental conservation to provide	The proposed intervention needs to be carried out in such a manner that the activities during the construction phase do not cause significant damage to the environment.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
	energy for sustainable economic growth so that the economic development activities of different sectors are not constrained due to shortage of energy. v. To meet the energy needs of different zones of the country and socio-economic groups. vi. To ensure optimum development of all the indigenous energy sources. vii. To ensure sustainable operation of the energy utilities viii. To ensure rational use of total energy sources. ix. To ensure environmentally sound sustainable energy development programs causing minimum damage to the environment. x. To encourage public and private sector participation in the development and management of the energy sector. xi. To bring entire country under electrification by the year 2020. xii. To ensure a reliable supply of energy to the people at reasonable and affordable prices. xiii. To develop a regional energy market for rational exchange of commercial energy to ensure energy security	
Noise Pollution (Control) Rules, 2006	These rules give authority to all the Union Councils, Pourashavas, City Corporations, City Development Authority (i.e. RAJUK, CDA, KDA, RDA etc.) to mark off the areas under their jurisdiction as silent, residential, mixed, commercial or industrial. They should also put signs to mark those areas. According to this act, daytime is counted from 6am to 9pm whereas nighttime is counted from 9pm to 6am.	This Rule is triggered by the Project as there is provision for using the rotatory machines and having noise generation potential due to various construction activities. Hence, EGCB is to take measures as per suggested mitigation measures to be given in the ESIA Report.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
The Motor Vehicle Ordinance, 1983	This regulation proposed to impose a penalty of maximum two hundred taka for those vehicles that are emitting smoke that poses health hazard in public places. It also restricts the passenger from smoking in public service vehicles and in any other vehicles with notice of not smoking. This ordinance is enforced occasionally but regular enforcement would be helpful to reduce air pollution in big cities.	The Project has the provision for using bulldozers, land levelers etc. for land development activities and transporting various waste to be generated at the construction site to outside the Project boundary and then to the vendors. The generated waste would be kitchen waste, construction waste etc. Moreover, internal roads may be constructed around the Project site, hence, traffic may be increased within the Study area. Therefore, there is a potential of air and noise pollution with associated health hazards. Hence, the Ordinance is triggered. Applicable measures need to be applied as per the suggestion of the ESIA Study.
The Bangladesh Water Act 2013	This Act ensures “integrated development, management, abstraction, distribution, use, protection and conservation of water resources”. By virtue of this Act all rights over surface water, ground water, sea water rain water and water in the atmosphere is vested on the State. Notwithstanding the above, “rights over the surface water on any private land shall remain with the owners of such land”, and such right to use the water shall be subject to the provision of the Act. Furthermore, under the provisions of this Act, “right to potable water, and to water for hygiene and sanitation shall be treated as the highest priority right”. Preventing the water sources from pollution is mandate of Water Act.	The Act is triggered as the Project has the provision of disposing the waste water may be generated from the panel washing and cleaning to the nearby Little Feni River which may have the susceptibility to contaminate river water. Moreover, it may affect ground water as the water for panel washing would be extracted from ground water system and thereby, concern with the proposed project activities Measures has been suggested in the ESIA Report which would be implemented by the EGCB.
The National Water Policy (1999)	This Policy ensures efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and institutional capacity building for water resource management. It has also addressed issues like River basin management, water rights and allocation, public and private investment, water supply and sanitation and water need for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc. It provides the framework for the management of water resources of the country in a comprehensive, integrated and equitable manner. The policy recognizes that water is essential	The Project has the provision of extracting ground water for solar panel washing other potable purposes. This may cause ground water depletion. Furthermore, the waste water from the proposed project will be discharged to the nearby waterbody. This might have impacts on the existing biodiversity of the surface water sources. Hence, the Act triggers the Project. Applicable measures need to be applied as per the suggestions to be mentioned in the ESIA Report.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
	for human survival, socio-economic development of the country, and preservation of its natural environment. It is vital that the continued development and management of the nation's water resources should include the protection, restoration, and preservation of the environment and its bio-diversity. The Policy also mentions about the monitoring of effluent disposal and take necessary actions to prevent water pollution.	
Bangladesh River Protection Commission Act, 2013	National River Protection Commission Act, 2013 (Act No. 9 of 2013). This Act, consisting of 4 Chapters, provides for creation the National River Protection Commission. It establishes the composition, duties and responsibilities of the Commission, entitled to: manage and control water and environmental pollution, caused by industrial pollution of rivers, construction of illegal structures and to prevent irregularities and restore the normal flow of the river, to control flood and drainage; hydrology, the use of surface and ground water; and to examine the equipment used in constructions of waterworks. It also applies to the proper maintenance of waterways necessary to ensure the socio-economic development of a multi-use and rational use of natural resources.	This act is triggered by this proposed project as the Little Feni River is situated very close to the site of the proposed project and its protection needs to be ensured.
National 3R Strategy for Waste Management, 2015	The 3R Strategy has been formulated in line with the National Goal of eliminating of waste disposal on open dumps, rivers and flood plain by 2015 and promoting recycling of waste through mandatory segregation of waste at source as well as creating a market for recycled products and providing incentives for recycling of waste. The priority sectors for 3R are identified as municipal solid waste, industrial waste, biomedical waste, institutional and commercial waste and agricultural waste. The first core principle of the National 3R Strategies distinguishes waste as a resource. Realizing the importance of the source separation of waste, it is regarded as the second core principle of the strategies. Third and fourth principles state that technologies should be environmentally friendly, appropriate and affordable. Cleaner production is another core principle which is the continual effort to prevent pollution, reduce the use of energy, water and material resources and to minimize waste in the production process.	The Act is triggered as the Project may have the potential to generate various wastes like solid, oil and grease etc. Moreover, at the end of the life cycle of this Project, a huge e-waste would be generated from the Solar panel. Mismanagement of these wastes to be generated at various stages for the implementation of the Project might have impacts on the environment. As a consequence, these may cause health hazards of the nearby community and workers. Applicable measures need to be applied as per the suggestions mentioned in the ESIA Study Report.
Solid waste Management	The Solid Waste Management Regulations 2021 were published in Bangladesh on December 23, 2021, under the Bangladesh Environmental Protection Act, 1995. The Regulations define the	

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
Rules 2021	responsibilities related to the businesses involved in solid waste management and impose collection, recycling, and disposal obligations according to Extended Producer Responsibility (EPR) on manufacturers of non-biodegradable products such as glass, plastic, and bottles. The Regulations also include provisions for the treatment of solid waste such as composting and energy recovery. The main provisions of the Regulations are as follows. • 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 are: Waste to be disposed according to the regulations of authorities including local government, waste to be disposed separately, do not dump, store, or burn waste outdoors. • Responsibilities of manufacturers are (not clearly defined) and importers of products shall 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. The regulations outline to determine work plans and implementation procedures for recycling and disposal process and ensure that EPR is properly implemented. In addition, shall 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 takas (approximately 270,000 yen), or both. The Regulations also include provisions for the treatment of solid waste such as composting and energy recovery.	The proposed project will comply with all directives mentioned under these rules.
E-Waste Management Rule 2021	In the E-Waste Management Rule 2021, the DOE has limited the use of heavy metals and substances including lead, mercury, chromium VI, polybrominated biphenyls (PBBs), polybrominated biphenyl ethers (PBDEs), di (2-ethylhexyl) phthalate (DEHP), butyl benzyl phthalate (BBP), dibutyl phthalate (DBP) and isobutyl phthalate (DIBP) up to 0.1%. The use of cadmium has been limited to 0.01%. The rule roughly states that manufacturers and importers of certain electronic products will be liable for limiting the use of these 10 substances. Also,	Solar PV panel, lithium-ion batteries and generators may produce e-waste during operation phase, and therefore this policy is applicable.



Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
	they must work to collect e-waste that comes out of their brands and help to scrap the goods in a way that the environment is not degraded.	
The Forest Act, 1927 and Amendment Act 2000	The Act provides for reserving forests over which the Government has an acquired property right. It has made many types of unauthorized uses or destruction of forest produce punishable. The Government may assign any village community its right to or over any land, which has constituted a reserved forest. According to the Act the government may prohibit certain activities in the declared reserved forest area such as any intervention kindles, keeps or carries any fire; trespasses or pastures cattle, or permits cattle to trespass; causes any damage by negligence in felling any tree or cutting or dragging any timber; etc.	The proposed location of the Power Plant is closed to the Sonagazi Forest which is composed of mangrove plants, and near Musapur Sea beach, patches of Jhaw forestry. Therefore, the Forest Act is applicable for this project. During the Study this law and rules and regulations under it will be taken into consideration. However, during implementation of the project, all related activities to be performed following regulation of this Act.
The National Forest Policy (1994)	This is the revised version of the National Forest Policy of 1977 in the light of the National Forestry Master Plan. The major targets of the Policy are to conserve the existing forest areas; management of protected areas, bring about 20% of the country's land area under the afforestation program, and increase the reserve forestland by 10% by the year 2015 through coordinated efforts of GO-NGOs and active participation of the people. The priority protection areas are the habitats which encompass representative flora and fauna in the core area of national parks, wildlife sanctuaries, and game reserves. The need of amendments of the existing forestry sector related laws and adoption of new laws for sectoral activities have been recognized as important conditions for achieving the policy goals and objectives. The Forest Policy also recognizes the importance of fulfilling the responsibilities and commitments under international multilateral environmental agreements	The Policy is triggered as the Sonagazi Forest falls under the study area that is composed of mangrove plantation area. In addition, there is also a Jhaw Patch near the Musapur Beach. These areas are rich in biodiversity and serve as essential winter refuges for migratory shorebirds further highlighting the ecological importance of the region. Therefore, Applicable measures need to be applied as per the suggestions to be mentioned in the ESIA Study Report.
Wildlife (Protection and Safety) Act 2012	The Act has empowered the government to declare any area as sanctuary, community conservation area, safari park, eco-park, botanical garden, wildlife reproduction center, landscape zone, buffer zone, core zone concerning wildlife and plant preservation, protection and their smooth multiplication. The focus of this act is the conservation of biodiversity. Salient features of the Act: The Act of 2012 has enabled the government to form a "Wildlife	The project site is located closed to the Sonagazi forest composed of mangrove plantation area. In addition, there is also a Jhaw Patch near the Musapur Beach. Hence, provision of this law shall be followed.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
	Advisory Board” comprised of experts. to assess present condition and give direction from time to time in relation to development and management of biodiversity. Under this Act, the hunting, trapping, killing of wildlife are strictly prohibited. There are certain provisions kept in this Act, e.g. entrance, management, rules and regulation of the protected area etc. The Act also includes the penalty provision for violation of the act.	
National Biodiversity Strategy and Action Plan for Bangladesh - 2004	The National Biodiversity Strategy and Action Plan of Bangladesh (NBSAP) “provides a framework for conservation, sustainable use and sharing the benefits of biodiversity of the country” (GoB 2004: v). The core focus of NBSAP has been ensuring cross-sectoral linkages and provides a framework for securing the necessary environmental settings to reduce poverty and ensure sustainable development. It is the basic instrument for implementing the Convention on Biological Diversity at the national level. This document has been prepared to fulfill the commitment of Bangladesh towards implementing the three objectives of Convention on Biological Diversity: conservation of biodiversity, the sustainable use of its components and fair and equitable sharing of benefits arising out of the utilization of genetic resources. It highlights national targets, activities and indicators for monitoring achievement to implementing NBSAP. Towards contributing to the global targets and implementation of NBSAP, 20 national targets have been proposed to take into action. Sixteen strategies have been developed to shape and direct the actions towards achieving the goals and objectives of NBSAP. NBSAP emphasizes integration of biodiversity conservation into the national development planning and processes.	From this perspective, the proposed project needs to recognize the value and importance of biodiversity and adopt measures to ensure that the ecosystems are not adversely impacted by project activities in any stages of project implementation and operations.
The Protection and Conservation of Fish Rules, 1985 and National Fisheries Policy, 1998	These are a set of rules in line with the overall objectives of the Fish Act. Section 5 of the Rules requires that “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”. Section 6 of the Rules states: “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”.	As Feni River, Little Feni River and several canals situated very close to the proposed project site and they are a home of many aquatic species, therefore, the Protection and Conservation of Fish Act, 1950 and Rules, 1985 are both applicable for this Project. Proponent shall ensure that the aquatic species of this area are not adversely affected due to the proposed project.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
National Conservation Strategy, 2016 - 2031	The overarching goal of the project is to foster development in the country through the conservation, development and enhancement of natural resources within the framework of sustainable development, particularly as envisioned under the Sustainable Development Goals (SDG). There are eight (08) core national conservation strategy sectors: 1. Land Resources 2. Water Resources 3. Forest Resources 4. Rural Development 5. Biodiversity 6. Inland Fisheries 7. Coastal and Marine Resources 8. Livestock Resources 9. Energy and Minerals	As the goal of this proposed project is in line with the strategy goal, hence this policy is triggered under this project.
Bangladesh Biodiversity Act, 2017	The Biodiversity Act is made in order to regulate the biodiversity conservation and sustainable use of its resources, biota and the fair and equitable share of the benefits derived from their use of and other matters. Consisting of nine Chapters, the Act deal with the following issues: Biodiversity and related activities undertaken and transfer restrictions, approved and rejected applications; Functions of the National and Technical Committees on Biological Diversity; Biodiversity management teams, associations and subcommittees, etc.; Biota fair share distribution; Biodiversity strategy and action plan, traditional activities causing adverse effects on biodiversity, etc.; Fund, accounting and audit and Annual Report; Crime, investigation, trial and punishment; and Miscellaneous. Significantly, the law bans non-residents and foreign entities from the use of bio-resources and their intellectual property rights over bio-resources in the country, while regulating the limited rights of citizens and communities over bio-resources through various structures from grassroots community to national levels. The law prohibits all actions harming or having adverse impact on the ecological system or endangers ecological community with fine and imprisonment	This act triggered as this project may have the potential of disrupting the biological environment. Therefore, project activities need to be conducted in such a way that doesn't violate any provision of this act.
National Climate Change Strategy and	The Bangladesh Climate Change Strategy Action Plan is presented in two parts. The first part provides background issues based on physical and climatic contexts, core socio-economic realities and policies in the country and the consequent rationale for a strategy is on sustainable	This is triggered as the proposed power plant project is a clean energy project relevant to low emission that is one of the key programs taken up by the government under this strategic action plan.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
Action Plan	development, poverty eradication and increased well-being of all vulnerable groups in society with special emphasis on gender sensitivity. The second part elaborates a set of programs based upon six pillars or broad areas of intervention which have been identified in the first part. It sets out 44 programs to be taken by Bangladesh over the short, medium and long term within six strategic areas – food security, social protection and health; comprehensive disaster management; infrastructure; research and knowledge management; mitigation and low carbon development; and capacity building and institutional strengthening	
Bangladesh Energy Regulatory Commission Act 2003	The Act consists of 14 Chapters divided into 66 sections. This Act provides for the establishment of the Bangladesh Energy Regulatory Commission to encourage private investment in the generation of electricity, and transmission, transportation and marketing of gas resources and petroleum products, etc. (Chapter 2). Chapters 3 and 4 deal with the financial matters of the Commission, and with its functions, powers and proceedings. The Government shall have the power to give policy directives for the development and overall planning in the energy sector (Chapter 5). Licenses shall be issued by the Commission for the following activities: power generation; energy transmission; distribution and marketing of energy; supply of energy; and storage of energy (Chapter 6). Tariffs on power generation and on supply of energy shall be determined by the Commission in consultation with the Government (Chapter 7). The remaining Chapters deal with the following: flow of information; settlements and appeals; offences and penalties; and provisions of miscellaneous nature.	The BERC's decision, and orders related to power sector including generation, transmission and distribution and mandatory to comply by the project entity. So, the act is applicable to the proposed project.
Electricity Act, 2018	The Act has been reinforced to develop, reform, provide better customer service and meet the growing demand for electricity in the power generation, transmission, supply and distribution sectors. It is also stipulated that under this act an independent system operator will be introduced in accordance with the existing laws and regulations for operation of the power sector in a coordinated manner. Furthermore, this act also clearly defines the provision of penalty and punishments for any kind of offence committed in the power generation sector.	This act is triggered as the proposed project will contribute in overall power generation and will abide by all the provisions stipulated under this act.
Electricity Rules, 2020	This rule has been formulated under section 59 of the Electricity Act 2018. It provides clear guidelines on electricity production, transmission and distribution. In addition to this, it also gives clear direction regarding maintenance and change in electricity line, cable etc. In Rule 51(5) and Schedule-2 of the Electricity Rule, 2020 defines the minimum distance to be	This rule is triggered under this project as the rule provides directives regarding permissions and construction and maintenance of power transmission line as well as substations.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
	maintained on either side of the electric wire, which in fact defines the ROW for transmission and distribution lines and associated safety clearance corridors. In addition, this defines safety measures relating to electrical works.	
Renewable Energy Policy, 2008	The main goal of this policy is developing renewable energy sources to meet 5% of total power demand by 2015 and 10% by 2020. Besides, this policy also enables, encourages and facilitates: ▪ Harness the potential of renewable energy resources and dissemination of renewable energy technologies in rural, peri-urban and urban areas ▪ Public and private sector investment in renewable energy projects. ▪ sustainable energy supplies to substitute indigenous non-renewable energy supplies. ▪ Scale up contributions of renewable energy to electricity production. ▪ Scale up contributions of renewable energy both to electricity and to heat energy.	As the goal of this proposed project is in line with the policy goal, hence this policy is triggered under this project.
8 th 5 Year Plan (July 2020-June 2025)	8th Five Year plan (8FYP), a projected course of action for a period of 5 years, represents the first phase of country's Perspective Plan 2041. For power and energy sector, the aim is to move towards the strategy for achieving the least cost energy mix for generation. The 8FYP strategy comprises of following components: 1. Move to an efficient least-cost power production structure; 2. Continue to enhance the generation capacity to match expansion of demand from all segments of the economy, particularly industry and manufacturing, to ensure supply of unhindered quality power from the grid, with 100% population connected to quality electricity supply; 3. While moving to a least-cost power production system, have regular power tariff adjustments to ensure long term sustainability of power generation and moving away from budgetary subsidy that is now prevalent; 4. In order to leverage higher levels of investments, undertake necessary reforms that can create a more conducive and healthier environment for the participation of private sector (IPPs and PPPs), domestic and foreign, in energy sector development under the supervision of effective regulatory authority; 5. Enhance the exploitation of gas, coal, renewable resources, increased energy imports particularly hydropower from the neighboring countries like Bhutan and Nepal in order to optimize the energy mix and reduce the dependence on imported furnace oil and HSD. In this regard hydropower, given its abundance in the neighboring countries and expected cheaper cost of production, will be given prime importance among other renewable resources. 6. Address the	As the proposed project aims to decrease the dependency on non-renewable resources and promote the use renewable resources therefore the Project is aligned with the 8 th 5 Year Plan.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
	identified issues including gas crisis, poor thermal power plant efficiency, and adulteration in furnace oil, fiscal prudence, and sustainability; 7. Improve Energy Efficiency & Conservation through demand side management; 8. Establishment of supply line network for the transportation of petroleum in quick, safe, efficient and environment friendly way all over the country; 9. Establishment of a few energy hubs in the country including Matarbari Ultra Supercritical Coal-fired Power Plant centric energy hub.	
Integrated Energy and Power Master Plan, 2023	Bangladesh is pushing forward its economic growth aggressively under the Vision 2041 aiming to achieve a high-income country status by its 70th anniversary of independence. Furthermore, rising global concerns on climate change, Bangladesh declared at the 2021 COP26 held in Glasgow, U.K. that the country will strive for achieving an up to 40% clean energy use in its power generation mix. Considering these recent movements Bangladesh wanted to review the existing long-term energy plans such as Power System Master Plan 2016 (PSMP2016) / Revisiting Power System Master Plan 2016 (Revisiting PSMP2016), Energy Efficiency and Conservation Master Plan 2016 (EECMP2016), and Gas Sector Master Plan 2017 (GSMP2017), and consolidate them into a comprehensive national plan setting out a tangible and practicable development roadmap. To this end, Bangladesh requested Japan for necessary support in formulation of the Integrated Energy and Power Master Plan (IEPMP) with a view to setting out middle/long term energy policies to establish a low carbon/decarbonized society. This IEPMP has been developed with an aim to establish a clean and efficient energy supply/demand system as the platform for sustainable development of Bangladesh. It also aims to develop a long-term energy plan up to 2050 with a concept of “S plus 3E” representing Safety, Energy Security, Economic Efficiency, and Environment as the central pillars, each element of which denoting the following: 1) Safety: energy must be supplied safely and stably; 2) Energy Security: maximize the use of indigenous energies and prepare energy import infrastructure. 3)Economic Efficiency: provide modern/convenient energies at minimum/affordable cost; 4) Environment: secure sound environmental conditions and lower the GHG emissions to a lowest possible level. In consideration of the current status of the nation and the pathway to its goal, it should be	This master plan will be taken into consideration as the proposed project is aligned with the main goal of this master plan.

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
	noted that particular attention has been given to the following points in implementing this Master Plan: Re-confirm the clean energy target as of 2041. - Reinvent energy efficiency and conservation actions - Maximize the benefits of indigenous conventional and renewable resources - Strengthening the energy organizations including human resources - Prepare market design and policy supports for clean energy development - Ensure safe and reliable nuclear power generation - Adopt novel and innovative energy technologies Formulate a Clean Energy Roadmap to promote the introduction of low-carbon technologies	
Electricity Grid Code, 2023	The Grid Code is a document that governs the boundary between the Licensee and Users and establishes procedures for operations of facilities that will use the Transmission System. The Grid Code specifies criteria, guidelines, basic rules, procedures, responsibilities, standards and obligations for the operation, maintenance and development of the Electricity Transmission System of Bangladesh to ensure a transparent, nondiscriminatory and economic access and use of the Grid, whilst maintaining a safe, reliable and efficient operation of the same to provide a quality and secure electricity supply as reasonably as practicable.	This is triggered as there is a provision of a 230kV transmission line along with the proposed power plant. Hence, this electricity grid code will be taken into consideration during construction and operation of the proposed transmission line.
The Fatal Accidents Act, 1855	This Act ensures that the respective authority with provide compensation to families for loss occasioned by the death of a person caused for wrongful Act.	The proposed project has possibilities of unplanned accidental events during project life cycle; hence this law is applicable, and the proposed intervention needs to follow proper health and safety measures during construction and operational phase. Hence, the Act is triggered.
Bangladesh Labor Law (2006)	Bangladesh's employment law is regulated by the 2006 Labor Act ("Act") and the 2015 Labor Rules ("Rules"). The laws and regulations prescribe working hours, weekly vacations, annual leave, medical leave etc.	It is applicable because it provides health, safety and wellbeing of work force during project life cycle. In addition, it also stipulated that children under 18 years are not allowed to be employed during the project life cycle and therefore this law requires to be complied

Policy/Act/Rules/Regulations	Compliance Requirements	Applicability
National Labor Policy-2012	The constitution has mandated the welfare of the people and established the rights of the labor forces of the country. Signatory countries of the ILO convention adopted the following policies in 1998, and as a signatory, Bangladesh has introduced the policies accordingly. 1. Abolition of Forced Labor Convention; 2. Elimination of discrimination in work. 3. Freedom for Association and Collective bargaining; 4. To stop Child labor effectively; 5. To prevent Children from risky work. Focused areas/ Policy issues: NLP-2012 focuses on the following issues: Dignity of labor, Labor right and development of lifestyle: The government will take the following measures: 1. Assurance of employment and professions; 2. Improving the skill of the employees; 3. Welfare services; 4. Reasonable wages; 5. Sharing labor in productivity and profitability; 6. Employee's welfare; 7. Health services for employees; 8. Social security; etc.	The National Labor policy 2012 triggers the proposed project to ensure the welfare of the employees needed in the project and the child labor will be prevented to comply with the policy
Fire prevention Act, 2003	This Act states to obtain a license from Director General of Fire Services in case of any fire.	The proposed project must need to comply with this act in order ensure fire safety of proposed project and workers.
Standing Orders on Disaster, 2010	The Standing Orders (SoD) on Disaster Management on Bangladesh have been prepared with the objective of making the concerned persons understand their duties and responsibilities regarding disaster management at all levels. All Ministries, Divisions/Departments and Agencies shall prepare their own Action Plans in respect of their responsibilities under the Standing Orders for efficient implementation. According to the SoD, the National Disaster Management Council (NDMC) and Inter-Ministerial Disaster Management Coordination Committee (IMDMCC) will ensure coordination of disaster related activities at the National level. The Disaster Management Bureau will render all assistance to them by facilitating the process.	It is applicable in a way that, as the project area is situated adjacent to the Feni River and Little Feni River, it is susceptible to flooding. In addition to this, in case of any disaster related emergency the proponent could receive assistance from the relevant authority.

2.4 Environmental and social safeguards policy of IsDB

The project is expected to get funding from the Islamic Development Bank (IsDB) and hence the report is prepared focusing on the environmental and social safeguard policy of IsDB. The The Islamic Development (IsDB) seeks to ensure, on the basis of Islamic principles, that the Projects it finances are environmentally and socially sustainable, thereby assisting its Member Countries (MCs) in managing their physical and human resources for the universal common good of all creation.

The IsDB screens and categorize each Project, as early as possible during Project preparation, to determine the nature and level of the environmental and social assessment, information disclosure and stakeholder engagement required of the Client for the Project. In its screening and categorization, the IsDB takes into consideration the type, nature, location, sensitivity and scale of the Project, so that the Client's subsequent assessment is proportional to the Project's potential environmental and social risks and impact

The IsDB bases its categorization of the Project on a combined review of both environmental and social risks and impacts and determines the Project's category on the basis of the Project's component presenting the highest environmental or social risk and potential impacts (including direct, indirect, cumulative and induced impacts, as relevant, in the Project area). It reviews these risks and impacts regardless of the categorization being considered and may adjust the categorization during the life of the Project, if warranted by changes in the environmental and social risks and impacts. The IsDB assigns each proposed Project to one of the following four categories

- ❑ **Category A:** A Project is categorized 'A' if it is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented, and whether temporary or permanent. The IsDB requires the Client to conduct a comprehensive environmental and social impact assessment (ESIA) for each Category 'A' Project, which examines the Project's potential environmental and social impacts, both positive and adverse, compares them with those of feasible alternatives (including the "without Project" situation), and recommends any measures needed to avoid, minimize, mitigate, or compensate for adverse impacts and improve the environmental and social performance of the Project. On the basis of the ESIA, the IsDB requires the Client to prepare and implement appropriate Environmental and Social Documentation.
- ❑ **Category B:** A Project is categorized as 'B' if it has a limited number of potentially adverse environmental and social impacts; the impacts are not unprecedented; few if any of them are irreversible or cumulative; they are limited to the Project area; and can be successfully managed using good practice in an operational setting. The IsDB requires the Client to conduct an initial review of the environmental and social risks and impacts of the Project. On the basis of this review, the IsDB determines the appropriate instrument for the Client to assess these risks and impacts, on a case-by-case basis. This assessment will often be an ESIA that is more narrowly focused than a Category A ESIA. The Client's assessment examines the Project's potentially adverse and positive environmental and social impacts and recommends any measures needed to avoid, minimize, mitigate, or compensate for adverse impacts

and improve the environmental and social performance of the Project. Based on this assessment, the IsDB may require the Client to prepare and implement appropriate Environmental and Social Documentation.

- ❑ **Category C:** A Project is categorized 'C' if it is likely to have minimal or no adverse environmental or social impacts. The IsDB does not require an environmental and social assessment but does require the Client to prepare an analysis of the environmental and social implications of the Project
- ❑ **Category FI:** A Project is categorized 'FI' if the financing structure involves the provision of funds or a line of financing to or through a financial intermediary (FI) for the Project, whereby the IsDB delegates to the FI the decision-making on the use of the IsDB funds, including the selection, appraisal, approval and monitoring of subprojects financed by the IsDB. The IsDB requires the FI Client, through the implementation of appropriate environmental and social policies and procedures, to screen and categorize sub-projects such as Category A, B or C; and to review, conduct due diligence on and monitor the environmental and social risks and impacts associated with these subprojects

According to the project description, the project falls under Category B under the Environmental and social safeguards policy of IsDB, so It requires a narrowly shorted ESIA for project surroundings features.

2.5 Safeguard Policy Statement of Asian Development Bank

ADB's environmental and social safeguards form the cornerstone of its support for inclusive economic growth and environmental sustainability in Asia and the Pacific. In July 2009, ADB's Board of Directors approved the new Safeguard Policy Statement (SPS) governing the environmental and social safeguards of ADB's operations. The key safeguard areas which must be addressed are (i) environmental; (ii) involuntary resettlement; and (iii) indigenous peoples.

The environmental objectives of the SPS are to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process." The objectives also include helping borrowers strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

ADB adopts a set of specific environment and social safeguard requirements that borrowers or clients are required to meet in addressing environmental and social impacts and risks associated with a specific project. ADB's environmental safeguards emphasize development and implementation of a comprehensive EMP. Key elements of EMPs are mitigation measures, monitoring programs, budgets, and institutional arrangements for implementation. In addition, the environmental assessment process emphasizes meaningful consultation, information disclosure, and consideration of alternatives.

ADB will not finance projects that do not comply with its safeguard policy statement, nor will it finance projects that do not comply with the host country's social and environmental laws and regulations. The safeguard policy statement applies to all ADB-financed and/or ADB-

administered sovereign and non-sovereign projects, and their components, regardless of the source of financing.

2.5.1 ADB's Environmental Safeguard Requirements

ADB's Safeguard Policy Statement (2009) defines the requirements to be followed with regards to project screening and classification, information disclosure, consultation and participation, due diligence, monitoring and reporting, local grievance redress mechanisms, and ADB's Accountability Mechanism.

Project screening and classification: ADB's Safeguard Policy Statement (2009) requires screening as early as possible to (i) determine the significance of adverse impacts; and (ii) identify the level of assessment and institutional resources required; and (iii) determine disclosure requirements. A project's category is determined by its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. Each project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts.

Category of the project: Table 2.2 presents ADB's system of Project Categorization. Accordingly, this project has been **Categorized as B** as no significant irreversible, diverse or unprecedented adverse environmental impacts are anticipated. The projected environmental impacts are site-specific and mostly will occur during the construction phase. They can be readily mitigated through the implementation of an Environmental Management Plan following national requirements and good international industry practice.

Information disclosure: ADB's Safeguard Policy Statement (2009) requires information about environmental safeguard issues to be made available in a timely manner, in an accessible place, and in a form and language(s) understandable to affected people and other stakeholders, including the general public, so they can provide meaningful inputs into project design and implementation.

Consultation and participation: ADB's Safeguard Policy Statement (2009) requires communities, groups, or people affected by proposed projects, and civil society to be engaged by EGCB through information disclosure, consultation, and informed participation in a manner commensurate with the risks to and impacts on affected communities. The consultation process and its results are to be documented and reflected in the ESIA report.

Monitoring and reporting: ADB's Safeguard Policy Statement (2009) requires that EGCB comply with national laws and regulations and implements the EMP as provided in the legal agreements, submitting periodic environment monitoring reports to ADB on their implementation performance.

Local grievance redress mechanisms and ADB's Accountability Mechanism: ADB's Safeguard Policy Statement (2009) requires that EGCB set up and maintain a GRM to receive and facilitate resolution of affected peoples' concerns and grievances about their environmental performance at project level.

Table 2-2: ADB's Environmental Safeguards Categorization and Requirements

Category	Definition	Assessment Requirement
A	Likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented, and may affect an area larger than the sites or facilities subject to physical works.	Environmental Impact Assessment (EIA)
B	Likely to have adverse environmental impacts that are less adverse than those of Category A. Impacts are site-specific, few if any of them irreversible, and in most cases mitigation measures can be designed more readily than Category A.	Initial Environmental Examination (IEE)
C	Likely to have minimal or no adverse environmental impacts.	No environmental assessment is required but the environmental implications of the project will be reviewed.
FI	Project involves investment of ADB funds to or through a Financial Intermediary (FI).	FIs will be required to establish an Environmental and Social Management System (ESMS) commensurate with the nature and risks of the FI's likely future portfolio to be maintained as part of the FI's overall management system.

2.6 JICA Guidelines for Environmental and Social Considerations (January 2022)

It is a comprehensive guideline for environmental and social assessments where the procedure, requirements and principles of environmental and social considerations have been clearly stated and detailed out. The main objectives of this JICA Guidelines are to encourage project proponents to have appropriate environmental and social considerations, as well as to ensure JICA's proper implementation of support for and review of environmental and social considerations. While project proponents bear the ultimate responsibility for the environmental and social considerations of projects, JICA supports and reviews appropriate environmental and social considerations undertaken by the project proponents. This is to avoid or to minimize impacts on the environment and local communities caused by development projects, and to prevent the occurrence of unacceptable adverse impacts. This guideline is based on eight (08) basic principles JICA recognizes are particularly important:

1. A wide range of impacts must be addressed
2. Environmental and social considerations must be implemented from an early stage until the monitoring stage.
3. JICA reviews the environmental and social considerations in accordance with the mitigation hierarchy.
4. JICA is responsible for accountability when implementing cooperation projects

5. JICA requests stakeholders for their participation
6. JICA discloses information
7. JICA enhances its organizational capacity.
8. JICA considers promptness

In this guideline as part of the environmental and social consideration procedure JICA classifies development projects in four (04) categories based on the extent of environmental and social impacts, taking into account the project's characteristics, scale, site condition, etc. which are very similar to the ADB's Environmental Safeguards Categorization and Requirements. According to this categorization the proposed project falls under "**B Category**".

2.7 Environmental, Health, and Safety Guidelines of the World Bank (WB)

The general guidelines of IFC contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors. It sets out guidelines on Environmental, Occupational Health and Safety, Community Health and Safety and Construction and Decommissioning aspects like environmental parameters (ambient air quality, water and wastewater quality, noise level, waste management), hazard and accident prevention, occupational and community health and safety (during commissioning and decommissioning works) etc.

To make the project environmentally and socially sustainable, these guidelines can be followed since they provide clear guidance on how to tackle the environmental and social impacts that may be raised from this proposed project.

2.8 Environmental and Social Framework (ESF) of World Bank

The World Bank Environmental and Social Framework sets out the World Bank's commitment to sustainable development, through a set of Environmental and Social Standards that are designed with the aim of sustainable development ensuring environmental and social protection. For this project almost all the environmental and social standards are applicable except ESS-9, which deals with Financial Intermediaries. The relevant standards for this project are:

- **ESS1- Assessment and Management of Environmental and Social Risks and Impacts:** This standard describes guidelines on managing and monitoring environmental and social risks and impacts associated with each stage of the project in order to achieve environmental and social outcomes consistent with the Environmental and Social Standards (ESSs).
- **ESS2- Labor and Working Conditions:** This standard recognizes that development project that are established and operated for the benefit of economy and urbanization often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services and the environment at the

local, regional, and global levels. This ESS sets out the requirements to address resource efficiency and pollution prevention and management throughout the project life-cycle.

- **ESS3- Resource Efficiency and Pollution Prevention and Management:** This standard recognizes that development projects that are established and operated for the benefit of economic and urbanization, often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services and the environment at the local, regional, and global levels. This ESS sets out the requirements to address resource efficiency and pollution prevention and management throughout the project life cycle.
- **ESS4- Community Health and Safety:** This standard addresses the health, safety, and security risks and impacts on project-affected communities and the corresponding responsibility to avoid or minimize such risks and impacts, with particular attention to people who, because of their circumstances, may be vulnerable.
- **ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement:** these standard states that involuntary resettlement should be avoided. Where involuntary resettlement is unavoidable, it will be minimized and appropriate measures to mitigate adverse impacts on displaced persons (and on host communities receiving displaced persons) will be carefully planned and implemented.
- **ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources:** It recognizes that protecting and conserving biodiversity and sustainably managing natural resources are fundamental to sustainable development and it recognizes the importance of maintaining core ecological functions of habitats, including forests, and the biodiversity they support. ESS6 also addresses sustainable management of primary production and harvesting of living natural resources and recognizes the need to consider the livelihood of project-affected parties, including Indigenous Peoples, who's access to, or use of, biodiversity or living natural resources may be affected by a project.
- **ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities:** It ensures that the development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource- based livelihoods of Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities. This standard is also meant to avoid adverse impacts of projects on Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities, or when avoidance is not possible, to minimize, mitigate and/or compensate for such impacts
- **ESS8: Cultural Heritage:** It recognizes that cultural heritage provides continuity in tangible and intangible forms between the past, present and future. ESS8 sets out measures designed to protect cultural heritage throughout the project life cycle.

- **ESS10: Stakeholder Engagement and Information Disclosure:** This standard recognizes the importance of open and transparent engagement amongst the stakeholders of the proposed project as an essential element of good international practice. Effective stakeholder engagement can improve the environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation. As these aspects will also come under this proposed project, the proponent needs to address and consider these issues to comply with these standards

The ESF framework of WB Guidelines are applicable in the implementation and operation stages of the proposed project because this framework supports green, resilient and inclusive development by strengthening protections for people and the environment and making important advances in areas such as labor, inclusion and non-discrimination, gender, climate change, biodiversity, community health and safety, and stakeholder engagement ensuring sustainable development.

2.9 IFC HES Guidelines

The International Finance Corporation (IFC) developed its Sustainability Framework in 2006 and further revised in 2012 which articulates its strategic commitment to sustainable development. The IFC's Environmental and Social Performance Standards, part of the overall Sustainability Framework, have been adopted by many as an international benchmark for identifying and managing environmental and social risks within the private sector. However, to access funds under this institution for this project, the IFC safeguard policies shall be followed.

In addition, IFC guidelines are also applicable where GoB does not have appropriate guidelines. Present study will follow all available standards from Bangladesh (including ECR, 2023, ECA, 1995 and Noise Pollution Control Rules, 2006) and IFC guidelines (IFC Health and safety general guidelines, 2008) as applicable. However, critical habitat assessment of any endangered species under WB-ESS6 and IFC-PS-6 is not included within the present project study contract.

2.10 Equator Principle 4

Large infrastructure and industrial Projects can have adverse impacts on people and on the environment. The Equator Principles (EPs) serve as a common baseline and risk management framework for financial institutions to identify, assess and manage environmental and social risks when financing Projects. The Equator Principles (EP) are a set of voluntary guidelines adopted by financial institutions to ensure that large scale development or construction projects appropriately consider the associated potential impacts on the natural environment and the affected communities. There are ten (10) statement of principles that ensures that the Projects are socially responsible and reflects sound environmental management practices.

- **Principle 1 - Review and Categorization:** When a Project seeks financing, the Equator Principle Financial Institution (EPFI) categorizes it according to the

potential environmental and social risks and impacts. This categorization follows the International Finance Corporation's (IFC) guidelines. The EPFI's due diligence process is then aligned with the project's nature, scale, stage, and risk level.

The proponent EGCB, operates at both the Corporate (Head) and Project Level. To build their capacity, the ESIA recommended specific positions and disciplines in the existing organizational structure. Additionally, the Environmental Consultant categorized the Project according to the ECR, 2023.

- **Principle 2- Environmental and Social Assessment:** For Category A and B Projects, the EPFI requires the Client to conduct an Assessment to address environmental and social risks to the EPFI's satisfaction. This Assessment should propose measures to minimize, mitigate, and offset adverse impacts, and must be accurate and objective. For Category A and appropriate Category B Projects, the Assessment includes an ESIA and may require specialized studies or human rights due diligence for high-risk cases. Other projects may require limited assessments or focused environmental or social assessments (e.g. audit) or straightforward application of environmental siting, pollution standards, design criteria, or construction standards.

The proponent EGCB operates at both the Corporate (Head) and Project Level to manage adverse impacts during the pre-construction, construction, and operation stages. Moreover, an environmental consultant was also hired by the proponent to identify environmental and social impacts and recommend mitigation measures.

- **Principle 3: Applicable Environmental and Social Standards:** The Assessment process must first ensure compliance with relevant host country laws, regulations, and permits concerning environmental and social issues. EPFIs operate in diverse markets, some with robust and others with evolving governance systems. For Projects in Non-Designated Countries, the Assessment must evaluate compliance with the IFC Performance Standards and the World Bank Group EHS Guidelines. For Projects in Designated Countries, it must ensure compliance with host country laws and standards related to environmental and social assessments, management systems, stakeholder engagement, and grievance mechanisms. Host country laws meet the requirements of environmental and/or social assessments (Principle 2), management systems and plans (Principle 4), Stakeholder Engagement (Principle 5) and, grievance mechanisms (Principle 6). The EPFI will ensure the Project's compliance with these standards or justify any deviations, and may apply additional requirements at their discretion.
- **Principle 4- Environmental and Social Management System and Equator Principles Action Plan:** For all Category A and Category B Projects, the EPFI will require the Client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client 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 Client and the EPFI will agree an Equator Principles Action Plan (AP). The Equator Principles 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 B Projects, the EPFI requires the Client to ensure effective Stakeholder Engagement with Affected Communities and relevant stakeholders in a structured, culturally appropriate manner. Projects with significant adverse impacts must conduct an Informed Consultation and Participation process, tailored to the project's risks, stage, and the needs of vulnerable groups. This process should be free from manipulation and coercion. Assessment Documentation must be accessible to stakeholders in the local language and culturally appropriate manner, with early and ongoing disclosure before construction begins.
- Projects affecting indigenous peoples require their Free, Prior and Informed Consent (FPIC) and must comply with relevant national and international laws. The Client must establish a grievance mechanism as part of the ESMS, scaled to the project's risks, to resolve concerns transparently and accessibly. This mechanism should not impede access to judicial or administrative remedies and must be communicated to Affected Communities during Stakeholder Engagement.
- **Principle 7: Independent Review:** For all Category A and, where appropriate, Category B Projects, an Independent Environmental and Social Consultant will conduct an Independent Review of the Assessment Documentation, including ESMPs, the ESMS, and Stakeholder Engagement process documentation. This review assists the EPFI's due diligence and assesses compliance with the Equator Principles. The consultant will also propose or advise on a suitable Equator Principles Action Plan (AP) to ensure compliance or indicate if compliance is not possible.
- For Project-Related Corporate Loans with high-risk impacts, such as those affecting indigenous peoples, critical habitats, significant cultural heritage, or involving large-scale resettlement, an Independent Review is mandatory. For other Category A and appropriate Category B Project-Related Corporate Loans, the EPFI will decide whether an Independent Review is needed or if an internal review is sufficient, considering due diligence by other financial institutions or agencies if relevant.
- **Principle 8: Covenants:** A key strength of the Equator Principles is the incorporation of covenants linked to compliance. For all Projects, the Client must covenant in the financing documentation to comply with all relevant host country environmental and social laws, regulations, and permits. For Category A and B Projects, the Client must also:
 - i. Comply with the ESMPs and Equator Principles Action Plan (AP) during construction and operation.
 - ii. Provide periodic reports, at least annually, prepared by in-house staff or third-party experts, documenting compliance with the ESMPs and Equator Principles AP and relevant local, state, and host country laws

- iii. Decommission facilities as per an agreed decommissioning plan when applicable.
 - iv. If a client is non-compliant with its environmental and social covenants, the EPFI will work with the Client on remedial actions. If compliance is not re-established within an agreed grace period, the EPFI may exercise appropriate remedies.
- **Principle 9: Independent Monitoring and Reporting:** It outlines requirements for projects and project-related corporate loans to comply with the Equator Principles, which are standards for environmental and social risk management in project finance. For Category A and, when necessary, Category B projects, an Independent Environmental and Social Consultant must be appointed to assess compliance and monitoring and reporting. Similarly, for projects requiring an independent review, an Environmental and Social Consultant must be appointed after financial close or external experts must verify monitoring information, which is then shared with the Equator Principles Financial Institution (EPFI). These measures aim to ensure projects adhere to environmental and social standards.
 - **Principle 10: Reporting and Transparency:** The following client reporting requirements are in addition to the disclosure requirements in Principle 5. For all Category A and, as appropriate, Category B Projects:

The client will ensure that, at a minimum, a summary of the ESIA is accessible and available online.

2.11 NEXI Guidelines

These guidelines outline the Environmental Policy and procedures employed by Nippon Export and Investment Insurance (NEXI) to confirm environmental and social considerations in trade insurance. NEXI verifies whether project sponsors implement appropriate environmental and social considerations to prevent or mitigate potential negative impacts on the environment (including both the natural and social environment, hereinafter referred to as the "environment") that may be caused by projects related to insurance services lasting two years or more. This confirmation of environmental and social considerations is one of the most important components of risk assessment. The Guidelines on Environmental and Social Considerations in Trade Insurance by NEXI outlines:

- (1) **Screening:** NEXI confirms environmental and social considerations in the projects to be applied by its insurance service, in principle, at the stage of risk assessment. The Applicants should submit a copy of the Screening Form to NEXI head office at the stage of application for commitment of NEXI's trade insurance for projects. NEXI may request the Applicants to submit additional information when necessary.
- (2) **Categorization:** The Screening Form filled and submitted by the applicant is used to categorize the project either as A, B or C, based on its impact on the environment. The Category A and B projects are subject to environmental review. Under this consideration the proposed 220 MW ac Grid Tied Solar Power Plant falls under "Category-B" project.

- (3) Environmental Review: NEXI reviews the ESIA report in accordance with the Environmental Checklist made for the project sector. It also determines whether a project complies with environmental laws and standards of the host national and local governments concerned. Furthermore, it also ensures if World Bank's Environmental and Social Standards as well as IFC's Performance Standards are followed. In addition, if there is a relevant section of the Environmental, Health, and Safety Guidelines

(EHS Guidelines) of the World Bank Group, NEXI will confirm whether the projects meet that section. However, referring to these standards as benchmarks is to be conducted based on the Common Approaches. It is to be mentioned here that, If NEXI believes environmental and social considerations of the project substantially deviate from these standards and good practices, it confirms the background and rationale for this, and when necessary, countermeasures against such deviation.

- (4) Incorporating Environmental Reviews into Decision-making: The outcome of screening and environmental review is taken into account in NEXI's decisions on issuance of commitment. In cases where a certain project might have any significant adverse environmental impact on the host country by lack of appropriate environmental and social considerations, NEXI will encourage the project sponsors, via the Applicants, to give such appropriate considerations. Under certain circumstances, where the project is not recognized to be contributive to sound development of Japan's external transactions or economic or social development of the host country, there may be cases where a commitment letter is not issued. If NEXI is unable to confirm the appropriate environmental and social considerations at the environmental review after the commitment decision, NEXI may cancel the commitment based on the Environmental Special Clauses, etc. or may terminate the insurance contract if the insurance contract has been signed already.
- (5) Ensuring the Environmental and Social Considerations: If the results of the environmental review show that the project might have a significant adverse impact on the environment, NEXI will encourage the project sponsor (indirectly through the insurance applicant or exporter) to take into account the environmental and social considerations. If the considerations are insufficient, NEXI may refuse to conclude the insurance contract. Even after concluding the contract, the insured (or exporter) is required to inform NEXI about the results of monitoring for a certain period of time.
- (6) Disclosure of Information Regarding Confirmation of Environmental and Social Considerations: Within the limits of commercial confidentiality, NEXI will disclose the following information in Japanese and English on NEXI's website.
 - a. Upon completion of the screening of a project, NEXI discloses, as soon as possible, the project, name, country, and location, an outline of the project and sector of the project, and its category, classification, as well as the reasons for the classification.
 - b. For Category A and Category B projects, NEXI publishes on its website the status of acquirement of the ESIA reports, etc. obtained from the Applicants for confirming environmental and social considerations and promptly makes

the ESIA reports, etc. available on its website. Of the documents other than the ESIA reports, etc. obtained by NEXI from the Applicants for confirming the environmental and social considerations, NEXI publishes the status of obtaining those that are being disclosed to the public in the project country and make them available on the NEXI website promptly.

- c. After the conclusion of an insurance contract, NEXI provides on its website the results of its environmental reviews of the projects in Categories A and B for public perusal.

(7) Ensuring Compliance with the Guidelines: To ensure NEXI's compliance with the Guidelines, NEXI accepts objections regarding its non-compliance and takes the necessary actions.

3 PROJECT DESCRIPTION

3.1 Project Proponent

The project will be developed by the Electricity Generation Company of Bangladesh (EGCB) Limited with fundings from the Government of Bangladesh (GoB) & Islamic Development Bank (IsDB).

3.2 Project Concept

The major components of the project include a solar power plant with a capacity of 220 MWac. The designed electrical infrastructure of the PV plant consists of central inverters/string inverters, three-winding 0.8/33 kV step-up transformers, MV switchgear, and 33/230 kV step-up transformers. The generated power would be evacuated to a newly constructed substation adjacent to the proposed Project. (Source: Feasibility Study and EGCB)

3.3 Project Location and Access Way

3.3.1 Project Location

The proposed Power Plant site is situated on the left bank of the Feni River and North side of the Shabazpur Channel, located at Sonagazi, Feni. The proponent would take 700 acres of land through land acquisitions by EGCB. The proposed Project will be constructed geographically at the Latitude 22.79°N; Longitude: 91.39°E; and administratively, it is in Purba Baradhali Mouza under Char Chandia Union of Sonagazi Upazila under Feni District. A location map of the Project Site is shown in **Figure 3.1**.

The BSMSN Economic Zone, Sonagazi National Forest, Rice Research Institute, Sonagazi Upazila Headquarter etc. are some important landmarks from the project site. **Table 3.1** show the tentative distances of the important landmarks from the Project site.

Table 3-1: Distances of the Important Landmarks from the Power Plant Site

Sl. No.	Landmarks	Distance
1.	National Special Economic Zone (Formerly BSMSN Economic Zone)	9.6 km
2.	Sonagazi Upazila HQ	6.4 km
3.	Companiganj Upzila HQ	14 km
4.	Sonagazi Municipality	6.6 km
5.	6 no. Char Chandia Union Parishad	5.9 km
6.	Sonagazi Union Parishad	6.9 km
7.	Shahbazpur Channel	3 km
8.	Muhuri Dam (KBA area)	7.3 km
9.	Little Feni River	2.5 km
10.	Feni River	4.4 km
11.	Musapur Union Parishad	8.04 km

Sl. No.	Landmarks	Distance
12.	Ganges-Brahmaputra-Meghna Delta (KBA area ²)	5.81 km
13.	Sonagazi National Forest	4.9 km
14.	Musapur National Forest	3.8 km
15.	Musapur Closure	2.9 km
16.	Musapur Regulator	4 km
17.	Rice Research Institute, Sonagazi	1.8 km
18.	East Boro Dhola Primary School	1.9 km
19.	Olema Bazar	5.6 km
20.	Akata Bazar	7.01 km
21.	Bangla Bazar	7.9 km
22.	Bhuiyan Bazar	4.10 km
23.	Fire Service Station, Sonagazi	7.5 km
24.	Upazilla Health Complex, Sonagazi	6.57 km

Source: IIFC ESIA Study, 2024

3.3.2 Study Area

Assessing the baseline condition and identifying the potential impacts, a 5 km radial area centering the 33/230 kV substation (considering it the most sensitive among the solar power plant elements) inside the power plant area has been considered as per the indication of ECR, 2023. A detailed location map indicating the project area and the study area is shown in the following **Figure 3.1**.

² KBA- Key Biodiversity Area

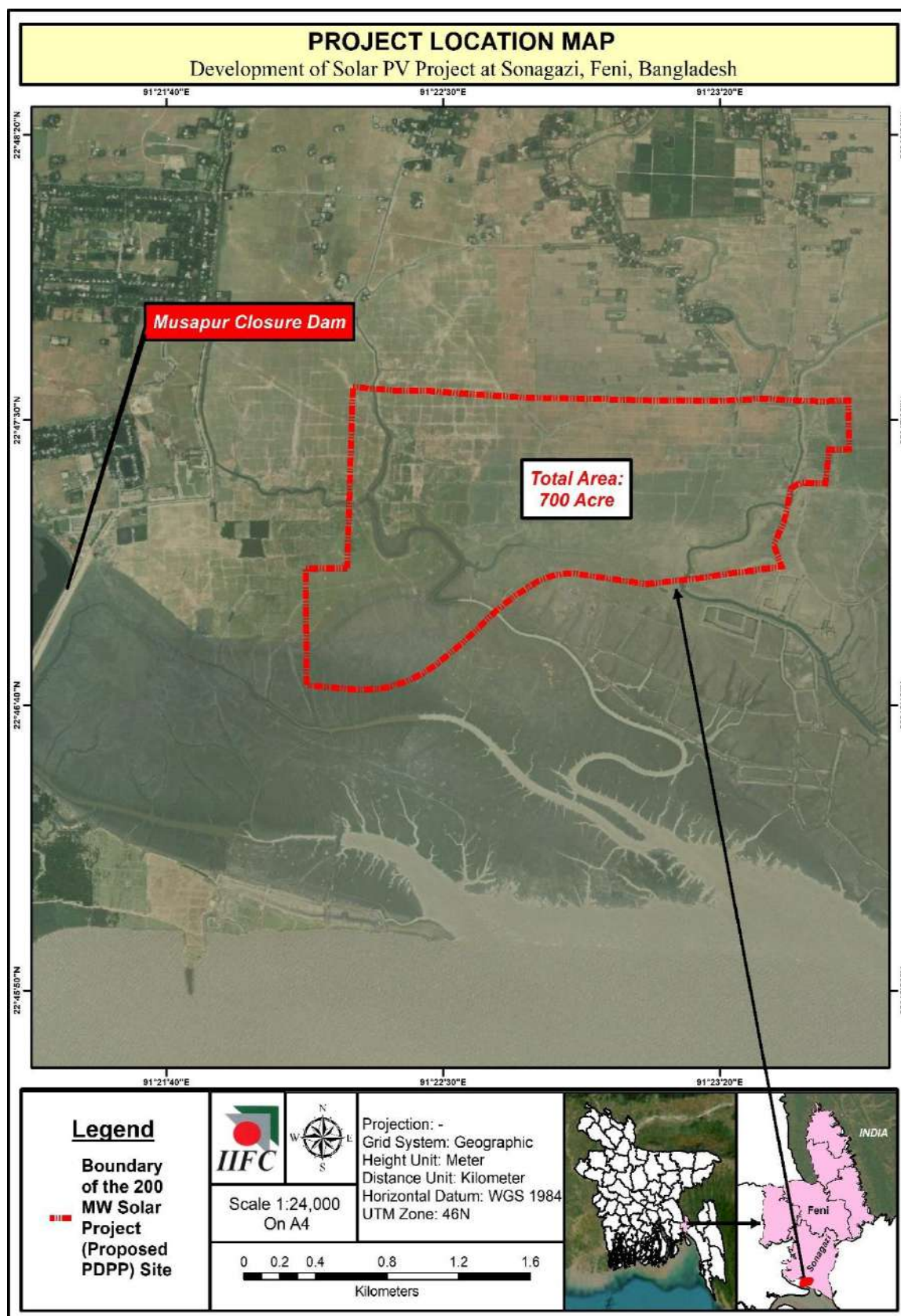


Figure 3.1: Base Map of the Study Area

3.3.3 Accessibility

The site is accessible from Dhaka/Chattogram through roadway. The existing roads are as follows:

- By road from Dhaka: Distance from Dhaka to Sonagazi is 182 km and Sonagazi to Project site is another 9 km.
- By road from Chattogram: Distance from Chattogram to Sonagazi 108 km and Sonagazi to Project site is another 9 km.

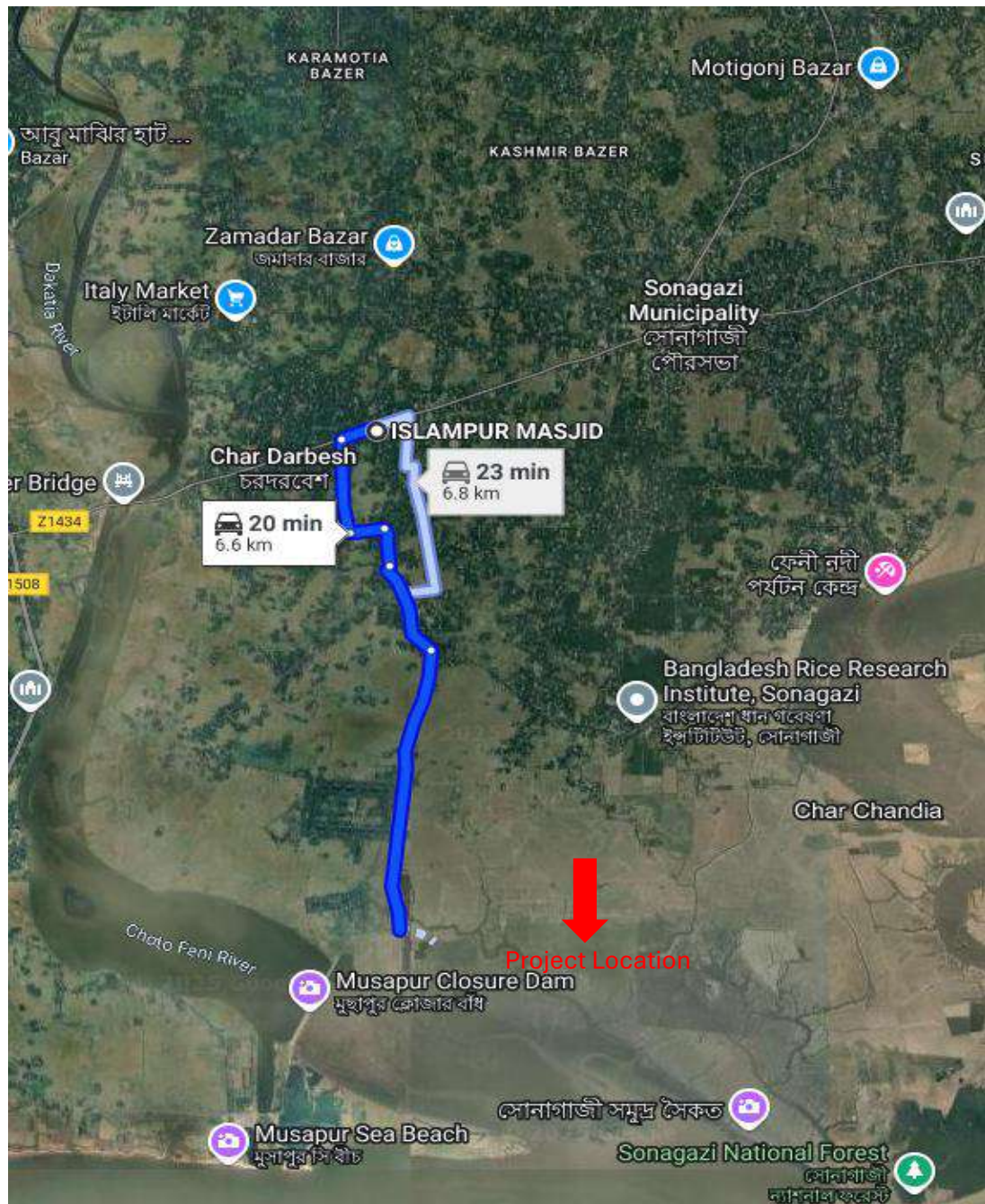


Figure 3.2: Access Road to Project Location

Figure 3.2 shows the location of the study area including the road communication from Sonagazi Pourashava

3.4 Power Plant Site Development

According to the Feasibility Study, the proposed site has generally even terrain with an average slope of 2%. No physical obstacles were identified on the ground surface during the topographical assessment. The terrain is considered suitable for ground-mounted PV, limited civil work will be required. Required soil for land development may be collected from the nearby available sources. The highest Flood Level (HFL) for 25-year return period becomes 6.94 mPWD and for 100-year return period it becomes 7.60 mPWD, with a tidal range of 6.27 m and 6.7 m respectively. The control room elevation level will be around 9.5 m PWD, which is same elevation as per dyke height at northern site boundary assuming the worst-case scenario. However, this will be finalized by EPC contractor at the detailed design stage.

3.5 Associated Facilities

The power generated would be evacuated through a nearby 33/230 kV EGCB substation. The substation will be a part of the proposed 220 MW Solar Power Plant. However, There could be Two substations with each having capacity of 110 Mw or one with the 220MW capacity which will be decided after feasibility study.

3.5.1 Internal Service roads / drainage system and power cables and evacuation lines

The provision for a ring road around the solar PV power plant has been considered. The ring roads can be used as service road and to keep clearance for avoiding shadow on installed solar PV panels from the neighboring areas or settlements or any plantation. Internal main service roads are 10meters and 5 meters wide. A drainage system will be constructed along the service roads for the project area and there will also be a 10m wide Bituminous Road along the northern part of the allocated area. There are three types of substations, the 0.63/33 kV substations are in the field and next to the inverters, these substations step up the generated electrical PV power from inverters to 33 kV and the power at 33 kV level are drawn to the 33/230kV station substation. The electrical power from solar power plant is then taken to the 33/230 kV solar Hub substation, from there the collected electrical power will be evacuated to the national grid at Mirershorai from the power hub of EGCB at Sonagazi.

3.6 Technology Selection and Process Description

Solar energy collected by photovoltaic solar panels and delivered to a power grid is called grid connected photovoltaic (PV) system. Generally, this system requires a large land area for each MW of power. With the improvement of technology, the present bi-facial solar panel requires about 2 acres of land for 1 MW of solar power as against earlier 3.5 acres of land for 1 MW of solar power using mono-facial solar panel. Power produced from solar panel is in DC form and that needs be converted to AC form by a grid-connected inverter. The output of the inverter is stepped up to grid voltage level by a step-up transformer of properly rated capacity. This inverter installs between the solar array and the grid and may be a large unit or may be a collection of small inverters, each physically attached to individual solar panels.

The inverter must monitor grid voltage, waveform, and frequency. The Inverter output voltage must be slightly higher than the grid itself, in order to flow the energy smoothly from the Inverter to the Grid.

3.7 Plant Component and Units

The major components of the Project include Solar panels, String inverters, step up transformers or Smart Transformer Station, lightning arrester, other electrical safety, protection and monitoring equipment, control room building, switch yard, transmission infrastructure, substation, civil structures for installation of PV panels while other components include roads, security post, fire station, laboratory, workshops, security office, admin building, canteen, boundary fencing, townships, Mosque etc. List of Major Component/Equipment and Quantity is provided below:

Table 3-2: List of Major Components

SN.	Component / Equipment	Specification	Part 01 (Block B)	Part 02 (Block C)
1	Solar PV Module	640 Wp	234,780 Nos (150.26 MWp)	234,780 Nos (150.26 MWp)
2	Inverter	8.8 MW @45°C	13 (each inverter have two blocks of inverters of 4.4 MVA)	13 (each inverter have two blocks of inverters of 4.4 MVA)
3	Inverter Block Transformer (0.63/33kV)	8.8 MVA @45°C	13	13
4	Power Transformer (33/230V)	60/80 MVA	2	2
5	Meteo station		1	1

3.7.1 Photovoltaic cell or solar cell

There are several types of solar cells which are presently being used and are available in the present market for power generation from solar radiation. The common technologies are given below:

- Crystalline families: Single or Mono Crystal, Multi Crystalline.
- Thin Film
- Among the crystalline families the cell materials can be different, like Si or GaAs etc.
- Among the thin film families, Amorphous Si, CdTe, CIGS are commonly used.

More than 80% of the present solar market is occupied by crystalline Si. Among the crystalline family Poly Si cells are widely used but the mono Si cells have higher efficiency. For this project highly efficient mono Si solar PV panels are proposed.

PV cell or solar cell is an electrical device that converts the energy of Sun light directly into DC electricity.

For this power plant the latest model of highly efficient bifacial solar PV panel has been considered. There are different sizes of solar PV panel for large scale ground mounted project. Considering the geographical location of the proposed plant which is close to the Bay of Bengal and prone to cyclonic surge and heavy wind moderate sizes of PV panel have been considered. There are some reputed tier one manufacturer of the world that produces solar PV panel of similar properties. Some names of the manufacturers are as follows: Trina Solar, JA Solar, Jinko Solar, Canadian Solar, Longi Solar and Risen Solar etc.

The Project is intended to use 640 Wp Solar PV module having aggregated total number of solar modules is 469,560 Nos which will form a total of 300.5 MWp Power Plant (for each part 234,780 number of solar PV panels having capacity of 150.25 MWp. Basic specification of solar PV module is given in the following table.

Table 3-3: Reference Specification of Solar PV Module from 3 different manufacturer

SL No.	Parameter	Acronym	Value			Unit
			Trina	Canadian Solar	JA	
1.	Dimensions (L / W / H)		2172 mm x 1303 mm	2384 mm x 1303 mm	2392m m x 1134m m	
2.	Power output Pmax	Pmax	640	640	640	Wp
3.	Power output tolerances	Pmax	0 to +5 Wp	0 to +10 Wp	+3%	%
4.	Open Circuit Voltage	Voc	44.5	44.6	49.39	V
5.	Short Circuit Current	Isc	18.3	18.31	16.24	A
6.	Maximum Power Voltage	Vmpp	37	37.5	41.20	V
7.	Maximum Power Current	Imp	17.3	17.07	15.54	A
8.	Module efficiency η_m %	m	22.6	20.6	23.71	%
9.	Maximum system voltage		1500	1500	1500	V (DC)
10.	Weight		34.9	37.9	33.70	kg
11.	Temperature Coefficient of Isc		+0.04 %	0.05%	+0.045%	/ °C
12.	Temperature Coefficient of Voc		- 0.24%	-0.26%	-0.24%	/ °C
13.	Temperature coefficients of Pmax		- 0.29%	-0.34%	-0.29%	/ °C
14.	Workmanship Warranty		12	12	12	Year
15.	Power Warranty		30	30	30	Year
16.	First Year Degradation		1%	2%	1%	
17.	Power attenuation per year (30 years)		0.4%	0.45%	<0.4%	%

Source: Feasibility Study and <https://static.longi.com/>

3.7.2 Central Inverter

Central inverter is an electronic device that changes Direct Current (DC) to Alternating Current (AC). The Project will be Ground mounted PV Power Plant with Central Solution. There are two types of inverters, namely Central and String inverter. Central inverters are larger in size and capacity and String inverters are smaller in size. The price of String Inverters are much higher than the price of Central inverters. Usually Central inverters are used for

large scale ground mounted solar PV projects. Whereas, String inverters are used in smaller sized ground mounted projects or in rooftop solar PV systems. Considering the geographical position of the proposed project the inverter platform needs to be raised higher from the ground. Therefore, Grid tied Central Inverters are to be used in this Project. There are tow worldwide reputed company who produces central inverters. Their comparative specifications is given below:

Table 3.4 summarizes the relevant technical parameters for the chosen inverters.

Table 3-4: Inverter Parameters

Technical Specifications	Sungrow	SMA
Inverter Type	Central	Central
Model	SG8800UD-MV	MVPS6000
Dimension (WxHxD)	12.192 m x 2.896 mx 2.438 m	12.192 m x 2.896 mx 2.438 m
Weight	31.5 ton	26 ton
Max. Efficiency	>99.0%	98.8%
European Efficiency	>98.8%	98.6%
Input		
Max. Input Voltage	1,500 V	1500 V
Max. Current per MPPT	8*1435 A	2*3200 A
Max Short Circuit Current Per MPPT	8*3528 A	
MPPT Operating Voltage Range	895 V ~ 1,500 V	
Number of independent MPP Inputs	8	2
Output		
Rated AC Active Power	9064kW @40°C, 8800kW @45°C,	5400 kW@45°C
Rated Output Voltage	630 V, 3W+PE	11 to 35 KV (built in stepup transformer)
Rated AC Grid Frequency	50 Hz / 60 Hz	50 Hz / 60 Hz
Max. AC Output Current	8*1160 A	105 A@33KV
Adjustable Power Factor Range	0.8 LG 0.8 LD	0 up to 60% of AC power
Max. Total Harmonic Distortion	<1.5%	< 3%
Protection		
DC Input protection	DC load switch + fuse	DC load switch + fuse
Inverter Output protection	AC circuit breaker	AC circuit breaker
Surge Protetion	DC Type II / AC Type II	DC Type I
Insulation monitoring	Yes	Yes
Ground fault monitoring	Yes	Yes
Overheat protection	Yes	Yes
Communication		
RS485	Yes	Yes
Ethernet	Yes	Yes
General		
Cooling Method	Temperature controlled forced air cooling	Optic Cooling
Max. Operating Altitude without Derating	1000m	

Self-Consumption (Stand by)		<740 w
Protection Degree	IP65	IP65

Source: Feasibility Study

Considering the efficiency and capacity of the inverters for this project Sungrow central inverter of 8800 kW has been chosen for simulation of this project.

26 nos. of 8800 kW Central inverter (each central inverter consists of 2 blocks of inverters. Each block consists of 4 numbers of 1.1 MW single inverter) will be required for inverting the DC power to AC (each section).

3.7.3 Mounting Structure

A gap of 2.2 meters between the adjacent PV panels array has been considered. The gap is sufficient to avoid any shading of PV panels' structures to the next one.

It is mentionable that during winter the panel array will create longer shading (the projection of shading in the north direction). From the orthographic projection of sun path, it is seen that during winter the panel array will create longer shading (the projection of shading in the north direction). From the orthographic projection of sun path, it is observed that if the gaps between the panel arrays is double the height difference of the panels lower side and upper side then no shading will be observed between 9:00 am in the morning to 4:00 pm in the afternoon during winter seasons. During summer, shading of one array to another cannot will not occur as the sun path during summer follows the zenith (thus the projection of shading in north direction is minimum).

3.7.4 Project Layout Plan and Single Line Diagram

For this project, all strings of the solar array will consist of 28 PV modules. Photovoltaic strings will be connected in parallel to the PV inverter (string inverter) and each inverter collects 20 strings. The PV system consists of 20 Power Plant Blocks each having 5 MWac of power. Each of the blocks consists of 20 string inverters, each collecting the power from 20 strings. Thus, each block comprises 400 strings. The PV inverter converts the DC into AC at a voltage level 0.8 kV. Each inverter is connected to the LV/MV transformer to step up the output voltage (0.8 kV) from the inverter to the medium voltage (33 kV) forming the transformer stations. The transformer stations will be interconnected through the MV system to the PV power plants substation. The solar power plant substation will be equipped with six 230/33 kV transformers, each with a rated power of 65 MVA. The design and rating of the equipment in addition to the SLD are indicative and shall be further analyzed and finalized by EPC Contractor.

The proposed Project will be designed with specifications as per the international standard of DIN, IEC, BS etc. suitable for the proposed 220 MWac Solar Power Plant. The detailed layout plan showing all structures and required facilities shall be developed by the EPC contractor before construction. The indicative layout plan of the proposed project prepared by the proponent is presented in **Figure 3.3**.

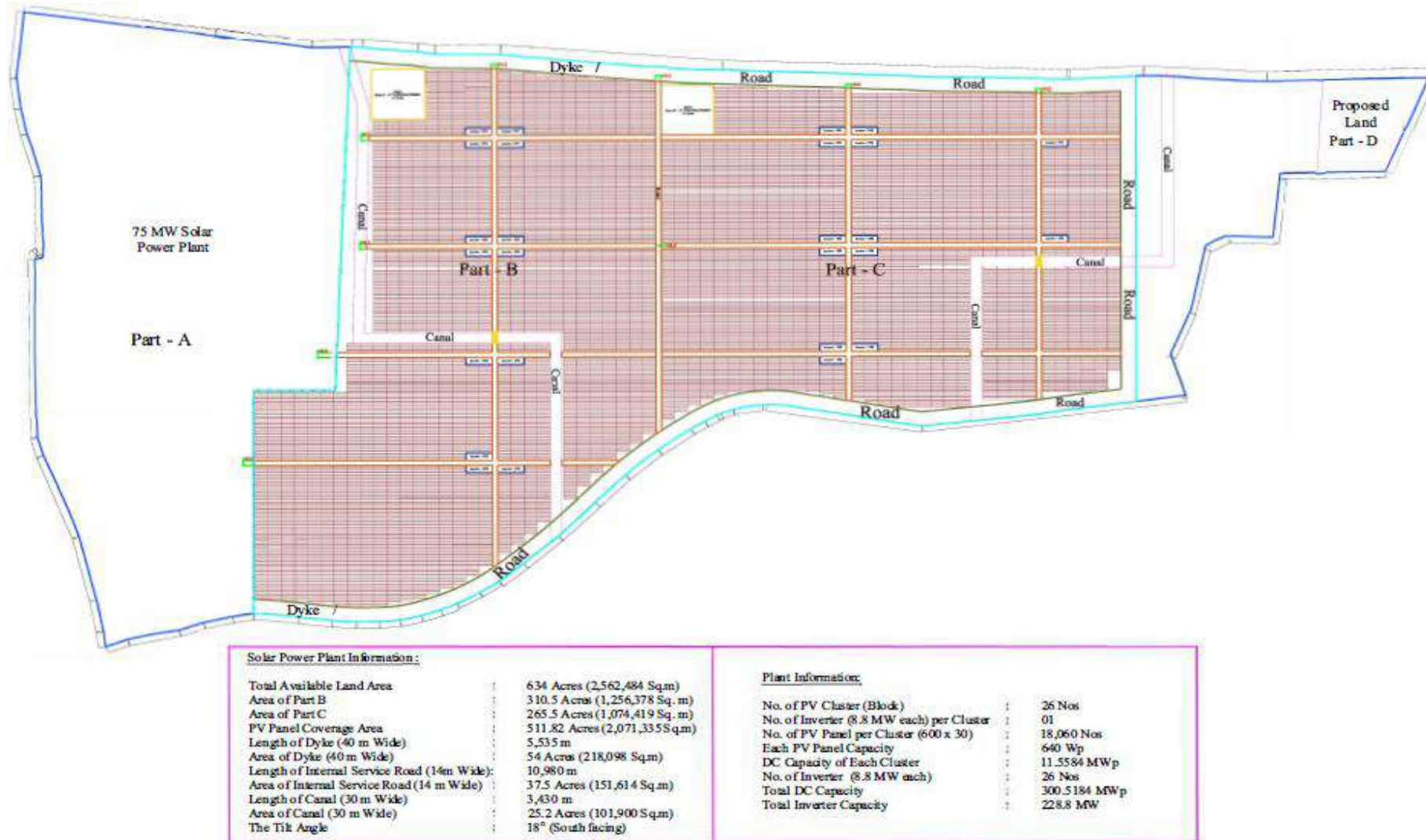


Figure 3.3: Indicative SLD for 220 MWac Solar Power Plant

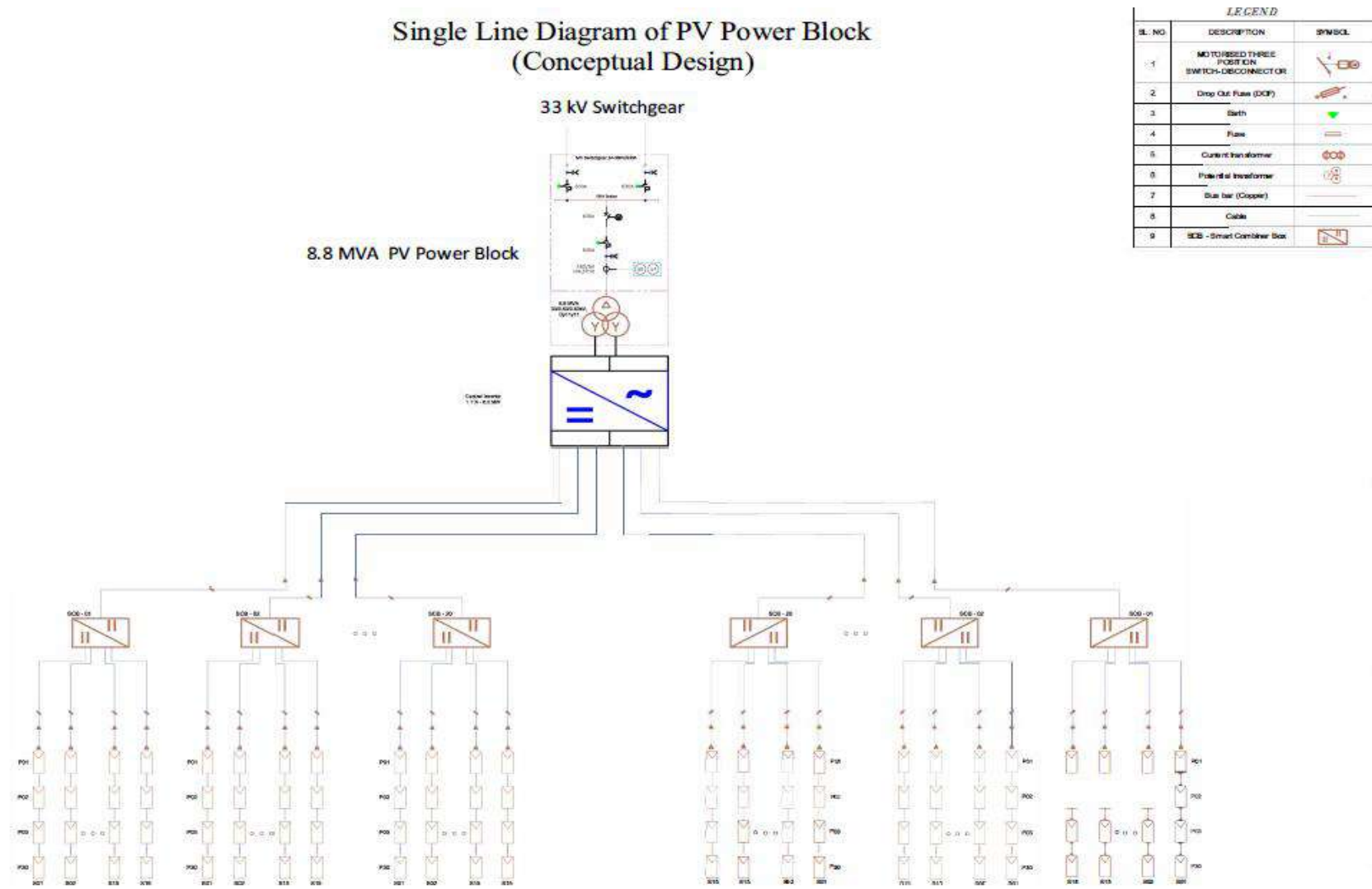


Figure 3.4: Single Line Diagram of Inverter Station

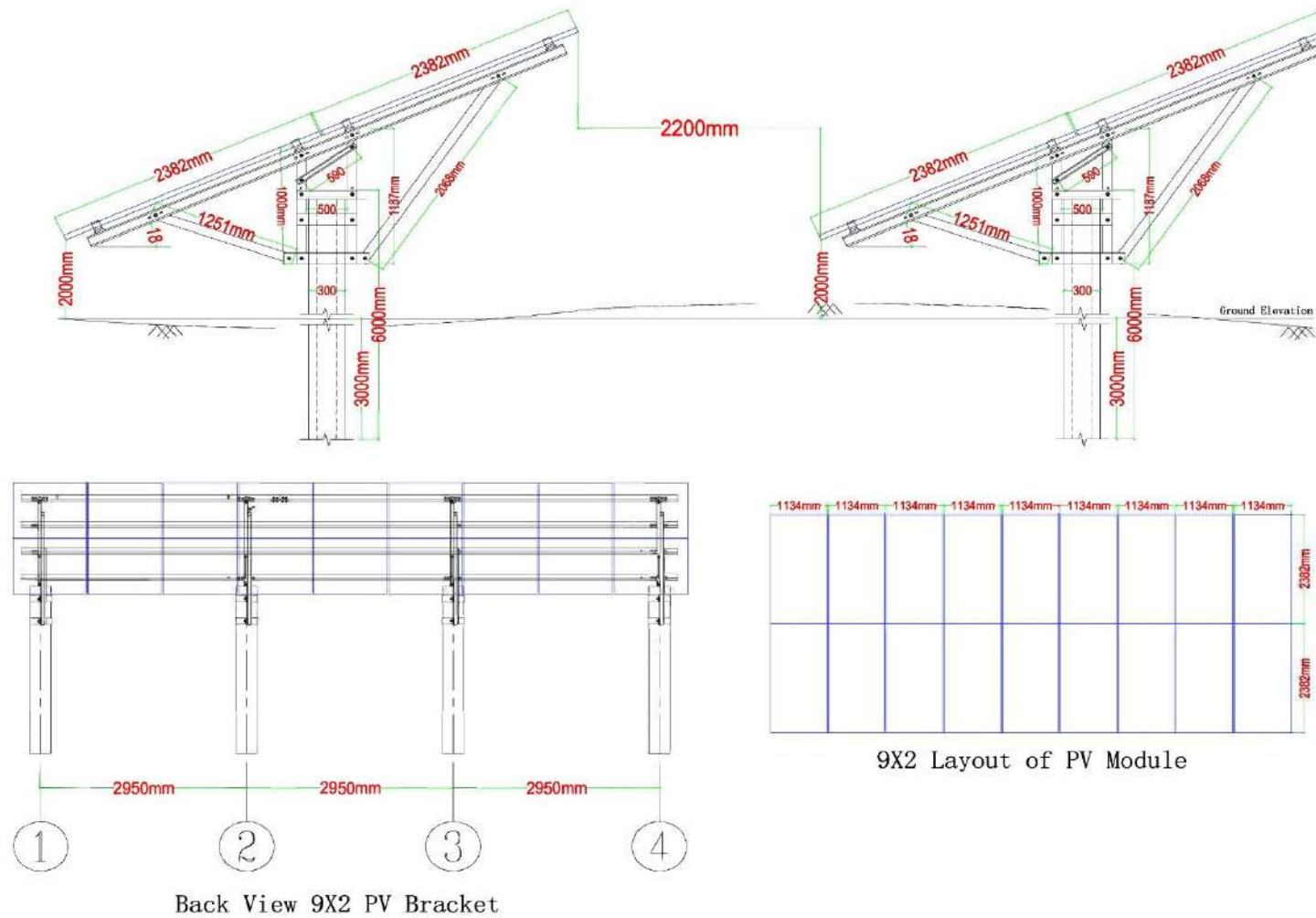


Figure 3.5: Typical Cross Section View of Solar PV Mounting Structure

Sonagazi 220 MW (AC) Solar Power Plant Project (SLD for Single Plant Substation) (Conceptual Design)

To the 230 kV Bay of Existing 33/230 kV
Substation of FGCR 75 MW Solar Power Plant @ Sonagazi

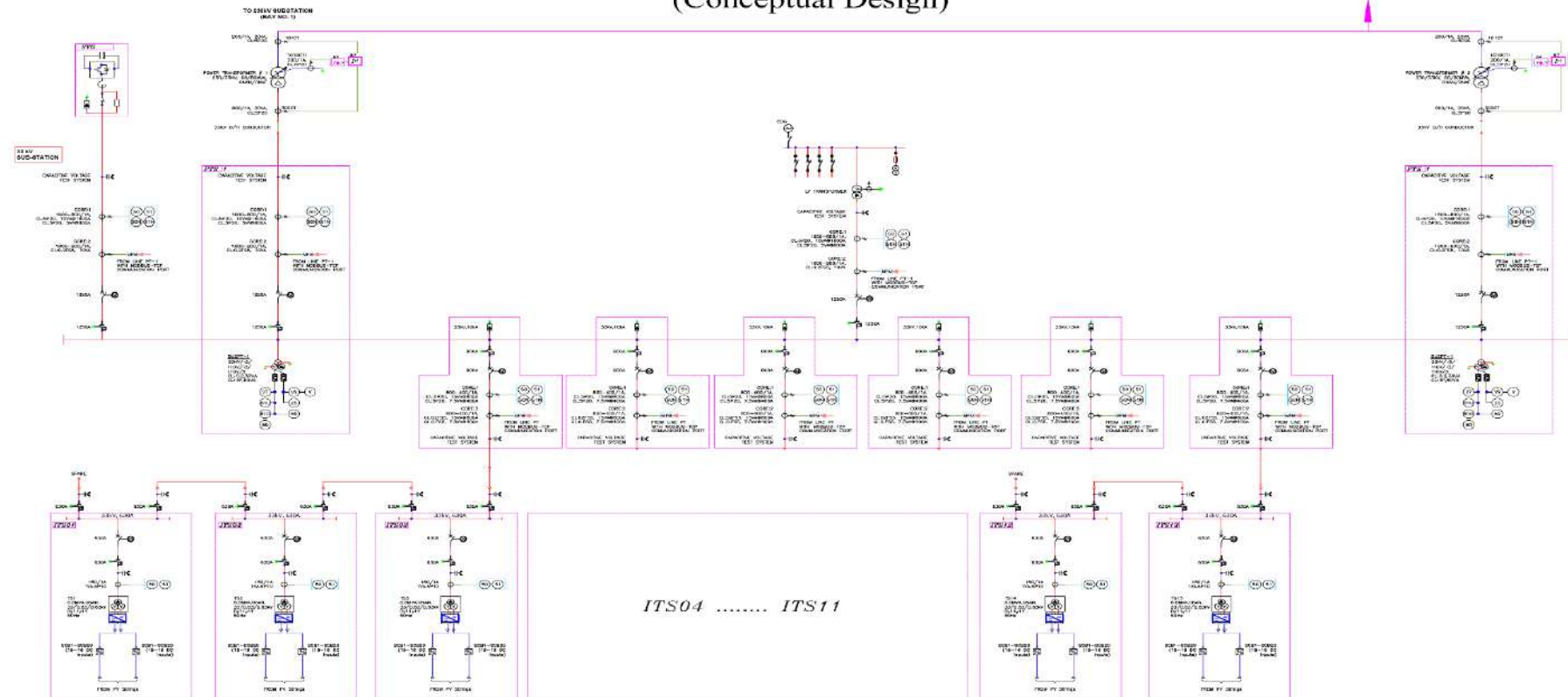


Figure 3.6: Single Line Diagram

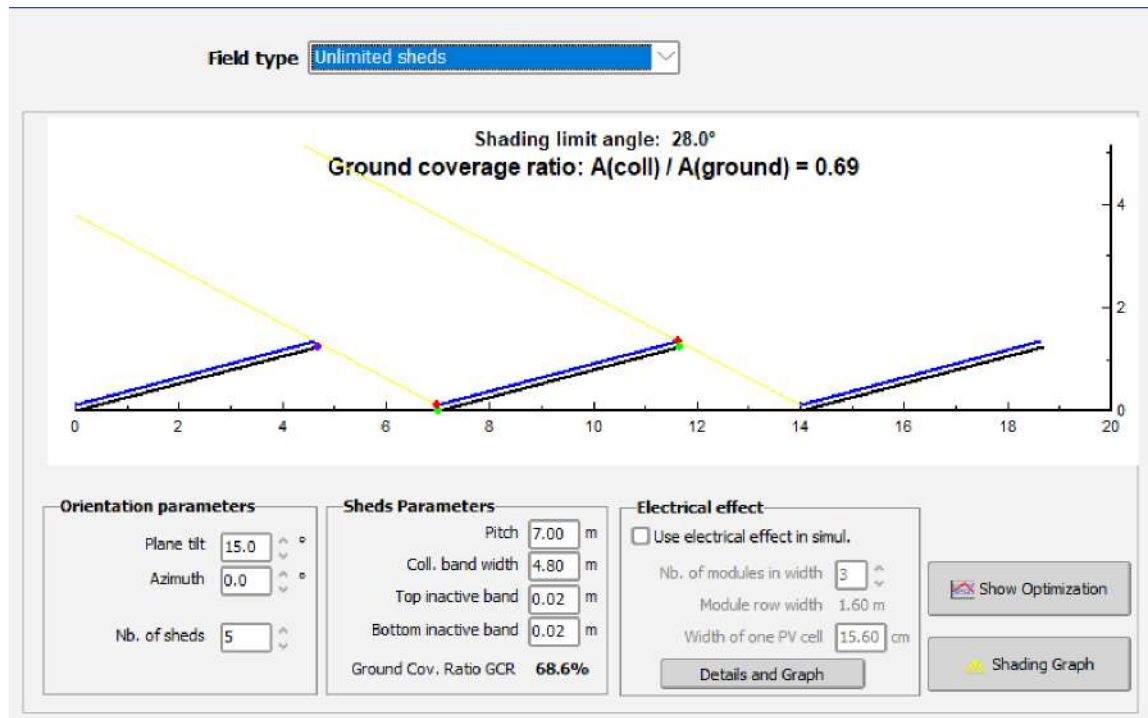


Figure 3.7: Azimuth (South facing) and Inclination Angle (18o) of PV Panel

3.8 Project Activities

The Project activities will be divided into three (03) separate stages, and these are: Pre-Construction Stage, Construction Stage and Post-Construction/ Operation Stage. Stage-wise activities are given as in Table 3-5.

Table 3-5: Phase-wise Construction Activities

Components	Activities by Phase		
	Pre-construction	Construction	Operation period
Power Plant	Topographical survey	Establishment of temporary access road(s)	--
	Sub-soil investigation, including land contamination survey	Establishment of material storage areas and work site(s)	--
	Detailed design	Site leveling	--
	--	Sourcing and transporting materials and equipment to site	--
	--	Civil and structural work (piling work for PV panel and building foundation, RCC work, control building installation)	--
	--	Equipment installation	--
	--	Testing and commissioning	--
	--	Clearing site	--
	--	Implementation of Construction Health & Safety (H&S) and other Plans throughout	--

Components	Activities by Phase		
	Pre-construction	Construction	Operation period
Dike & Admin Building	Dike will be constructed during preconstruction stage and site preparation phase	Admin building work will start during the construction phase and will run simultaneously with the solar panel configuration work. Since there are existing admin buildings several tasks will also be inspected from the existing facility.	Maintenance of dike and admin building as and when necessary
Underground TL Cable Line	Contractor and construction worker recruitment	Establishment of temporary access road(s)	Implementation of Occupational Health & Safety (OHS) and other Plans throughout
	Route survey	Establishment of material storage areas and work site(s)	--
	Detailed design	Clearing of RoW	--
	--	Transport of materials and equipment (cable) to the trenching site	--
	--	Civil works (trenching, RC of trench walls, concrete casting)	--
	--	Underground cable laying	--
	--	Backfill and reinstatement of the cable trenching site	--
	--	Testing and commissioning	--
	--	Implementation of Construction Health & Safety (H&S) and other Plans throughout	--

Source: IIFC ESIA Study, 2024

3.9 Analysis of Alternatives

Alternative analysis is an analytical comparison of the suitability of alternative locations and solutions. It focuses on identification and analysis of alternatives to avoid, minimize or mitigate impacts or risks. Alternatives in environmental studies can be analyzed and compared in terms of a 'No Action' option with the proposed 'Action Option(s)'. No action option is basically a No Project Scenario as it defines the present scenario as it illustrates the present scenario without any interventions but continuing as business as usual. The study of alternatives of a Power Plant is an analytical comparison of different alternatives of sites and technologies. The purpose of this Study is to select the best possible option considering Project sustainability, financial viability, social acceptability and environmental sustainability. Right selection of these Project components shall make the investment viable with sustainable return and it is a part of the feasibility study. This section summarizes the alternative analysis conducted in the feasibility report.

3.9.1 No Alternative Option

Clean and green energy production is now a global concern. Under this project, a solar power plant is proposed to be constructed to produce power from the power plant and will be added to the national grid. This additional power will strengthen the national grid and enhance the green energy share in the national energy mix. Without these proposed

infrastructures the green power generated will not be contributed to the national grid. As a result, No project Scenario has been seen as “not an acceptable” option.

3.9.2 Selection of Site

The project site is selected by the proponent which is already acquired by EGCB. The site is settlement-free, away from ECA and KBAs, fallow land with few canals, and not directly exposed to the sea. The selected site will minimize disturbance to the environment and social perspective. So, the site is environmentally safe and socially acceptable.

3.9.3 Selection of Technology

The main components of the Solar Power Plants are Modules, Inverts and Mounting Structure. In the feasibility study, the techno-economic optimization of the following 8 cases is evaluated during the detailed analysis-

- Case 1: Fixed Tilt System with Mono-facial Modules and String Inverters
- Case 2: Fixed Tilt System with Bi-facial Modules and String Inverters
- Case 3: Single Axis Tracked System with Mono-facial Modules and String Inverters
- Case 4: Single Axis Tracked System with Bi-facial Modules and String Inverters
- Case 5: Fixed-Tilt with Mono-facial Modules and Central Inverters
- Case 6: Fixed-Tilt with Bi-facial Modules and Central Inverters
- Case 7: Single Axis Tracking with Mono-facial Modules and Central Inverters
- Case 8: Single Axis Tracking with Bifacial Modules and Central Inverters

The results from the techno-economic optimization show that the fixed tilt system with double glass bifacial modules and string inverters is the most promising configuration based on the techno- economic optimization results, since this configuration promises the needed module long-term quality performance under marine environment, and tends to have the highest Internal Rate of Return (IRR) and the lowest levelized cost of electricity (LCOE) among all the configurations. However, with the uncertainty associated with the module price and precise 12-month on-site measurement for albedo, Case 1– fixed tilt system with mono-facial module and string inverters has been selected as best case. Nevertheless, it should be further analyzed in detail with the EPC Contractor at the time of contract finalization.

3.10 Resources and Utility Demand

Resources and utilities required to develop the Project include soil, construction materials, manpower, electricity, fuel, water, etc. Most of the Project components like Solar PV Panels, Solar Panel Mounts and Transformers etc. will be imported from abroad. Only materials like cement, MS rod, brick etc. and some small and minor tools and machinery will be used in the construction work from local sources. These items would be available in Sonagazi, Feni's local market or Bangladesh's regional markets. During pre-construction and construction periods, laborers of different disciplines from unskilled to skilled level will be needed and they can be hired from the nearby locality. During the installation and commissioning period, most skilled laborers will be required. Local skilled laborers can be hired locally or through advertisements in the national daily newspapers. The required power supply during the pre-construction and construction period can be taken from the existing 75 MW solar power

project of EGCB (Adjacent to the proposed project location) or from the nearest BREB office, Sonagazi/nearby EGCB Substation.

3.11 Water System and Management

The plant water requirements will be predominant for cleaning of solar PV arrays and personnel use. About 469,560 Nos of modules are expected to be installed under the project and considering surface area of $2.382 \times 1.134 \text{ m}^2$ for each module, the total surface area would be 1,268,369.8 Sqm. Considering 2 liter/ m^2 and two cleanings per month an average requirement of about 5,073,476 liters of water will be required.

The required water for the Plant will be taken from the groundwater source and Nearest surface water source (Canal inside the project location). The Plant will use this water for panel washing and other potable use. The waters of the Feni and the Little Feni Rivers are saline in nature with varying degrees of salinity front seasonally, hence, the project authority may extract the groundwater to fulfill the water demand for this Project. It is also to be mentioned here that rainwater may be used also to fulfill the water demand after harvesting. The Solar panels can be used to gather water which can eventually go via pipe network and then in the existing canal or any other storage system.

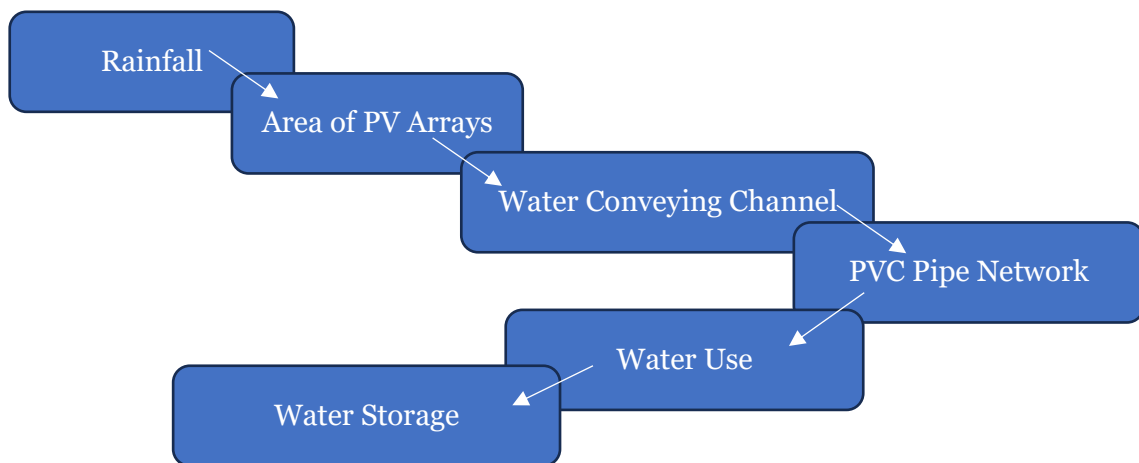


Figure 3.8: Rainwater Harvesting Using Solar Pannels



Source: Rainwater Harvesting in a 600 Kw solar power project, Hitit University

Figure 3.9: PV Array water collection System

To show variation within the months and not just the monthly totals, we show the rainfall accumulated over a sliding 31-day period centered around each day of the year. Feni experiences extreme seasonal variation in monthly rainfall.

The rainy period of the year lasts for 9.8 months, from February 16 to December 9, with a sliding 31-day rainfall of at least 0.5 inches. The month with the most rain in Feni is July, with an average rainfall of 17.5 inches.

The monthly maximum and average rainfall data of the last 30 years (1992-2022) was collected, analyzed and shown in **Figure 4.3**. The analysis of data shows that the monthly average rainfall varies from 212 mm to 631 mm in monsoon and the area received the maximum of 1128 mm in July 2015. The historical maximum annual rainfall of this station was recorded as 4476 mm in 2017, minimum was 1251 mm in 2022, while the average is 2840 mm. The annual rainfall of this period is shown in **Figure 4.4**.

The rainless period of the year lasts for 2.2 months, from December 9 to February 16. The month with the least rain in Feni is January, with an average rainfall of 0.2 inches.

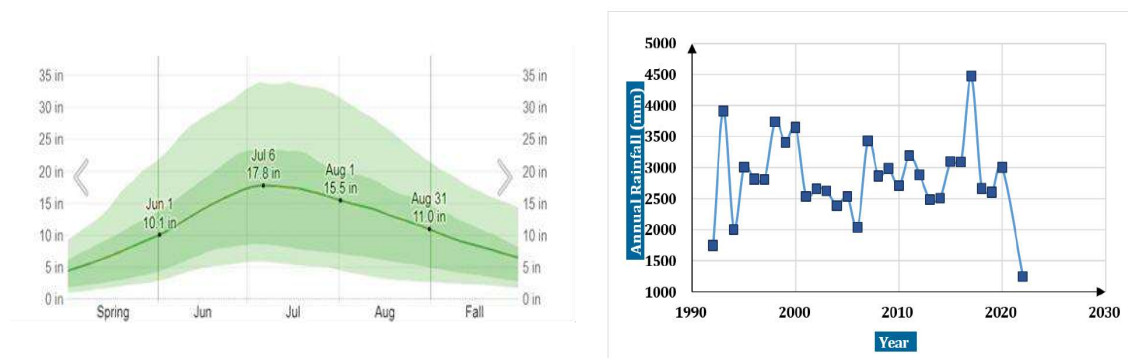


Figure 3.10: Average Rainfall Pattern (Feni)

3.11.1 Calculation of Rain:

Total Area	= 700 Acre
1 Acre	= 4046.86 Sq-meter
700 Acre	= 700×4046.86 Sq-meter
	= 28,32,802 Sq-meter
Now Total Average Yearly Rainfall	= 2840mm
	= 2.84 Meter
Total Average Yearly Rainfall	= 2832802×2.84
	= 80,45,157 m ³

With the current data it is estimated that an average of 80,45,157 m³ of rainwater can be accumulated from 700-acre land per Year.

However, Rainfall pattern in this area should be analyzed further before implementing the rainwater harvesting system in the area.

3.12 Material Storage and Handling

Open and Close store yards need to be constructed in the Project area for storing the plant component and types of machinery, construction materials and sum miscellaneous items. Open store yards are normally barbed wire fenced areas to store mostly construction materials like brick, MS rod, sand etc. After the completion of construction, access materials will be sold in auction following the approved procedure. Closed store yards are normally constructed with corrugated iron sheets, iron bars and angles to store plant machinery, their components and some construction materials like cement. These materials will be taken from the store yards using tracks, pick-ups, vans, buoy tracks etc. All heavy materials need to be loaded and unloaded using appropriate cranes.

3.13 Civil Structure and Urban Facilities

A number of civil structures and facilities are planned with the project. The possible civil and urban facilities to be constructed are listed below:

3.13.1 Power Plant

Infrastructures and civil structures for the Plant facilities, administrative facilities and Road network are given as follows:

- **Plant Facilities:** These include Control Room, Steel foundation for the PV Panels Mounting, Workshop and permanent stores, drainage, sewerage network, security fencing, etc.;
- **Administrative Facilities:** These include office building; laborer camp/shed, Security Barrack, garage, etc.
- **Road Network:** These include access road (10 Km), necessary bridge, culvert & sluice gate (if any) and internal road network.

3.13.2 Township

The infrastructure for residential facilities and township facilities are as follows:

3.13.2.1 Residential Facilities

The residential facilities include Rest house, Officials' quarter/dorm, Staff quarter, Guard shed and Canteen. EGCB has already a Rest House including canteen and sanitation facilities for officials and staffs of around 100 person.

For laborers, a temporary basecamp should be built near the project location which should have an adequate number of sanitation facilities and bathing facilities. 10 Nos Toilet and bathing facilities should be enough for the laborers; however additional facilities should be developed by contractors depending on the requirements and situations.

3.13.3 Other Infrastructural Facilities

3.13.3.1 Drainage Facilities

The surface water drainage system shall be designed to effectively drain the site and collect and discharge the rainfall runoff without flooding roads and the plant facilities. Clean storm water shall be collected and discharged to the on-site canal and then to the permitted outfall structure.

All the major and minor systems of the storm water design should comply to the local authorities and national requirements and standards. The capacity of the surface water drainage system, including perimeter surface water run-off interceptor ditches, shall be designed in accordance to a 100-year return period for rainfall. All buildings shall be provided with roof drainage for disposal of storm water and be connected to the station storm water drainage system.

3.14 Project Design and Construction

The project will be designed in accordance with the international standards for Solar PV Power Plant. Moreover, sufficient protective measures shall be incorporated in the design of the Plant for environmental protection.

The design of support facilities and associated work will be in accordance with appropriate national and international standards. The plant design will cope with local seismic conditions. The design life of the plant will be at least 25 Years. Solar PV will be mounted in accordance with the layout plan provided by the Proponent. The site will require 1 meter filling to expand its elevation. Civil work will involve construction of the Solar PV panels mounting structures, their auxiliary facilities and buildings. Mechanical and electrical works will include both on-site and off-site fabrication, assembly, installation, and erection.

3.15 Transportation of Equipment and Machineries

Required machineries and equipment like Solar PV, Transformer, switchyard equipment etc. need to be imported from abroad. The machineries and equipment will be on boarded to Bangladesh through the Chattogram Port Gateway using the facilities like piloting the ships, quarantine, custom clearance etc. From the port, these heavy machineries will be transported to the project site through roadway just like the way the adjacent EGCB Power Plant adopted during construction of 75MW Power Plant.

3.16 Central Control, Monitoring and Protection

For monitoring and controlling the solar power plant effectively by detecting faults or defect a Supervisory Control and Data Acquisition (SCADA) system needs to be installed so that the problems can be traced & rectified within minimum possible time and impact over plant production can be minimized. Combination of communication protocols could be used in order to have smooth communication within the solar power plant at the main control room. It is recommended to use additional hardware such as PLC and servers in order to achieve the highest level of availability within the system.

3.17 Human Resources Requirement

The estimated manpower loading during (i) Pre-construction (ii) Construction and (iii) Operation stages are provided in the following sections. It may be noted that at all stages local people with prerequisite qualifications and experience should be given preference over others.

3.17.1 Pre-Construction Stage

Site Preparation Activities: At this stage, the pattern of manpower loading would be around 75 at peak and about 50 in regular basis which may include unskilled, semiskilled and skilled laborers, technicians, engineers and about five (05) numbers of supervisors and management staff and five (05) numbers of expatriate engineers, etc. It is assumed that about six (06) months would be required for the land development activities.

3.17.2 Construction Stage

Construction Activities: EPC contractors are expected to have around 350 unskilled, semi-skilled and skilled laborers temporarily for the construction activities that include civil works and plumbing at peak conditions. It is assumed that during this tenure on average 250- 300 laborers would work in the construction site daily. Around 10 supervisors will be engaged to monitor and supervise them. Among the manpower, expatriate employees of different disciplines preferable the engineers will be around 10- 20. During this stage, it is assumed that a maximum of five (05) supervisors and 20 expatriates would stay in the construction site. At this stage, around 150 workers/ laborers would stay at the construction site and the rest of the laborers would be day laborers. It is assumed that civil construction would run in full swing for about twenty-four (24) months' period.

3.17.3 Commissioning Stage

The Plant would be under commissioning stage for about three (03) months period. During this stage, EPC Contractor will employ around 25- 30 people, in which, expatriates will be around 10- 15 and rest will be local. In addition, around 25 laborers would be involved in various activities based on the requirements at this stage. It is assumed that a maximum of about 15 laborers would be the resident laborers (24/7 hrs. period) at this stage and rest of the laborers would be day-laborer.

3.17.4 Operation Stage

During this stage, the Proponent will employ around 40 people, of which 25 people will be for the managerial posts and the rests will be for staff and other posts. At this stage, around 10 laborers would be involved in various activities as per requirement. It is assumed that the life cycle of this Plant would be 20 years.

3.18 Embedded Control/ Abatement Measures

Solar Plant uses only sunlight to produce DC electricity using its PV equipment. So, there is no emission of air pollution, noise, or odor generated from this process. The only potential environmental impacts associated with solar power is land use and habitat loss. During the

transportation of equipment and materials may pose potential risks of dust emissions from material spillage, SO_x and NO_x, emission from vehicle exhaust, road accident, damage of road surface, etc. The contractor should take care of the project's environmental and social management plan (ESMP), like use of vehicle with good engine condition, covering the trucks properly with tarpaulin and traffic officers should regulate the hauling truck traffic movement, etc. Since the activities are short lasting and limited to daytime only, the impacts can be considered trivial and negligible.

3.19 Waste Generation, Storage and Disposal

During various stages of the proposed Project, a significant quantity of waste including solid & liquid, hazardous/ non-hazardous, kitchen waste, sewage waste, etc. would be generated. All kinds of solid waste to be generated would be disposed of onsite maintaining DoE's standards.

3.19.1 Solid and Liquid Waste

The major solid waste would be generated from the laborer camp/shed and the staff dorm during pre-construction and construction stage. Here, kitchen waste and sewage waste would be generated. However, during the construction stage, beside kitchen and sewage wastes, construction wastes like concrete pieces, small cut pieces of MS bars/rods, plastic pieces, iron pieces, wood pieces, empty cement bags, empty cartons, waste papers, residual paint material, residual oil/grease from construction machine maintenance etc. may also be generated. Solid waste is mainly of three (03) types. They are Perishable waste, Non-perishable waste and Sanitary waste.

3.19.1.1 Perishable Waste

A maximum of about 50 and 150 numbers of laborers would stay at the construction site during pre-construction and construction stage respectively. On the other hand, around 15 laborers would stay at the Plant site for 24/7 hrs. period during both commissioning and operation stages. These laborers would be involved with various works as per requirement for the Plant commissioning and operation by turns. Although, a maximum of 150 laborers would be resident laborers, considering the volume of activities in the construction site, the number of laborers would be variable, and it is assumed that the highest number of laborers would be 350 during peak period of the construction activities.

On the other hand, at all stages of Power Plant implementation, expatriate officials and the supervisors/ monitoring staff are engaged for surveillance of whole of the pre- construction, construction and commissioning works. It is assumed that around 10 supervisors (05) and expatriate officials (05) during pre-construction stage, around 5-10 supervisors along with 20 numbers of expatriate officials during construction, around 15 numbers of expatriate officials during commissioning stage and 15 numbers of expatriate officials would be engaged during Operation Stage under this Project.

Considering this, several laborers camp/shed, staff dorm, sewage system, kitchen waste disposal system etc. would be implemented for them during pre-construction stage.

It is assumed that most of the day laborers would carry their food from their home, and it is estimated that around 30% of the average number of laborers would take their food from the laborer camp/shed kitchen. Therefore, for this additional percentage of laborers, kitchen waste has been calculated for the construction stage. On the other hand, it is assumed that the laborer would work for 10 hours daily for 26 days per month. Hence, sewerage waste has been calculated based on the working hours of the laborers.

The officials, including supervisors and expatriates, would work 8 hours daily for 22 days per month. It is assumed that they would carry their food from home but some of them may take food from the kitchen. They would use the toilets in the construction site. Therefore, waste generation like kitchen waste and sewage waste has been considered for the expatriate officials and the supervisors.

3.19.1.2 Kitchen Waste

The laborer camp/shed would be constructed by the EPC Contractor at the defined and pre-selected location within the Project site. A kitchen would also be constructed beside the laborer camp/shed. **Table 3.6** shows the estimation of kitchen waste to be generated during the pre-construction stage.

Table 3-6: Estimation of Kitchen Waste during project activities

Sl. No.	Economic Classes of Employee	Project Employee /Worker	Rate of Kitchen Waste Generation (kg/ day/capita) *	Total Generated Waste (kg/ day)
1	High-Income Group (Tk. >20,000/month)	5	0.56	2.8
2	Middle-Income Group (Tk. 10,000- Tk. 20,000/month)	5	0.5	2.5
3	Low-Income Group (Tk. < 10,000/month)	50	0.32	16
Total		60		21.3

Source: Jodder et. al. Generation and Characteristics of Household Solid Waste in Khulna City, Bangladesh, 2022

It is estimated that around 21 kg of kitchen waste will be generated each day from the laborer-shed and staff's residence. On the other hand, during civil construction activities, around 240 laborers (considering the resident laborers and 30% of average number of laborers) might have food from the laborer shed kitchen at the Project Site. In addition, 10 supervisors recruited by the EPC Contractor, 20 expatriate officials from Owner's Engineers, Supervision or Monitoring Consultants, and Environmental Consultants of this Power Plant would be involved also for the construction activities. **Table 3.7** shows the estimation of kitchen waste during civil construction and erection works.

Table 3-7: Estimation of Kitchen Waste during Civil Construction

Sl. No.	Economic Classes of Employee	Project Employee /Worker	Rate of Kitchen Waste Generation (kg/day/capita) *	Total Generated Waste (kg/day)
1	High-Income Group (Tk. >20,000/month)	20	0.56	11.2

2	Middle-Income Group (Tk. 10,000-Tk. 20,000/ month)	10	0.5	5.0
3	Low-Income Group (Tk. < 10000/month)	240	0.32	76.8
Total		270		93.0

Source: Jodder et. al. Generation and Characteristics of Household Solid Waste in Khulna City, Bangladesh, 2022

It is estimated that around 93 kg of kitchen waste will be generated each day from the labor-shed and staff dorm.

During the commissioning stage, it is assumed that around 30 numbers, about 15 numbers of officials and 15 laborers will be living at the site for about 3 months' time. On the other hand, during operation stage, around 40 people will be living at site in which 30 would be the high-income group and rest of the people would be the low-income group. **Table 3.7** shows the estimation of kitchen waste during commissioning and operation period.

Table 3-8: Estimation of Kitchen Waste during Post-Construction/ Operation Period

Sl. No.	Economic Classes of Employee	Project Employee	Rate of Kitchen Waste Generation (kg/ day/ capita) *	Total Generated Waste (kg/ day)
1	High-Income Group (Tk. >20,000 /month) and Low-income Group (Tk. <10,000 / month) for commissioning stage in three months period	30 (15+15)	0.56 (HIG) 0.32 (LIG)	8.4 4.8
Sub-Total				13.2
2	High-Income Group (Tk. >20,000 /month) and Low- Income Group (Tk. <10,000 /month) for operation stage in 25 years period	40 (30+10)	0.56 (HIG) 0.32 (LIG)	16.8 3.2
Sub-Total				20.0
Total				33.2

Source: Jodder et. al. Generation and Characteristics of Household Solid Waste in Khulna City, Bangladesh, 2022

It is estimated that around 13 kg of kitchen waste will be generated each day from the dorm/township area of resident staff for the Plant during the commissioning stage and around 20 kg per day in the operation stage.

Careless disposal of these wastes would create pollution, odor problems, nuisance, and aesthetic tiring. However, the impact would be for a temporary period, limited within the project site, reversible and may happen only in the worst-case scenario (i.e., no management of kitchen waste). Hence, there should be a provision of good housekeeping for managing the kitchen waste.

These perishable kitchen waste should be disposed of in covered plastic containers to be kept at designated places, which would be required to collect periodically by local authority for final disposal, maybe for land filling purposes. In short, generated waste should be disposed of onsite maintaining DoE's standards.

3.19.1.3 Non-perishable Waste

Non-perishable solid wastes like metal pieces, empty cartons, plastic materials, paper bags etc. will be disposed of in covered plastic containers of different colors specified for different types of wastes kept at a designated place. Recyclable and plastic waste will be sold to the re-cycling companies and other interested buyers.

3.19.1.4 Organic Solid Waste/ Sewage Waste (Sanitary Waste)

Organic solid waste/ sewage would be generated in all stages. For calculating the volume of sewage wastes might be generated during various stages of the Project implementation, the number of laborers, supervisors/ monitoring staff and expatriates those would stay at the Plant site have been considered. In addition, the tenure of each stage has been considered here also. It is to be mentioned here that for the implementation of the Solar PV Power Plant, Pre-construction activities would be conducted within six (06) months' period. Similarly, for the construction, commissioning and Operation stages the tenure would be two (02) years'/ twenty-four (24) months', three (03) months' and twenty (20) years' periods respectively.

Based on the above considerations, it is estimated that approximately 2.7 m³ of organic solid waste (sewage)³ would be generated at pre-construction stage, from the temporary laborer sheds and staff dorm. Similarly, during the civil construction, approximately 32.4 m³ volume of sewage⁴ would be generated from the above-mentioned sources. Therefore, considering the highest volume of sewage waste, a septic tank with a volume of about 17 m³ including a soak well may be constructed during the pre-construction stage which may be finally demolished and dressed with adjacent land. This waste should be cleaned after a certain time interval based on the requirement.

On the other hand, it is assumed that a central sewage treatment plant (STP) for treating sanitary waste would be constructed at the township area within the Power Station Complex during the operation stage of the Project. It is estimated that, during commissioning stage, approximately 0.8 m³

volume of sewage⁵; and during operation stage, about 125 m³ volume of sewage⁶ would be generated from the township area.

3.19.1.5 Sewage Treatment Plant

'Sewage' is the contaminants from wastewater, including household sewage and industrial wastewater. The sewage contains organic matter such as human waste; nutrients like nitrogen and phosphorus etc.; pathogens like bacteria, fungi, parasites and viruses; and chemicals like detergents, pharmaceuticals, and industrial chemicals etc. Hence, it is a complex mixture of substances. Organic materials are usually biodegradable; hence these materials may be treated by the sewage treatment process. However, nutrients of sewage

³ Considering 0.29 wt.(kg)/ person/ day for 26 working days for Lower Income Group and 0.6 wt.(kg)/ person/ day for 22 working days for Medium and Higher Income Group.

⁴ Considering 0.29 wt.(kg)/ person/ day for 26 working days for Lower Income Group and 0.6 wt.(kg)/ person/ day for 22 working days for Medium and Higher Income Group.

⁵ Considering 0.29 wt.(kg)/ person/ day for 26 working days for Lower Income Group and 0.6 wt.(kg)/ person/ day for 22 working days for Medium and Higher Income Group.

⁶ Considering 0.29 wt.(kg)/ person/ day for 26 working days for Lower Income Group and 0.6 wt.(kg)/ person/ day for 22 working days for Higher Income Group

may cause eutrophication in water bodies which may lead to depletion of dissolved oxygen, decreased biodiversity, water intoxication and invasion of new species. These may also cause even the death toll to fish species if these wastes mix with surface water sources. On the other hand, pathogens cause waterborne diseases like cholera, typhoid jaundice etc. to humans may be occurred. Therefore, direct contact with this wastewater to any surface water source may degrade the quality of water. The drainage canal inside the Project area, hence, there is a potential to have this occurrence if this wastewater is not treated properly. In this regard, it is essential to have the provision for a Sewage Treatment Plant (STP) for this Project to dispose of the wastewater to the environment with due treatment or to reuse the water safely for other purposes like gardening, car washing, service activities, etc. It may be a possibility of a central STP considering the existing 75MW and the proposed plant on an equity-based sharing provided the existing plant did not build STP.

The STP might be of biological type or in combination with physical, chemical, and biological type. Generally, STP consists of screening devices, aeration, active sludge treatment, sedimentation, clarification, and separation/recirculation of sewage sludge. Membrane bio reaction is a good alternative. The EPC contractor should construct an STP including the sewerage system. The STP should have the capacity corresponding to the number of employees in the proposed Plant. The Plant should be designed in a way that would comply with the effluent standards (sewerage) of IFC and MoEFCC. The provision of reusing the treated waste should be considered in the design. The treated water can also be supplied to the nearest agricultural lands for irrigation.

The sludge, semi-solid or solid residual materials may be generated during treatment of wastewater in STP. The STP rejected sludge can be used as compost once maintains compliance with the IFC standards and ECR 2023.

In addition, the disposal and management of sludge should consider the Bangladesh Environment Conservation Act, 1995 (Amendment 2010), Bangladesh Standards and Guidelines for Sludge Management (BSGSM) 2015 and National 3R Strategy.

3.19.1.6 Hazardous Waste

While solar power is generally considered a clean and renewable source of energy, but the production and disposal of solar panels can generate hazardous waste. Some of the hazardous materials that can be found in solar panels include:

- **Silicon Tetrachloride:** This is a highly toxic substance that is used in the production of solar cells. It is a corrosive and reactive chemical that can cause burns, respiratory problems, and other health issues if it is not handled properly.
- **Cadmium:** Cadmium is used in thin-film solar cells and is considered a carcinogen. It can also cause kidney damage and other health problems if it is not properly managed.
- **Lead:** Lead is used in the soldering of solar cells and can be toxic if it is ingested or inhaled. It can cause lead poisoning, which can lead to brain damage, developmental problems, and other health issues.

Proper disposal of hazardous waste from solar panels is essential to prevent environmental contamination and protect public health.

3.19.2 Waste Management

Considerable quantities of wastes (general & construction) will be generated due to the construction of water supply schemes. Three types of wastes will be generated during construction:

3.19.2.1 OBJECTIVES

The main objective of the WMP is to organize disposal of all wastes generated during construction/drilling in an environmentally acceptable manner specially consider the following:

- Health hazards of the project personnel as well as community people should not be occurred;
- Manage the wastes in such a way that environment (specially air, soil, water etc.) will not be polluted;
- Odor means bad smell should not be generated;
- Always friendly environment at the construction sites and construction camps.

3.19.2.2 Site for disposal of wastes

EGCB will select the site for disposal of general wastes at the area within the construction camp at some site which is as much as possible far away from the project workers' and community residents & cultural site.

3.19.2.3 Method of disposal of wastes

3.19.2.3.1 General Waste

Contractor will collect the general wastes in separate waste bin at sources (means organic waste in one bin & inorganic waste in another bin) and dumped at the designated waste disposal site. The Contractor will construct concrete waste disposal site (means concrete floor and wall and covered by shed to avoid, air, bad smell, soil and ground water pollutions. Based on the quantity of general waste (organic & inorganic waste), the following three chambers (rooms) of the concrete disposal site will be constructed by Contractor-

- Two chambers for organic waste;
- One Chamber for inorganic waste.

Just after filling one chamber (say after 6 months) by organic waste through pocket gate, it should be covered by earth (soils) properly & keeps it for about 6 months for converting organic fertilizer for the agricultural lands. After filling 1st chamber by organic waste, disposing of waste will be started for 2nd chamber.

In the same way, inorganic waste will be dumped in the chamber, designated for inorganic waste. Just after filling, these inorganic wastes can be given to the vender free of cost. Contractor collects construction waste separately & dump in to the room at the designated area. Contractor will maintain log book for the measurement of quantity of the waste, disposed every day.

3.19.2.3.2 Construction Waste

Organize disposal of all wastes generated during construction in an environmentally acceptable manner. This will include consideration of the nature and location of disposal site, so as to cause less environmental impact.

Train and instruct all personnel in waste disposal practices and procedures as a component of the environmental induction process.

Make sure all containers, drums, and tanks that are used for storage are in good condition and are labeled with expiry date. Any container, drum, or tank that is dented, cracked, or rusted might eventually leak. Check for leakage regularly to identify potential problems before they occur.

Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach.

- Segregate and reuse or recycle all the wastes, wherever practical.
- Prohibit burning of solid waste.
- Provide reuse containers at each worksite.
- Request suppliers to minimize packaging where practicable.
- Maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal.

3.19.2.3.3 Hazardous Waste

- Transport waste of dangerous goods, which cannot be recycled, to a designated disposal site.
- Broken panes, batteries and other hazardous waste should be stored in a safe place so that no one can easily get exposed to it.

Overall, in such cases a contract with the supplier should be made to take out all the broken panels, batteries and dispose to their own responsibility.

3.19.2.3.4 Institutional arrangement

Contractor under EGCB will be responsible for environmental monitoring for the waste management. The PMU will setup a 'Waste Management Committee' with the representatives of the EGCB and Contractor to effectively disposing the wastes. The committee is also responsible for monitoring procedure for the collection and carrying of wastes without causing any environmental hazards.

3.20 Post Operation Monitoring Program

Regular monitoring of critical parameters in different environmental disciplines like radiation, drainage system, corrosive effect etc. shall be conducted and to the Department of Environment (DoE) regularly following the Environment Monitoring Plan (EMoP) proposed under this Study. The monitoring locations will be finalized based on sensitivity and in consultation with DoE. The Plant will be equipped with all necessary apparatus and manpower for ensuring effective monitoring.

The environmental monitoring officer shall monitor the EMP implementation and submit a quarterly report to the said department. As well as another yearly monitoring report with

quarterly monitoring data shall be submitted to the DoE to renew the Environmental Clearance Certificate. Two training courses per year shall be planned for safety professionals.

3.21 Decommissioning of the PV Plant

This section is intended to provide an overview of the work required for decommissioning the PV plant and the costs associated with the disposal and recycling of the components and construction materials.

3.21.1 Disposal, recycling, transport cost and residual value

Module disposal: As of today, clarity regarding possibilities for further usage of PV modules after dismantling utility scale plants is still missing. Hence, disposal of the modules at end of lifetime has been considered.

Electronic waste: i) Similarly to PV modules, inverters and other electric small components (e.g., sensors, communication units, etc.) are assumed that the components would need to be disposed; ii) It is assumed that the transformer stations have not yet reached the end of their service life after an operating period of 20 years and can therefore be handed over to recycling companies free of charge.

Residual value: i) Components from metal: The mass calculation assumes that all steel parts the mounting system as well as the cables (LV, MV and grounding wire) will be collected separately to ensure proper recycling. ii) Estimating future metal prices is a complex task. Market prices for metals are very volatile and subject to high fluctuations, but yet, it plays an important role in the calculation of costs.

Transport cost: A transport distance of 75km was assumed. This corresponds approximately to the distance from the plant location to Chattogram Port.

- PV modules, electronic waste, steel, cables, etc.: 75 km
- Transformer stations: Free collection

3.21.2 Dismantling Works

The aim is to return the land to a condition comparable to its original state. To achieve this, decommissioning of a PV project involves various activities, such as:

- Disconnecting and dismantling of PV modules
- Dismounting of substructure including foundations
- Disconnecting and dismantling of electrical equipment and small parts (inverter, transformer stations, sensors, security and monitoring system)
- Detaching and excavating the cables
- Site cleaning (dismounting of fence, levelling etc.)

3.22 Project Schedule

The project is scheduled to be constructed and commissioned within 24 months (**Table 3.8**). The detailed work program will be prepared by the EPC Contractor. The underground cables

will be laid in 500m sections. The UG transmission line is about 1 km and may take 15-20 days to complete.

Table 3-9: Work Schedule

Package	Duration
Design, Supply, Installation, Testing and Commissioning of 220 MW ac PV solar plant including switchyard and substation, and 230kV Underground Transmission Line	24 Months

Source: IIFC ESIA Study

4 ENVIRONMENTAL AND SOCIAL BASELINE

4.1 Introduction

Baseline study refers to the proper documentation of the present condition of all the environmental and social components of the study area before implementation of any Project. This chapter represents the existing situation of the environmental and social context before implementing the proposed 220 MWac Solar Power Plant project in the proposed locations. In broad sense, environmental and social condition for baseline study comprises outlining the physical environment (e.g., including meteorological, hydrological, geological components and processes), biological environment (e.g., including flora, fauna, and ecosystems), land use pattern, agricultural practices, culture and capture fisheries, and social environment (cultural activities, economic status, livelihoods and hazard) of the Study area. Under this project, primary and secondary data have been used to analyze the baseline condition of the study area.

4.2 Physical Environment

4.2.1 Setting of the Area

Study Location

The study area has fallen under the Sonagazi Upazila of Feni District, situated on the coast of the Bay of Bengal. The study area consists of about 700 Acres of barren land. The Little Feni River flows along the south-east and the Feni River flows along the east of the project area. Geographically, it is situated in a very dynamic tidal floodplain, where morphological changes occur in estuaries and rivers due to regular tidal flooding. The nearest landmark is the Musapur Closures dam situated in the west side of the project area in the mouth of the Little Feni or Dakatia River before emptying into the sea which has been damaged by last flood in August 2024. **Figure 3.1 & 3.2** shows the location of the study area and the project area along with some significant locations within the periphery of the project boundary.

Topography

Sonagazi Upazila of Feni District is located in the southeast of Bangladesh, under the Chattogram Division. It is bounded by Feni Sadar Upazila on the north, Companiganj Upazila (Noakhali) on the south, Mirsarai Upazila (Chattogram) on the east, Companiganj and Daganbhuiyan (Feni) Upazilas on the west. And the estuary of the Bay of Bengal to the south.

Area-Elevation Curve

Digital Elevation Model (DEM) was used to describe the topography of the study area. The 30m x 30m DEM has been used to analyze the study area's elevation. It reveals from the area elevation curve that the land elevation of the study area ranges between -0.47 to 7.06 mPWD (-0.01 to 7.52 MSL)⁷. Around 20 percent of the area is very low lying with permanent water

⁷ Transformation of mPWD to MSL: Add 0.46m to mPWD to obtain MSL

bodies and rivers. About 80% of the study area has an elevation above 3.5 mPWD (3.96 MSL), and about 1% of the study area has an elevation higher than mPWD (6.46 MSL), with highest elevation of 7.06mPWD (7.52 MSL) along the areas near the Shahbazpur Channel.

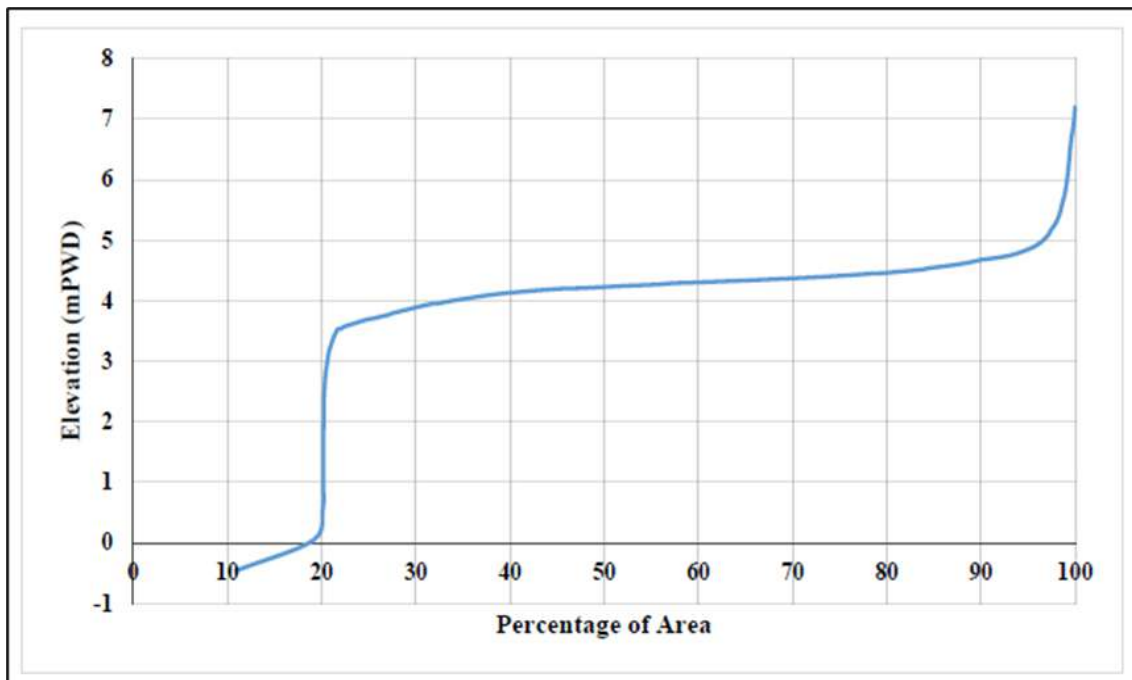


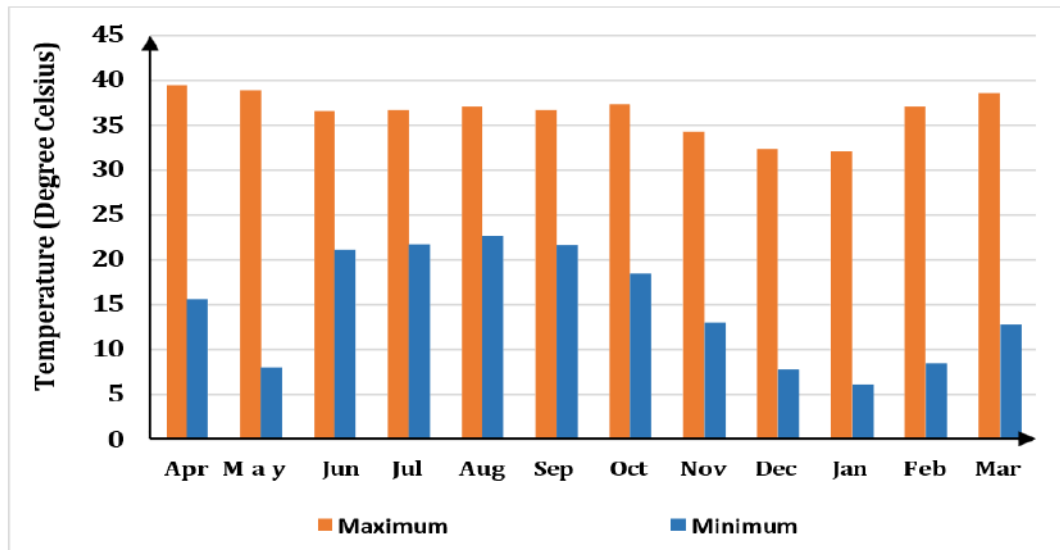
Figure 4.1: Area Elevation Curve of the Study Area

4.2.2 Climate and Meteorology

Bangladesh has a humid, warm climate influenced by pre-monsoon, monsoon and post-monsoon circulations and frequently experiences heavy precipitation and tropical cyclones. The substations and the transmission and distribution lines would be exposed to the climatic condition of the study area. For drawing the climatic and meteorological condition of the study area, various meteorological data like rainfall, temperature, relative humidity, wind speed, sunshine hours, and evapotranspiration were collected from Feni BMD station and evaporation data was collected from Cumilla BMD station, as data was not available. These stations are closest to the study area. The data were analyzed, and their status is discussed briefly in the following sections.

4.2.2.1 Temperature

The analysis of monthly average temperature data of the last 30 years (1992-2022) shows that the maximum temperature varies from 32°C to 39.4°C and April is the warmest month, while the minimum temperature varies from 6.1°C to 22.7°C and January is the coldest month. The monthly average of maximum and minimum temperatures of Feni station are shown in **Figure 4.2**.

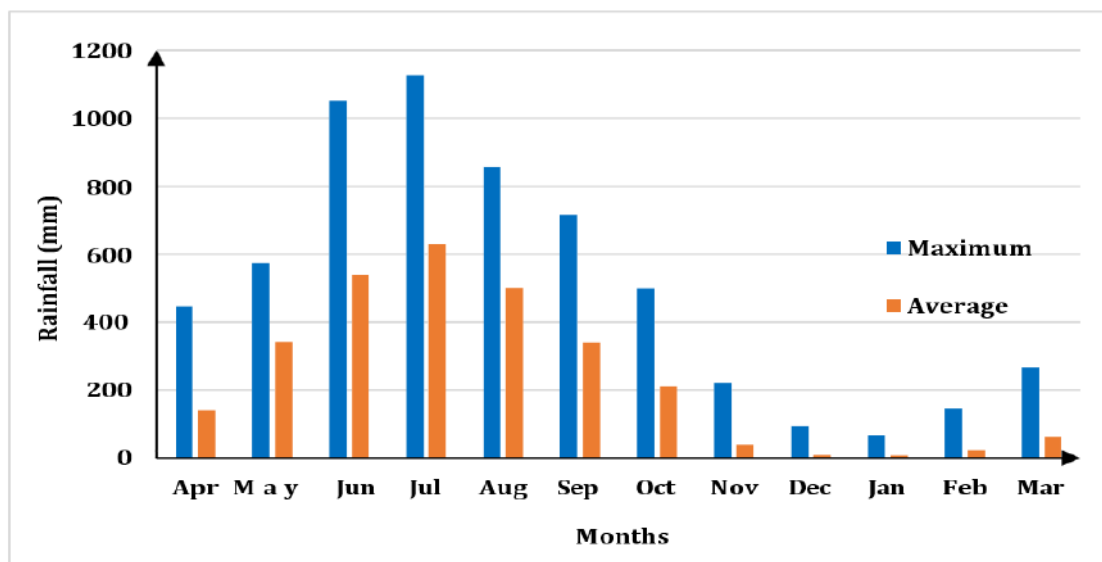


Source: Feni BMD Station (1992-2022)

Figure 4.2: Monthly Temperature (°C) at Feni BMD Station (1992-2022)

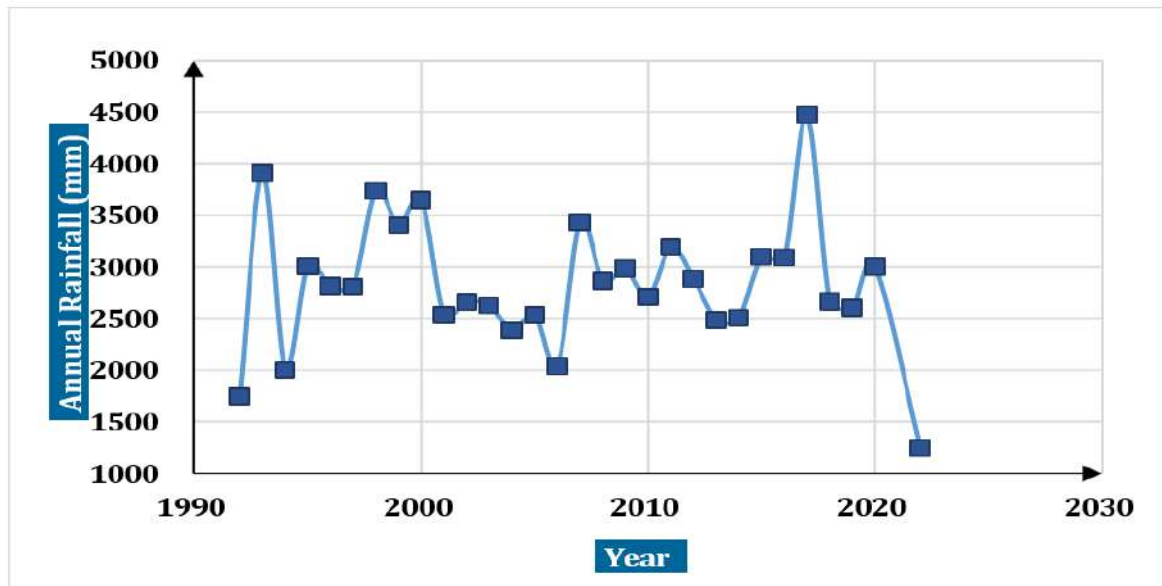
4.2.2.2 Rainfall

The monthly maximum and average rainfall data of the last 30 years (1992-2022) was collected, analyzed and shown in **Figure 4.3**. The analysis of data shows that the monthly average rainfall varies from 212 mm to 631 mm in monsoon and the area received the maximum of 1128 mm in July 2015. The historical maximum annual rainfall of this station was recorded as 4476 mm in 2017, minimum was 1251 mm in 2022, while the average is 2840 mm. The annual rainfall of this period is shown in **Figure 4.4**.



Source: Feni BMD Station (1992-2022)

Figure 4.3: Monthly Maximum and Average Rainfall at Feni BMD Station (1992-2022)

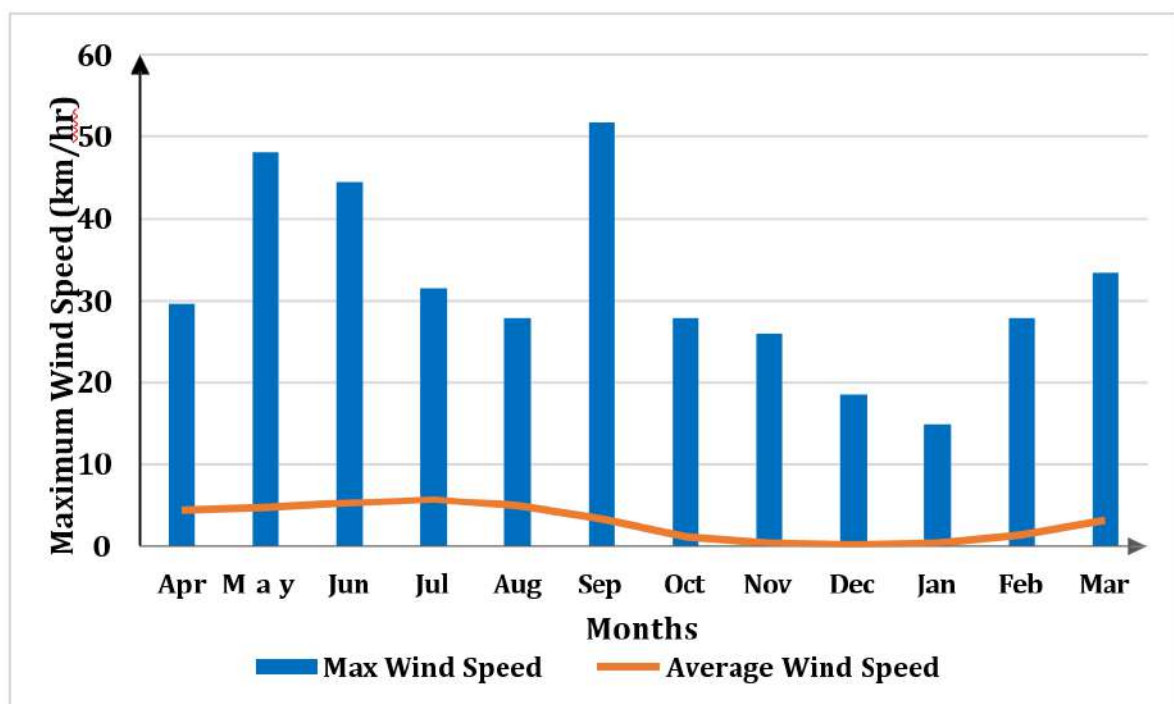


Source: Feni BMD Station (1992-2022)

Figure 4.4: Annual Rainfall at Feni BMD Station (1992-2022)

4.2.2.3 Wind Speed

The analysis of data of the maximum wind speed for the last 30 years (1992 to 2022) shows that the monthly maximum wind speed of 51.86 km/hour occurred in September 1997. On the other hand, the average maximum wind speed varies from 0.28 km/hour in December to 5.71 km/hour in July. The monthly maximum and average of maximum wind speeds are shown in **Figure 4.5**.

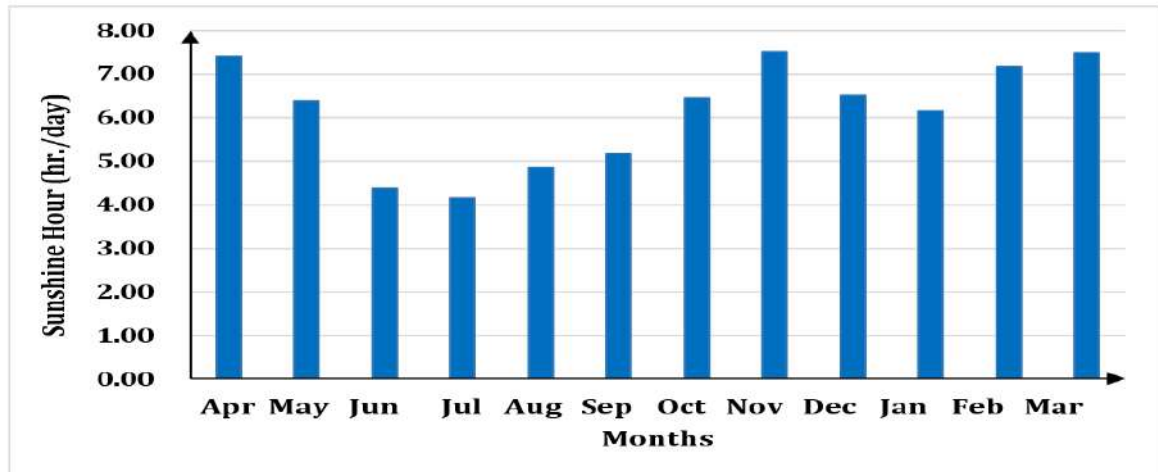


Source: Feni BMD Station (1992-2022)

Figure 4.5: Monthly Maximum and Average of Maximum Wind Speed at Feni BMD Station (1992-2022)

4.2.2.4 Sunshine Hours

The data of sunshine hours for the last 30 years' period (1992-2022) was collected and analyzed. It reveals from the analysis that the monthly average sunshine hour varies from a minimum of 4.15 hours/day in July to a maximum of 7.50 hours/day in November. The variation of monthly average sunshine hours is shown in **Figure 4.6**.

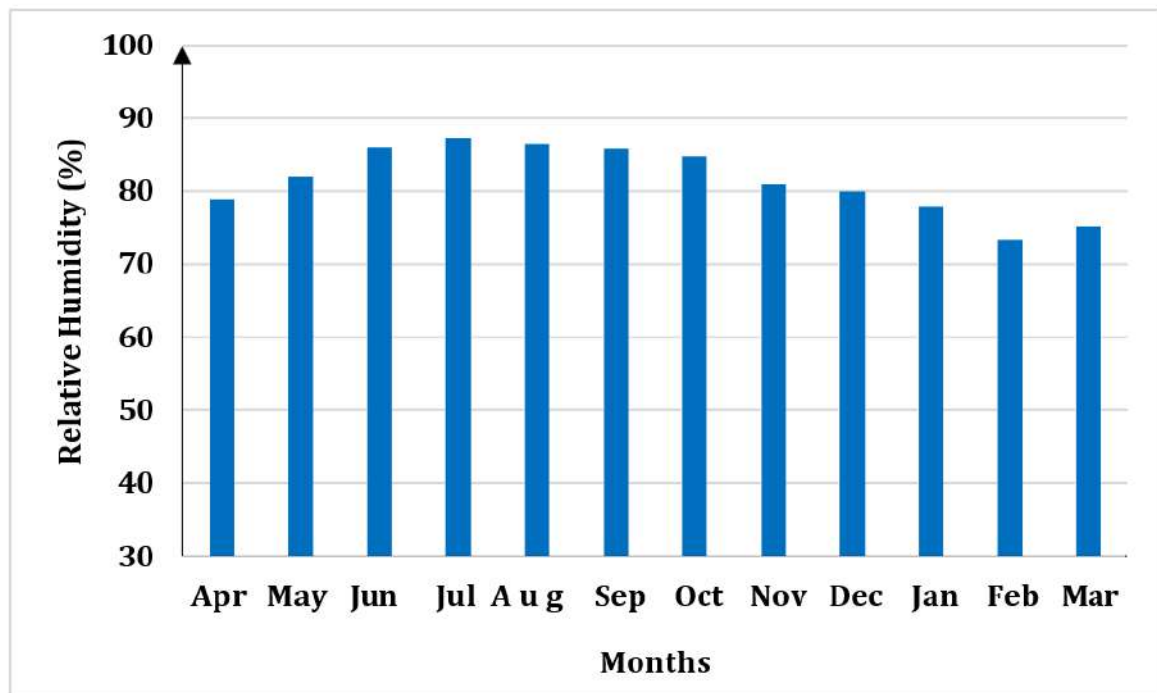


Source: Feni BMD Station (1992-2022)

Figure 4.6: Monthly Variation of Sunshine Hour at Feni BMD Station (1992-2022)

4.2.2.5 Relative Humidity (RH)

The analysis of the Relative Humidity (RH) data for the period from 1992 to 2022 indicates that the average RH varies seasonally from a minimum of 73.34% in February to a maximum of 87.27% in July. The variation of mean monthly RH data for the above period is shown in **Figure 4.8**.

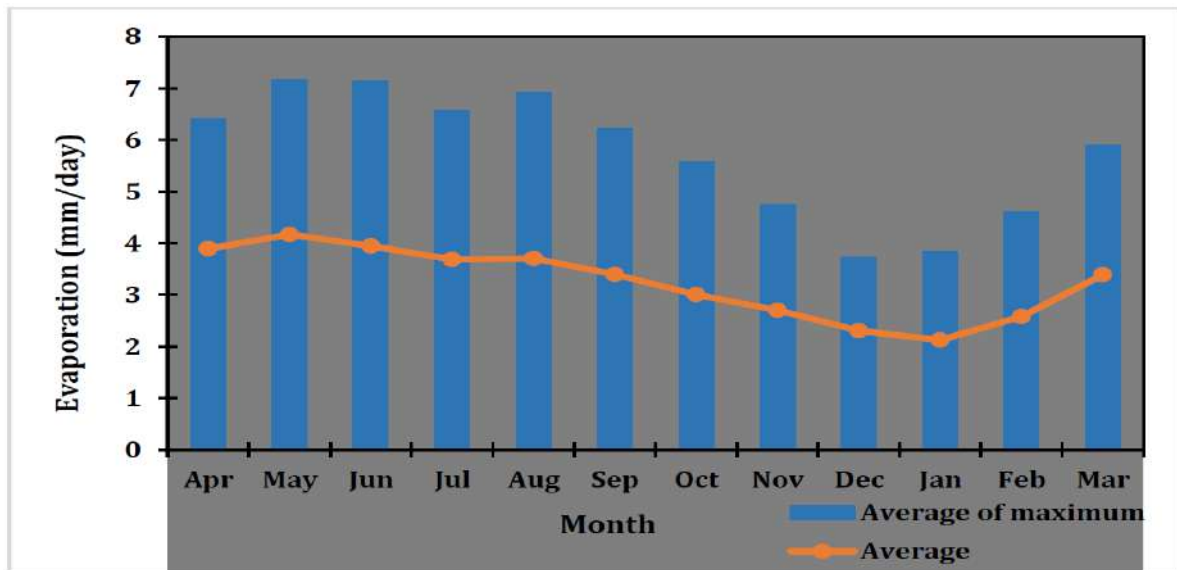


Source: Feni BMD Station (1992-2022)

Figure 4.7: Monthly Relative Humidity at Feni BMD Station (1992-2022)

4.2.2.6 Evaporation

The evaporation data was unavailable in the BMD station of Feni; hence data of Cumilla BMD Station was collected due to its closest proximity with the study area. The average maximum and average monthly evaporation data collected from BMD station at Cumilla for a 34 years' period (1986-2019) is shown in **Figure 4.8**. The data of 2012-2014 was not used due to their inconsistencies. It is observed that evaporation changes with increasing temperature. The average maximum evaporation in the area varies from 3.71 mm/day in December to 7.17 mm/day in May. On the other hand, the average of average evaporation varies from 2.13 mm/day in January to 4.17 mm/day in May.

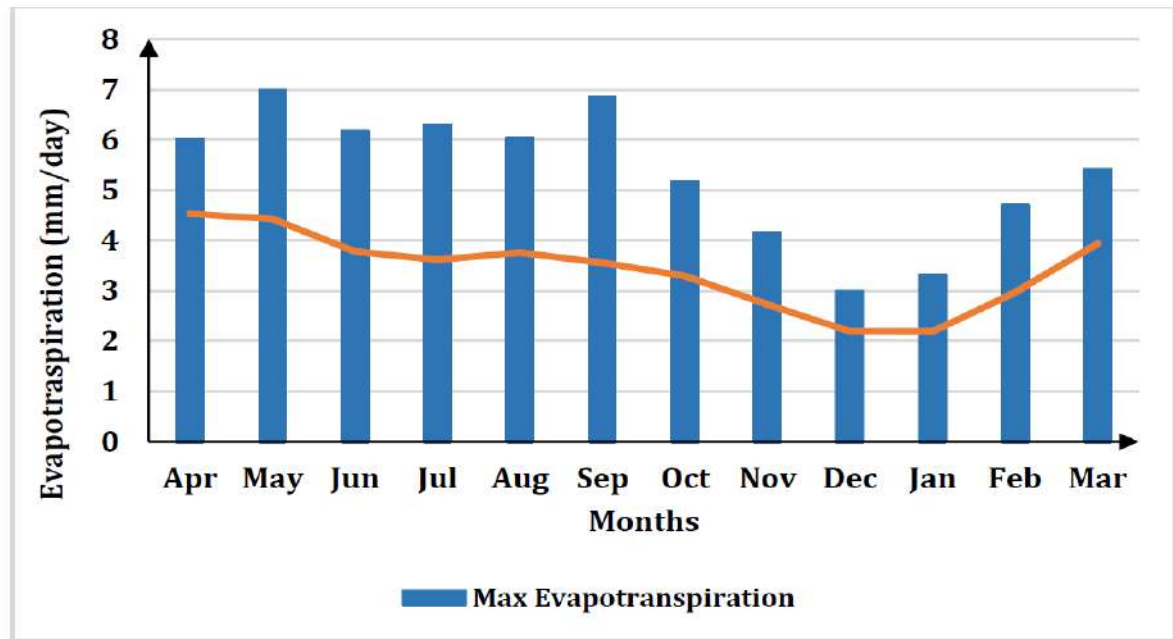


Source: Feni BMD Station (1992-2022)

Figure 4.8: Monthly Variation of Evaporation at Cumilla BMD Station (1983-2011)

4.2.2.7 Evapotranspiration (ET_o)

The maximum and average monthly ET_o data collected from the BMD station at Feni for the last 30 years (1992-2022) is shown in **Figure 4.9**. It is observed that evapotranspiration changes with the increase of temperature, and with the change of humidity and wind speed. The monthly average of maximum ET_o in the area varies from 2.99 mm/day in December to 7 mm/day in May. On the other hand, the average of average ET_o varies from 2.19 mm/day in December to 4.53 mm/day in April.



Source: Feni BMD Station (1992-2022)

Figure 4.9: Monthly Variation of Evapotranspiration at Feni BMD Station (1992-2022)

4.2.3 Environmental Quality

4.2.3.1 Air Quality

This section illustrates and interprets the local atmospheric characteristics of air quality which have been classified into two major criteria (i) Particulate Matters (PM₁₀ and PM_{2.5}), and (ii) Gaseous Pollutants (NO_x, SO₂, CO, and O₃). To assess the baseline condition of the ambient air shed, the monitored results were compared with national standards set by the Government of Bangladesh in the Air Pollution Control Rules, 2022, as well as with international standards, specifically the Sustainable Finance Framework of IsDB. However, in the absence of specific guidelines on Air quality the standards also compared with the World Bank Group (WBG) guidelines (IFC). These guidelines have been developed primarily with the aim of providing a basis for protecting public and ecological health from the adverse effects of air pollution.

The dispersion of air pollutants greatly depends on the emission sources, prevailing wind direction, and weather conditions, such as atmospheric stability, the height of the source, and barriers. Therefore, air quality monitoring was carried out continuously for 24 hours for all criteria pollutants at six (06) locations during March 2024, which is considered the end of the dry season, as well as during July, which is considered the wet season. The details of ambient air quality monitoring locations and results have been outlined in **Table 4.1** and **Table 4.2** respectively.

Table 4-1: Air Quality Monitoring Locations

Sl. No.	Location Name	Location Code	Geographic Location
1.	Adarsha gram Darul Ulum Madrasha, Sonagazi, Feni	AQ1	22°47'59"N 91°21'29"E
2.	Near to the Project Site, Sonagazi, Feni	AQ2	22°47'27"N 91°22'18"E

Sl. No.	Location Name	Location Code	Geographic Location
3.	Darul Ulum Ahmadia Madrasha, Bhuiya Bazar, Sonagazi, Feni	AQ3	22°48'11"N 91°22'53"E
4.	Purba borodhali, Bunia market, Sonagazi, Feni	AQ4	22°48'46"N 91°22'26"E
5.	Hafej lokman House, Madina Bazar, Sonagazi, Feni	AQ5	22°47'46"N 91°23'19"E
6.	Hazi Mustofa londoni Bari, Boroshali, sonagazi, Feni	AQ6	22°48'39"N 91°23'34"E

Table 4-2: Ambient Air Quality Monitoring Results

Sl. No.	Criteria Pollutants	Avg. Duration	Season	Location						Air Pollution Control Rules, 2022 (DoE, Bangladesh)	IFC, 2007
				AQ-1	AQ-2	AQ-3	AQ-4	AQ-5	AQ-6		
1	PM ₁₀ (µg/m ³)	24 hr.	Dry	49.42	80.91	46.93	29.93	25.57	34.50	150	150(IT-1)
			Wet	13.41	12.51	21.86	6.72	7.36	8.25		
2	PM _{2.5} (µg/m ³)	24 hr.	Dry	32.12	64.72	30.50	20.95	15.34	18.97	65	75(IT-1)
			Wet	8.72	7.88	15.08	3.7	4.12	6.19		
3	SPM(µg/m ³)	24 hr.	Dry	85.99	121.3	77.53	50.88	40.91	53.47	-	-
			Wet	15.78	16.68	27.33	9.46	8.98	12.13		
4	SO ₂ (µg/m ³)	24 hr.	Dry	22.58	10.37	14.15	7.84	5.22	6.41	80	125(IT-1)
			Wet	9.41	9.81	10.45	5.76	5.38	7.38		
5	NO ₂ (µg/m ³)	24 hr.	Dry	14.57	13.43	13.19	12.36	13.19	13.29	80	-
			Wet	18.31	18.46	13.1	9.09	12.25	10.89		
6	O ₃ (µg/m ³)	8 hr.	Dry	19.14	20.57	18.25	19.11	19.68	18.73	100	100(G)
			Wet	19.69	19.59	18.6	19.11	21.13	15.9		
7	CO (mg/m ³)	8 hr.	Dry	0.35	0.20	0.22	0.20	0.22	0.23	05	-
			Wet	1.4	0.27	0.291	0.221	0.79	0.365		

Note: IT- Interim Target; G- Guidelines; Source: Field Survey by CEGIS Team, March and July, 2024

From the air quality monitoring results presented in Table 4.2 it is evident that, concentration of all the criteria measured in and around the project site during both dry and wet season have been observed to be well within the compliance standard set by DoE and IFC.

4.2.3.2 Noise Level

Ambient noise levels were measured and recorded at 12 (twelve) pre-selected distinct locations around the study area twice daily (day and night) for a 1-hour (each time) using the portable ANSI Type II noise level meter. Different categories of zones mentioned in the Noise Pollution (Control) Rules, 2006 as well as the sensitive receptors in and around the project site, have been taken into consideration while selecting the monitoring sites. The noise monitoring locations are shown in **Figure 4.11**, and the monitoring results are shown in **Table 4.3**.

The monitoring results indicate that all the monitoring results of daytime are within acceptable limits except NL-2 (commercial), NL-5 (residential zone), and NL-8 (mixed zone). On the other hand, during the nighttime, noise levels at three locations NL-2 (commercial zone), NL-8 (mixed zone), and NL-11 (silent zone) have been found to exceed the national and IFC standards. The sites where exceedances were observed are located very close to the village road, local market and crowded labor colony.

Table 4-3: Noise Level Monitoring Results

ID	Locations	Coordinates	Noise Level dB(A)		Location Type	Noise Pollution Control Rules, 2006		IFC, 2007	
			Day	Night		Day	Night	Day	Night
NL-1	EGCB Office and Guest House, Sonagazi, Feni	21°50'43"N 90°05'30"E	65.2	53.5	Commercial	70	60	70	60
NL-2	Near to the Project Site, Sonagazi, Feni	22°13'10"N 90°16'16"E	73.2	65.4	Commercial	70	60	70	60
NL-3	Adarsha Gram School and College, Sonagazi, Feni	22°21'33"N 90°14'39"E	65.8	55.6	Commercial	70	60	70	60
NL-4	Al Madina Jame Mosque, Sonagazi, Feni	22°39'24"N 90°18'40"E	59.3	48.5	Mixed	60	50	60	50
NL-5	Kaji bari, Boro dholi, Sonagazi, Feni	22°43'43"N 90°17'21"E	57.2	45.1	Residential	55	45	55	45
NL-6	Hafej lokman House, Madina Bazar, Sonagazi, Feni	22°48'22"N 90°11'51"E	55.7	41.3	Mixed	60	50	60	50
NL-7	Char chandia, Sonagazi, Feni	22°51'19"N 90°10'41"E	51.3	43.2	Residential	55	45	55	45
NL-8	Panjekhana Mosque, Char Chandia, Sonagazi	22°53'32"N 90°04'41"E	63.8	54.6	Mixed	60	50	60	50
NL-9	Makka Bazar, sonagazi, Feni	22°54'27"N 89°57'54"E	65.7	55.1	Commercial	70	60	70	60

ID	Locations	Coordinates	Noise Level dB(A)		Location Type	Noise Pollution Control Rules, 2006		IFC, 2007	
			Day	Night		Day	Night	Day	Night
NL-10	Aziz Master Bari, Sonagazi, Feni	22°54'27"N 89°45'14"E	52.2	42.5	Residential	55	45	55	45
NL-11	Muktijudda Jame Mosque, Char chandia, Sonagazi, Feni	22°47'03"N 89°27'45"E	50.2	45.2	Silent	50	40	50	40
NL-12	Inside the Project, Sonagazi, Feni	22°52'06"N 89°29'41"E	46.4	40.1	Silent	50	40	50	40

Source: Field Survey and Data Collection March 2024

Note: Shaded values show exceedances from the respective standards

4.2.3.3 Vibration

Vibration consists of rapidly fluctuating motions of the particles without any net movement. Objects can vibrate differently in three mutually independent directions, which are vertical, horizontal and lateral. It is common to describe vibration levels in terms of velocity, which represent the instantaneous speed at a point on the object that is displaced. Vibrations are transmitted from the source to the ground and propagate through the ground to the receiver.

Measuring the peak particle velocity (PPV) is mostly used for representation of vibrating situation when the pressure wave passes through the particles. Soil conditions have a strong influence on the level of ground-borne vibration. The PPVs are usually expressed in terms of m/s or mm/s. The PPVs were measured in the study area (**Table 4.4**). The Kanomax machine (model 4200) was used to directly obtain the value during field visit.

Table 4-4: Vibration Levels in the Study Area

SL	Location	Sampling code	GPS Point	Vibration (mm/s)
1	EGCB 75 MW Solar near SS Area	VL-01	22°47'25.36"N 91°22'50.58"E	0.53
2	EGCB rest house	VL-02	22°47'27.53"N 91°22'19.08"E	0.37
3	Proposed PP inside study area	VL-03	22°47'26.90"N 91°23'20.98"E	0.20
4	Chor Chandia settlement area	VL-04	22°47'50.83"N 91°23'10.81"E	0.12
5	Adrashogram settlement area	VL-05	22°47'57.02"N 91°21'39.98"E	0.06
6	Madinabazar Settlement area	VL-06	22°48'11.36"N 91°22'43.03"E	0.05

Table 4-5: Magnitude of Impact from Vibration Levels (Human Response)

SL. No.	Vibration Level, PPV	Effect	Magnitude of impact
01	0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration	Negligible / No Change
02	0.3 mm/s	Vibration might just be perceptible in residential environments.	Minor
03	1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if warning and explanation has been given to residents.	Moderate
04	10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure of this level	Major

Source: British Standard BS5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration

Humans are known to be highly sensitive to vibration, with the typical threshold of perception in the PPV range being from 0.14 to 0.3 mm/s (British Standard BS 5228-2:2009). The table presented above shows that the vibration levels in most locations of the study area are below the PPV range of human perception, except at two locations, VL-01 and VL-03 (still significantly less than the moderate level). At these locations, the operation of rotating machines such as generators, motors, pumps, and fans were observed in the existing 75 MW EGCB Power Plant while measuring vibration levels. Additionally, heavy vehicular movement on the road and ongoing construction work in these locations could contribute to the comparatively high (still less than the moderate level) vibration levels observed compared to other locations.

4.2.3.4 Water Quality

Surface and ground water samples were collected from a total of (04) four locations of the study area. Sampling locations of surface and ground water are shown in **Table 4.6 & Figure 4.10**. The samples were tested and analyzed to determine the physico-chemical status of both the surface and ground water in order to get an idea about the baseline condition of water quality of the study area. Afterwards, the test results were compared with National Standard of Environment Conservation Rules (ECR), 2023-Schedule 2 (a) inland surface water, ECR-Schedule-2(b) drinking water standard as well as IFC standards to identify if there is any exceedance. The details of the analysis methods are presented in **Table 4.7**.

Table 4-6: Surface and Ground Water Quality Sampling Location in and Around the Project Area

Sl. No.	Sampling Location	Sampling Code	GPS	Type of Source
1.	Near project site channel, Sonagazi, Feni	SW1	22°47'03"N 91°22'32"E	River
2.	Inside the project area channel, Sonagazi, Feni	SW2	22°47'08"N 91°23'21"E	River
3.	Near to the Project Site, Sonagazi, Feni	GW1	22°47'20"N 91°21'51"E	Tube well
4.	Purba borodhali, Madina Bazar, Sonagazi, Feni	GW2	22°47'59"N 91°23'03"E	Tube well

Source: EGCB, ESIA Study, October 2024

Table 4-7: Method for Water Quality Parameters Analysis

Sl. No.	Parameters	Unit	Analysis Method
1.	pH	-	Electrometric
2.	Temperature	°C	Temperature Sensor
3.	Total Dissolved Solid (TDS)	mg/l	Conductivity
4.	Electrical Conductibility (EC)	µS/cm	Conductivity
5.	Turbidity	NTU	Nephelometric
6.	Salinity	ppt	Conductivity
7.	Dissolved Oxygen (DO)	mg/l	Electrochemical
8.	Total Suspended Solids (TSS)	mg/l	UV-VIS
9.	BOD	ppm	5 days Incubation
10.	COD	ppm	Closed Reflux Method (CRM)
11.	Total hardness	mg/l	Titrimetric
12.	Total alkalinity	mg/l	Titrimetric
13.	Chloride	mg/l	APHA
14.	Sulphate	ppm	UV-VIS
15.	Nitrate (NO ³⁻)	ppm	UV-VIS
16.	Phosphate (PO ₄ ³⁻)	ppm	UV-VIS
17.	Fluoride	ppm	UV-VIS
18.	Sodium	mg/l	AAS
19.	Potassium	mg/l	AAS
20.	Total nitrogen	mg/l	APHA
21.	Total phosphorus	mg/l	APHA
22.	Phenol	mg/l	APHA
23.	Cd	Mg/l	APHA
24.	Ni	ppm	UV-VIS
25.	Mn	ppm	UV-VIS
26.	Arsenic (As)	mg/l	AAS
27.	Mercury (Hg)	mg/l	APHA
28.	Cr+6	ppm	UV-VIS
29.	Lead (Pb)	mg/l	APHA
30.	Fe	ppm	UV-VIS
31.	Cu	ppm	UV-VIS
32.	Zn	mg/l	APHA
33.	Total Coliform	N/100ml	Membrane Filtration Method (MFM)
34.	Faecal Coliform	N/100ml	Membrane Filtration Method (MFM)
35.	Ammonia	mg/l	UVS
36.	Colour	Hazen	UVS
37.	Barium	mg/l	AAS
38.	Boron	mg/l	UVS
39.	Calcium (Ca)	mg/l	AAS
40.	Magnesium (Mg)	mg/l	AAS

Sl. No.	Parameters	Unit	Analysis Method
41.	Anionic detergents	mg/l	APHA (24 Edition), 5540 C
42.	Chloramines	mg/l	IS 3025 (Part 26)-1986; Rffm:2003_(O)
43.	Sulphide	mg/l	APHA (24 Edition), 4500 S2-D
44.	Total chromium	mg/l	APHA
45.	Cyanide	mg/l	In-house
46.	Mineral Oil	mg/l	APHA
47.	Phenolic Compounds	mg/l	APHA
48.	Free Residual Chlorine	mg/l	Titrimetric
49.	Odour	-	In-house
50.	Taste	-	In-house
51.	Aluminum	mg/l	APHA

4.2.3.5 Surface water quality

The surface water quality test results presented in the **Table 4.8** indicate that they are well within the acceptable limits as compared to the National and International standards except BOD and COD at both the locations and Nitrate at SW1. High concentration of BOD and Nitrate indicates that high volume of organic matter is present in the surface water. Due to heavy rainfall in the study area during the sampling period is most likely the reason behind increased runoff of organic material, decayed plant's residuals, debris, pollutants etc. from the adjacent agricultural land. All these reasons cumulatively could be the possible reason behind high concentration of the said parameters in the surface water.

Table 4-8: Surface Water Quality Test Results

Sl. No.	WQ Parameters	Unit	SW1	SW2	Bangladesh Standard, (Schedule-2), ECR, 2023	IFC, 2007
1.	pH	-	8.3	8.56	6-9	6-9
2.	Temperature	°C	31.5	29.3	-	-
3.	Total Dissolved Solid (TDS)	mg/l	5000	4000	1000	-
4.	Electrical Conductibility (EC)	µS/cm	9660	6910	-	-
5.	Turbidity	NTU	105	550	-	-
6.	Salinity	ppt	5.4	3.8	-	-
7.	Dissolved Oxygen (DO)	mg/l	7.17	5.92	5 or more	-
8.	Total Suspended Solids (TSS)	mg/l	366.6	266.6		
9.	BOD	ppm	96	88	6 or less	
10.	COD	ppm	456	440	50	
11.	Total hardness	mg/l	3600	2200	200-500	
12.	Total alkalinity	mg/l	500	200		
13.	Chloride	mg/l	13.9	9.94		
14.	Sulphate	ppm	228.8	220.6		
15.	Nitrate (NO ³⁻)	ppm	8.9	3.3	7.0	-
16.	Fluoride	ppm	1.2	0.89		
17.	Sodium	mg/l	2512	1578		
18.	Potassium	mg/l	127	131		

Sl. No.	WQ Parameters	Unit	SW1	SW2	Bangladesh Standard, (Schedule-2), ECR, 2023	IFC, 2007
19.	Total nitrogen	mg/l	1.5	13.4		
20.	Total phosphorus	mg/l	<0.5	<0.5		
21.	Phenol	mg/l	<0.1	<0.1		
22.	Cd	Mg/l	<0.001	<0.001		
23.	Ni	ppm	MDL	MDL		
24.	Mn	ppm	MDL	MDL		
25.	Arsenic (As)	mg/l	0.001	0.004		
26.	Mercury (Hg)	mg/l	<0.001	<0.001	0.004	
27.	Cr+6	ppm	0.0035	0.0045		
28.	Lead (Pb)	mg/l	<0.01	<0.01	0.1	
29.	Fe	ppm	1.7	3.8		
30.	Cu	ppm	0.67	1.06		
31.	Zn	mg/l	0.03	0.03		
32.	Total Coliform	N/100ml	136	164		
33.	Faecal Coliform	N/100ml	64	80		

4.2.3.6 Groundwater quality

Ground water quality test results have been presented in **Table 4.9** and compared with National standard (ECR, 2023) and International Standard (IFC, 2007). The findings indicate that the ground water quality parameters are consistent as compared to the National and International standards except Copper, Iron and Manganese. Land development activity near the project site study area might be the potential sources of manganese in local groundwater.

Table 4-9: Ground Water Quality Test Results

Sl. No.	WQ Parameters	Unit	GW1	GW2	(Schedule-2), ECR, 2023	IFC, 2007
1.	pH		7.5	6.76	6.5-8.5	6.5-8.5
2.	Total Dissolved Solid (TDS)	mg/l	130	400	1000	-
3.	Salinity	ppt	0.1	0.3	-	-
4.	Turbidity	NTU	0	0	5	-
5.	Nitrate (NO ³⁻)	ppm	1.03	2	45	50
6.	Phosphate (PO ₄ ³⁻)	ppm	1.2	0.81	6	-
7.	Arsenic (As)	ppm	0.001	0.019	0.05	
8.	Ammonia	mg/l	0.30	0.26	1.5	
9.	Colour	Hazen	1.6	2	15	
10.	Odour		agreeable	agreeable		
11.	Taste		unobjectionable	unobjectionable		
12.	Aluminium	mg/l	<0.03	<0.03	0.20	
13.	Anionic detergents	mg/l	<0.02	<0.02	0.2	
14.	Barium	mg/l	0.09	0.08	0.7	
15.	Boron	mg/l	0.23	0.21	1	

Sl. No.	WQ Parameters	Unit	GW1	GW2	(Schedule-2), ECR, 2023	IFC, 2007
16.	Calcium (Ca)	mg/l	22	42	75	
17.	Chloramines		<0.3	<0.3		
18.	Chlorides	mg/l	3.59	119	250	
19.	Copper (Cu)	ppm	1.7	2.22	1.5	
20.	Fluoride	ppm	0.1	0.03	1	
21.	Free Residual Chlorine	mg/l	<0.2	<0.2	0.20	
22.	Iron (Fe)	ppm	1.1	0.61	0.3-1.0	-
23.	Magnesium	mg/l	17	68	30-35	
24.	Manganese (Mn)	ppm	2.11	2.18	0.4	
25.	Mineral Oil	mg/l	<2.0	<2.0		
26.	Nitrate	mg/l	1.03	2	45	
27.	Phenolic Compounds	mg/l	<0.1	<0.1	0.002	
28.	Sulphate	ppm	0.9	8.3	250	
29.	Sulphide	mg/l	<0.1	<0.1	0.05	
30.	Total Alkalinity	mg/l	210	293	-	
31.	Total Hardness	mg/l	230	480	200-500	
32.	Zinc (Zn)	mg/l	0.03	0.03	5	
33.	Cyanide	mg/l	Not detectable	Not detectable	0.05	
34.	Lead (Pb)	mg/l	<0.01	<0.01	0.01	
35.	Cadmium (Cd)	mg/l	<0.001	<0.001	0.003	
36.	Mercury (Hg)	mg/l	<0.001	<0.001	0.001	
37.	Polychlorinated biphenyls	μ/l	Not detectable	Not detectable		
38.	Polynuclear Aromatic Hydrocarbons	μ/l	Not detectable	Not detectable		
39.	Total chromium	mg/l	<0.005	<0.005	0.05	
40.	Total Coliform	CFU/ 100ml	0	0	0	
41.	Faecal Coliform	CFU/100ml	0	0	0	

4.2.3.7 Soil Quality

Soil quality is the basic indicator for crop production. According to Upazila Nirdeshika of SRDI, general fertility level of soil is low to medium with very low to low in Nitrogen (N). Phosphorus (P) status is low to high, and Potassium (K) status is low to very high. The Sulfur (S) status is low to medium. There were four number soil samples collected from the Power plant, TL and Study area in the month of April, 2024 and random sampling method was followed to eliminate the tendency of biasing. Soil texture, Soil reaction (pH), Electrical Conductivity (EC), Organic Matter (OM), Nitrogen (N), Phosphorus(P), Sulfur (S), Potassium (K), Magnesium (Mg) and Calcium (Ca) were analyzed in the Soil Resource Development Institute (SRDI) laboratory in Dhaka. But, other parameter Sodium (Na), Chlorine (Cl), Florin (Fl), Cation Exchange Capacity (CEC), Porosity, Permeability and Infiltration were analyzed in the laboratory of Dhaka University. Soil sampling location is presented in **Table 4-10**.

Table 4-10: Soil Sampling Location of the Power plant, TL and Study Area

S.L	Sampling Location	GPS Co-ordinates		Sample depth (cm)
1	Boro Douli, Sonagazi, Feni	22° 48' 24.05'' N	91° 22' 50.845'' E	0-15
2	Purbo Boro Douli, Sonagazi	22° 47' 30.94'' N	91° 22' 21.136'' E	
3	Char Chandia	22° 47' 11.75'' N	91° 23' 10.970'' E	
4	Boro Douli, Sonagazi	22° 47' 08.03'' N	91° 22' 59.860'' E	

Source: Field information, April, 2024

Soil pH is the most important factor in the nutrient available of soils. The pH values of the studied area varied from 7.2 to 8.4 which is the soils are neutral to slightly alkaline and within acceptable limits. The Organic Matter (OM %) contents range from 0.87 to 1.38, which corresponds very low to low level of organic contents (≤ 1.0 -3.7%) in all locations (FRG, 2018). A good soil should have at least 2.5% organic matter, but in Bangladesh most of the soil has less than 1.5%, and some soil possess even less than 1% organic matter (BARC, 2005; SRDI, 1985). The EC value ranges from 0.57 to 0.93 ds/m. According to the SRDI, (2003); BARC, (2005) and Chowdhury et al. (2011) the standard value of EC as non-saline is (0–2 ds/m). It indicates that all locations' soil is non saline. The Nitrogen (N) level was found to vary from 0.09% to 0.13%, which is considered to low nutrient content. Potassium (K) contents were found within the range of 0.32 to 0.38(meq/100g) at all the locations, which exhibits optimum to high. The concentration of Phosphorus (P) was within a range of 4.33 to 7.25(ppm) which is considered as very low to low content. The Sulphur (S) contents of soil were found within the range of 89.10 to 104.10 (ppm), which is considered as critical limits. The Calcium (Ca) contents were found within the range of 7.04 to 8.61(meq/100g) which is considered as high to very high, but Magnesium (Mg) content was found within the range of 7.86 to 10.81(meq/100g) which is considered as critical limits. However, other parameters such as Sodium (Na:0.15 to 0.23%), Chlorine (Cl:293.75 to 430.50 ppm), Florin (Fl:157.41 to 230.69 ppm), Cation Exchange Capacity (CEC:4.21 to 5.07 meq/100g), Porosity (45.00 to 51.38 %), Permeability (0.466 to 19.94 cm/hr.) and Infiltration (9.0 to 10.0 mm/hr.) are commonly found in all the locations. Location specific soil quality information is presented in **Table 4.11**.

Table 4-11: Soil Quality (Analyzed) of the Power Plant, TL and Study Area

Sample	Texture	pH	EC (ds/m)	OM	N	Na	P	S	Chlorine	Fluorine	K	Ca	Mg	CEC	Porosity	Permeability	Infiltration
				%			ppm				mg/100g soil				%	(cm/hr)	(mm/hr)
1	Sand: 4.74% Silt: 92.69% Clay: 2.57%	8.1	0.93	0.87	0.09	0.20	5.52	89.10	334.27	179.12	0.32	7.04	9.46	4.31	48.90	19.94	10.0
2	Sand: 8.44% Silt: 68.67% Clay: 12.89%	8.4	0.81	1.27	0.12	0.23	6.02	102.25	369.72	198.12	0.38	8.42	10.11	4.21	45.00	0.533	9.0
3	Sand: 7.70% Silt: 68.57% Clay: 23.73%	7.9	0.87	1.19	0.12	0.17	7.25	92.77	430.50	230.69	0.35	7.48	10.81	5.07	46.55	16.28	9.0
4	Sand: 7.60% Silt: 89.76% Clay: 2.64%	7.2	0.57	1.38	0.13	0.15	4.33	104.10	293.75	157.41	0.37	8.61	7.86	4.86	51.38	0.466	10.0

Source: Divisional laboratory of the SRDI, Dhaka and laboratory of Soil, Water and Environment division, Dhaka University

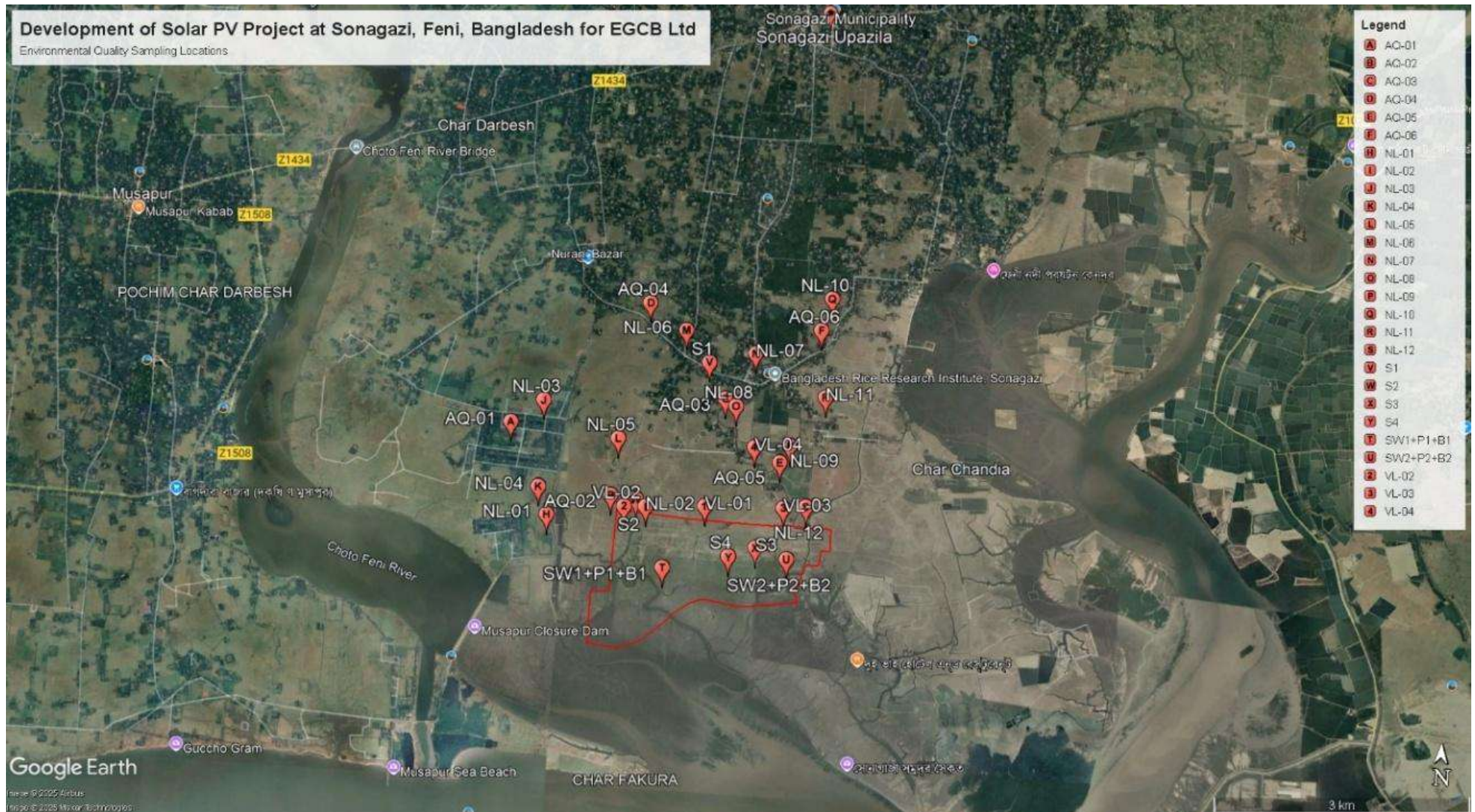
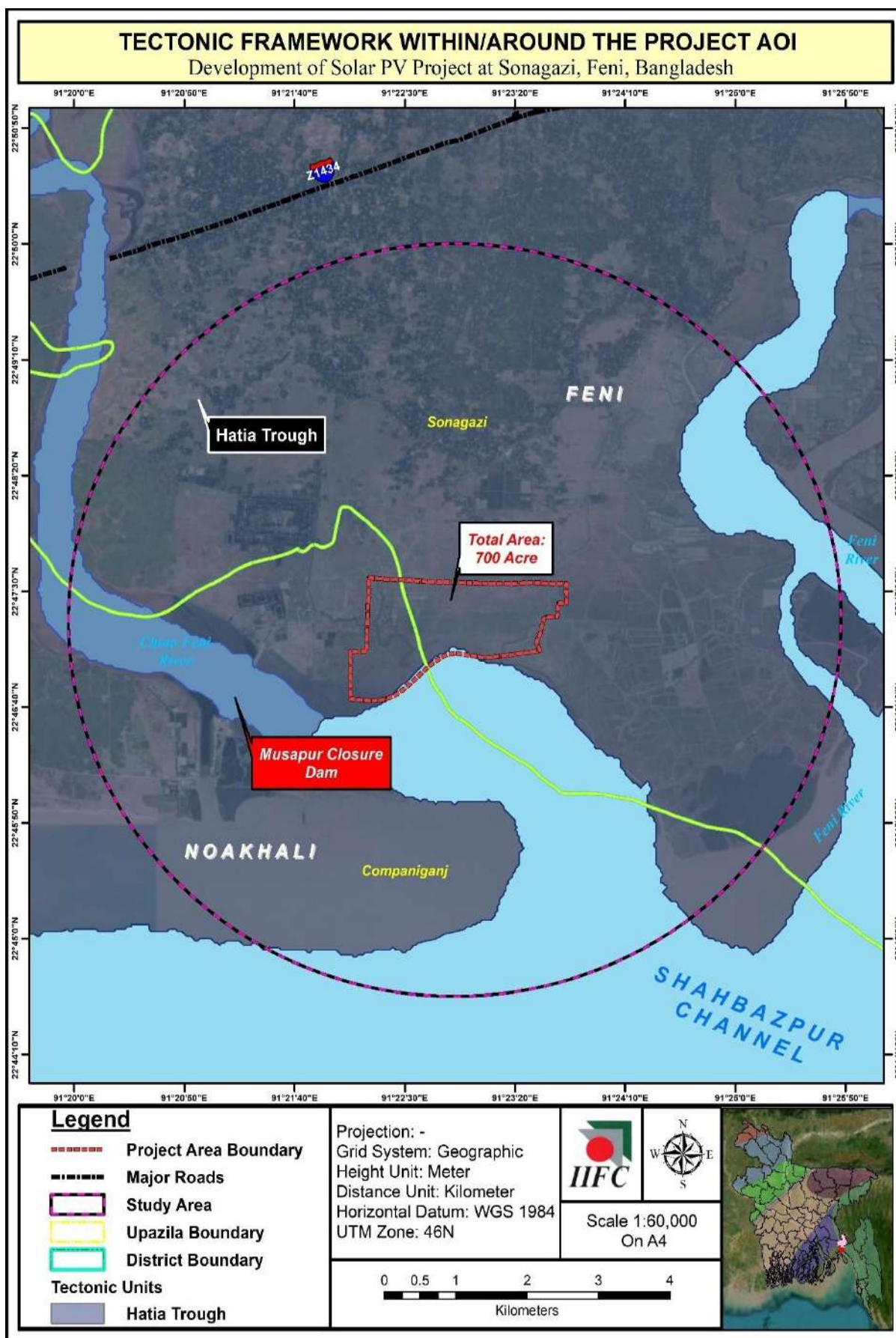


Figure 4.10: Environmental Quality Sampling Locations

4.2.4 Geological Settings

4.2.4.1 Tectonic Setting

Bangladesh is a part of Bengal Basin. The frequent tectonic activities among the Indian, Tibetan (Eurasian) and Burmese (West Burma Block) Plates have made the Bengal Basin dynamic in nature. A major collision of the Indian plate with South Tibet and Burma plates took place in the Early Miocene, and rapid uplift occurred in the Himalayas and Tibet. At the same time, a major up thrust movement occurred along the Dauki Fault resulting in separation of the Sylhet Trough from the stable shelf, and the Trough formed an important sediment deposition hub. However, subsurface geophysical characteristics of Bangladesh has divided the country into nine major tectonic units- the Himalayan Fore Deep, Rangpur Platform, Bogura Shelf, Calcutta-Mymensingh Hinge zone, Faridpur Trough, Sylhet Trough, Barisal Gravity High, Hatiya Trough and Indo-Burman Ranges. The study area falls under Hatiya trough. The Hatiya Trough of the Bengal Basin is located in the southeastern part of the basin and forms the outermost part of the west-propagating Chattogram Tripura Fold Belt (CTFB), situated in between CTFB to the east and the Barisal High to the west (**Figure 4.11**) The base of this tectonic element is formed by oceanic crust of the Indian Plate. This tectonic element represents the deepest trough of the Bengal Foredeep Basin and has received the highest accretion of clastic sediments. Sediment thickness in the Hatiya Trough exceeds 18 km, and beneath this sediment, the Indian Plate is not more than 16 km thick. The Himalaya forms the dominant source for the Late Neogene-Recent sediments in the Hatiya Trough. Data from the Shahbazpur 1 well in the Hatiya Trough indicate the presence of more than 2000 m of Plio-Pleistocene sediments overlain by 480 m thick Holocene sediments. As in Faridpur Trough, the more or less flat and tectonically less disturbed Moho has also been observed at 31–32 km depth beneath this tectonic element (Khan and Agarwal 1993; Singh et al. 2016). Guha et al. (2010) claimed that the axis of the Bengal Foredeep runs through the apex of this tectonic element. Char Kajal, Shahbazpur, Kutubdia/Magnama, Sangu and a number of offshore anticlinal structures are located in this tectonic element, of which Sangu and Shahbazpur yield hydrocarbons. Recently obtained GPS derived geodetic data suggest variable subsidence rate for the Hatiya Trough (Reitz et al. 2015). The northern onshore part of this tectonic element (in Raipur, Noakhali) shows lower subsidence rate (*3 mm/year) than the southern offshore part far from the Magnama structure (*5 mm/year).



4.2.4.2 Surface and Subsurface Lithology

The surface geological exposure of the study area is tidal deltaic deposit of recent to subrecent period. A general subsurface lithological succession of the study area is given in **Table 4-12**.

Table 4-12: A Generalized Stratigraphic Succession (Tectonic Province-2 of Bengal Basin) of the Study Area

Age (Appx)	Group	Formation	Lithology	Max Thick. (m)	Depositional Ent.	Tectonic Events
Holocene		Alluvium		3350	Fluvial	Folding in the eastern Bengal Basin
Pleistocene	Dihing	Dihing	Poorly consolidated sandstone and clayey sandstone		Fluvial	
Late Pliocene	Dupi Tila	Upper	Medium to coarse ferruginous sandstone with layers of quartz pebbles and siltstone with lignitic fragments and petrified wood.			
		Lower Dupi Tila				
Mid Pliocene		Girujan Clay	Clay and Siltstone	3500	Alluvial	
	Tipam	Tipam Sandstone	Coarse-grained, pebbly, cross bedded sandstone.			
Early Pliocene Miocene	Surma	Upper Marine Shale	Shale	3900	Fluvial	Uplift of the Himalayas.
		Bokabil	Dark grey pyrite bearing shale, sandy shale, siltstone and, Sandstone		tidal-deltaic	Orogeny Subduction and folding
		Bhuban	Sandstone and sandy shale, siltstone		estuarine	
Oligocene	Barail	Unidentified Barail	Pale grey, multi-colored, fine grained sandstone and siltstone, grey carbonaceous siltstone and silty sandstone and shale	7200	Shallow marine to basinal shale	Hard collision, closing of the Eurasian Tethys
Eocene Paleocene	Jainta	Koili Shale	Sandstone, glauconitic shale, carbonaceous and highly fossiliferous limestone; calcareous sandstone, carbonaceous shale and coal seams		Shelf edge Limestone	Soft collision Northward movement of India and sea- floor spreading
		Sylhet Limestone				
		Tura Sandstone			Marginal part of the shelf	
Pre- Paleocene	Undifferentiated sedimentary rocks with some volcanics?		Medium to coarse grained sandstone			

Source: Modified after Evans (1964), Holtrop and Keizer (1970), Khan et al. (1988), Hiller and Elahi (1988), Khan (1991a, b) Reimann (1993), Shamsuddin et al. (2001) and Alam et al. (2003)

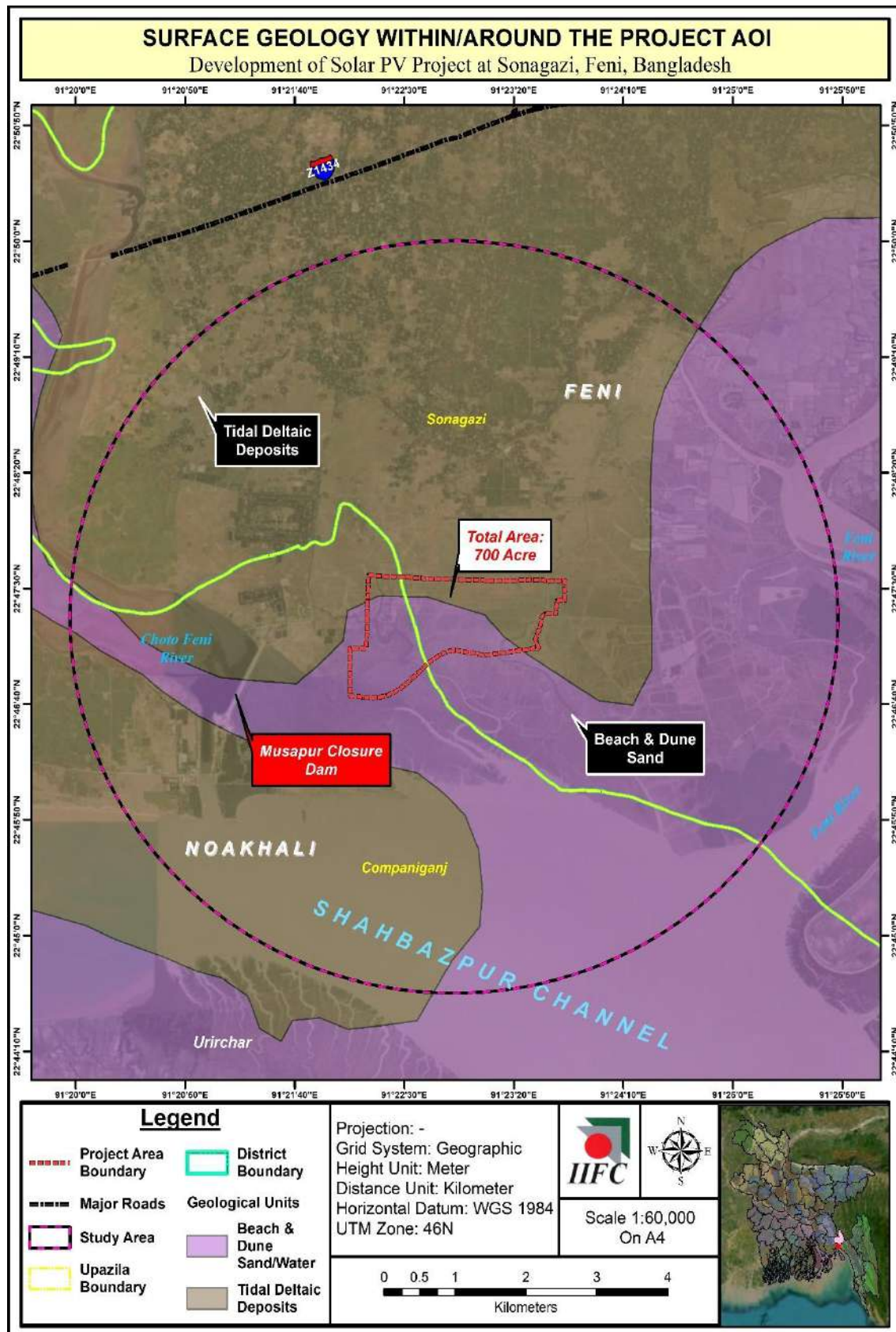


Figure 4.12: Surface Geological Units of the Study Area

4.2.4.3 *Physiography of the study area*

In the context of physiography, Bangladesh may be classified into three distinct physiographic regions-

- (a) floodplain areas,
- (b) terraces, and
- (c) hills.

Each of the units has distinguishing characteristics that make each unit unique from others. Physiographically, almost 95 % of the study area falls under Young Meghna Estuarine Floodplain. The remaining part of the study area falls under Chattogram Coastal plain (**Figure 4.13**). Hundred percent of the project area falls under Young Meghna Estuarine Floodplain. The Young Meghna Estuarine Floodplain occupies almost level land within and adjoining the Meghna estuary. It includes both island and mainland areas. Flooding by salt water occurs mainly on the land margins and during exceptionally high tides in the monsoon, when storm surges are associated with tropical cyclones.

New deposition and erosion are constantly taking place on the margins, continuously altering the shape of the land areas. The sediments are deep silts, which are finally stratified and slightly calcareous. In many, but not in all parts, the soil surface becomes saline to varying degrees in the dry season. Seasonal flooding is mainly shallow, but fluctuates tidally, mainly by rainwater or non-saline river water. On the other hand, the Chattogram Coastal Plain along the coast extends from the Feni River to the Matamuhuri delta, a distance of 121 km. 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 young estuarine floodplain in the north, adjoining the Young Meghna Estuarine Floodplain, and sandy beach ridges adjoining the coast in the south. Sediments near the hills are mainly silty, locally sandy, with more extensive clays in floodplain basins. The whole of the mainland area is subjected to flash floods. Flooding is mainly shallow and fluctuates in depth with them. The average daily rise in the tide is about two meters. Some soils on tidal and estuarine floodplains become saline in the dry season.

4.2.4.4 *Seismicity*

Analysis of earthquake hazard is more regional concern than that of local. For example, an earthquake occurred in Nepal may cause damage to Bangladesh. So, regional earthquake analysis is necessary to predict any earthquake hazard in Bangladesh. According to Bangladesh National Building Code (BNBC), 2020; whole land area of Bangladesh has been divided into four seismic zones (**Figure 4.14**). The zone coefficients (Z) for four zones respectively are: Z= 0.12 (Zone-I), Z= 0.20 (Zone-II), Z=0.28 (Zone-III) and Z= 0.36 (Zone-IV). The study area is situated under earthquake Zone II (**Figure 4.14**). This zone belongs to mid-level of seismic vulnerability with respect to Bangladesh point of view. It is known that seismic zone co-efficient is considered to provide adequate earthquake resistance for the structure. If any civil structure is designed in the study area with a seismic coefficient of Z equal to 0.20, then according to the relationship between Z values and the Richter Scale, the structure should be designed in such a way that it can withstand a minimum earthquake of 6.0 to 7.0 on the Richter Scale. A summary table of seismic intensity and the historical records of earthquake in and around the Bangladesh that occurred during last 450 years is presented

in the in **Table 4-13** as ready reference for future planning and designing purposes for this project.

Table 4-13: The Regional Earthquake History of Bangladesh for Last 450 Year

SL	Year	Source Area	Magnitude (Richter Scale)	Depth (Km)
1	1548	Sylhet	-	-
2	1664	Shillong-Plateau	-	-
3	1762	Chattogram-Arakan	≤8.8	-
4	1858	Sandway, Myanmar	6.5	-
5	1869	Cachar, India	7.5	48
6	1885	Sirajganj, Bangladesh	7	72
7	1897	Assam, India	8.1	60
8	1906	Calcutta, India	5.5	-
9	1912	Mandalay, Myanmar	7.9	25
10	1918	Srimangal, Bangladesh	7.6	14
11	1930	Dhubri, India	7.1	60
12	1934	Bihar, India-Nepal	8.3	33
13	1943	Numaligarh, Assam, India	7.2	13
14	1938	Mawlaik, Myanmar	7.2	60
15	1950	Assam, Himalaya	8.6	25
16	1950	Chattogram, Bangladesh	6	-
17	1954	Manipur, India	7.4	180
18	1975	Assam, India	6.7	112
19	1981	Sundarbans, Bangladesh	4.9	-
20	1984	Cachar, India	5.7	4
21	1988	Bihar, India-Nepal	6.6	65
22	1988	Phek, Manipur, India	7.3	90
23	1995	Monipur, India	6.4	-
24	1997	Sylhet, Bangladesh	5.6	35
25	1997	Bangladesh-Myanmar	5.3	56
26	1999	Maheshkhali, Bangladesh	4.2	10
27	2003	Rangamati, Bangladesh	5.6	-
28	2011	Sikim, India	6.9	-
29	2015	Gorkha, Nepal	7.8	8.2
30	2016	Imphal, India	6.7	-
31	2016	Baniachang, Sylhet, Bangladesh	4.4	30
32	2023	14 km ESE of Dohar upazila, Dhaka	4.3	10
33	2023	Ramganj Upazila in Lakshmipur	5.5	10

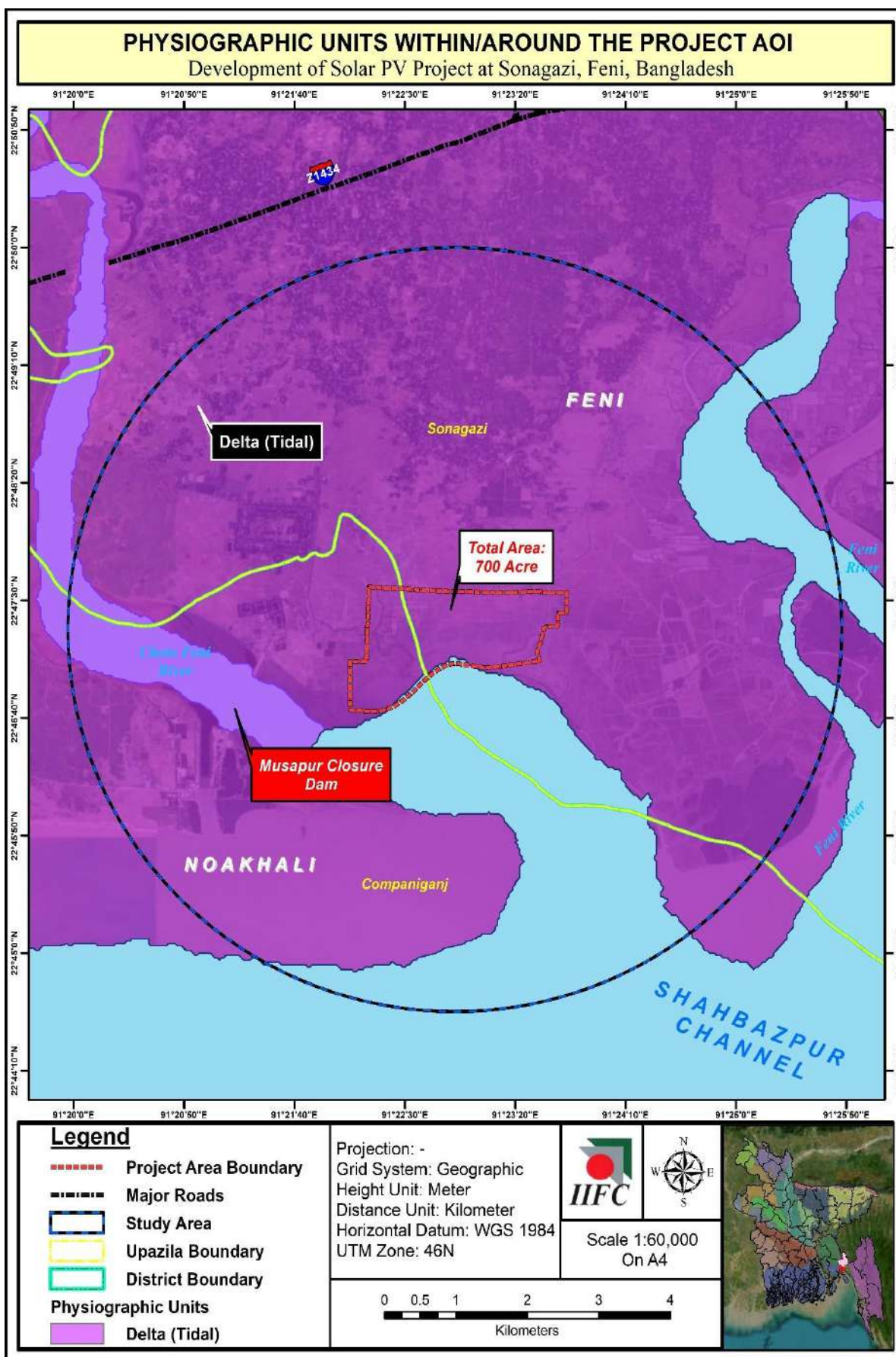


Figure 4.13: Physiographic Units of the Study Area

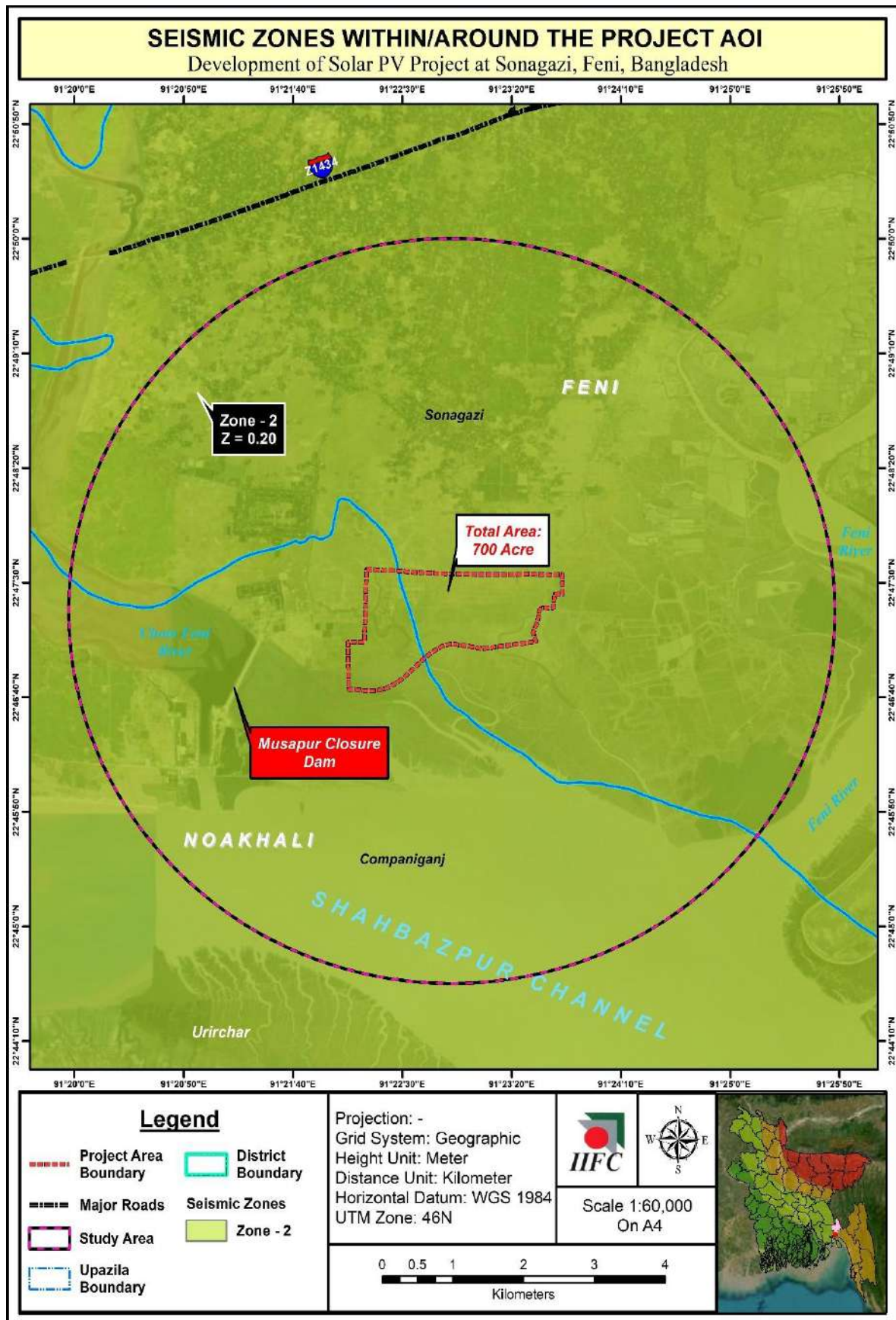


Figure 4.14: Seismic Zoning Map of Bangladesh Showing the Study Area

4.2.5 Water Resources

The study area comprises both surface water and ground water resources. The sources of surface water are estuary, rivers, khals/canals, ponds and other wetlands. The details of surface water & groundwater resources are provided in the subsequent sections.

4.2.5.1 River and Khal System

The main sources of surface water in the study area are two rivers, i.e., the Little Feni and the Feni Rivers and an estuary, i.e., the Shahbazpur Channel. Besides, there are several natural khals and irrigation canals, but only 04 canals (Khal) are connected to the two rivers that serve the drainage purpose. The study area is enclosed by the Little Feni River on the west side, the Feni River on the east and Shahbazpur channel on the south. This area is subjected to significant tidal influences due to its location near the Bay of Bengal. Tides from the Bay of Bengal travel upstream through the estuary/creeks/rivers/khals and causes variations in water levels. This tidal characteristic influences the hydrodynamics of the region.

4.2.5.2 The Feni River

The Feni River is a transboundary river. It originates in India, enters Bangladesh through the Taindong Union of Matidanga Upazila of Khagrachari District, and finally reaches its outfall in the Sandwip Channel, flowing through the Sonagazi Upazila of Feni District. The Muhuri and Salonia rivers are the tributaries of this river. The river is tidal and perennial in nature. The length of the Feni River is approximately 153km, and the average width is 159m. This river does not have any distributaries or any branch rivers. The soil type of the river surroundings becomes infertile as the area faces salinity intrusion and a lack of fresh water during the dry season.

4.2.5.3 The Little Feni River

The Little Feni River originates from the Kakri River in Kashinagar Union of Chaddogram Upazila under Cumilla District. This river flows through Cumilla, Feni and Noakhali Districts, and its outfall is in the Musapur Union of Companiganj Upazila of Noakhali District. The river is influenced by the tidal effect due to its close proximity with the Bay of Bengal, experiencing a tidal range of 2.5m. The Little Feni River reaches over a length of 112km approximately, with an average width of 147m. This river does not have any tributaries, distributaries or branch rivers.

4.2.5.4 Khals in and around the Study Area

Apart from the river system, a crisscrossed Khal network is situated to form the full hydrological system, which collects the surface runoff from the floodplains and flows towards the rivers of the system to discharge into the Bay of Bengal finally. Mainly two Khals are found inside the project area which receives tidal floods and discharges during ebb tide. The presence of these Khals is very important to maintain the hydro-morphological aspects of the study area and its surrounding area, and to manage surface runoff and drainage. A well-known Sonagazi Khal resides in the eastern part of the study area from Feni River towards sea, while some other 4 unnamed Khals are found traversing in middle and western part of the area. The average width of the canals is less than 20m. During monsoon seasons, the canals facilitate the internal drainage system for the study area. Among all 5 Khals the

southernmost and the eastern most Sonagazi Khals are found contributing mostly for the internal drainage of the study area. The average width of the Khals and their description is given below:

4.2.5.4.1 The Char Darbesh Khal

Char Darbesh Khal is a re-excavated canal, that connects with the Little Feni river in its outfall. This canal extends for 4.2 km, with a width of 4-5m, but at its outfall, the width increases upto 15-20m as the canal connects with the Little Feni river.

4.2.5.4.2 The Char Chandia Khal

Char Chandia khal flows through the project area, specifically, crossing the project's transmission line. This canal acts as a major drainage canal during floods, due to its connection with the Shahbazpur Channel in its outfall. This canal extends for 3.6 km approximately, with an average width of 3-4 m.

4.2.5.4.3 The Masjid Khal

Masjid khal is a canal extending for 4.8 km approximately, with an average width of roughly 4-5m. This canal contributes significantly in the drainage system of the study area, through its connection with the Feni river and Shahbazpur Channel in its outfall.

4.2.5.4.4 The IR6A Down Khal

IR6A Down Khal is a re-excavated canal extending for 4.2 km approximately, with an average width of 5m. This canal contributes significantly in the drainage system of the study area, due to its connection with the Little Feni River in its outfall.

4.2.5.4.5 The IR7A & IR8B Khal

IR7A & IR8B canals are two irrigation canals in the northern part of the study area, extending for 4.2 km approximately, with an average width of 4m. This canal mainly contributes to irrigation in the study area. Besides, this canal contributes to flood drainage due to its connection with the Masjid khal in its outfall.

4.2.5.5 Tidal Water Level

The study area is encircled by two peripheral rivers: Feni and the Little Feni River. Both the rivers are tidal in nature, hence the tidal water level data of the stations of BWDB for the two rivers were collected and analyzed. For the Feni River, data were collected from BWDB observation station at Sonapur, Feni (Station ID: SW-87), and for the Little Feni River, the data of the BWDB observation station at Companiganj, Noakhali (Station ID: SW-182) was collected and analyzed. Maximum and minimum water level were analyzed for both high tide and low tide scenarios.

4.2.5.5.1 The Feni River

During High tide The Surface water data of Feni River at BWDB observation Station Sonapur (SW-87), Feni was collected for the period from 1990 to 2023, analyzed and plotted in **Figure 4.15**. It is observed from the figure that the maximum water level increases in the monsoon. On the other hand, the water level drops in the dry season, and the highest level is observed in January. This deviation in water level observed, is due to the Muhuri Project's sluice gate

in the upstream, where the water is stored during dry season. The monthly maximum and minimum water level during high tide and low tide range between 3.65 and 4.08 mPWD (4.11 and 4.54 MSL) and from 2.23 to 3.96 mPWD (2.69 and 4.42 MSL) respectively, as shown in **Figure 4.15**.

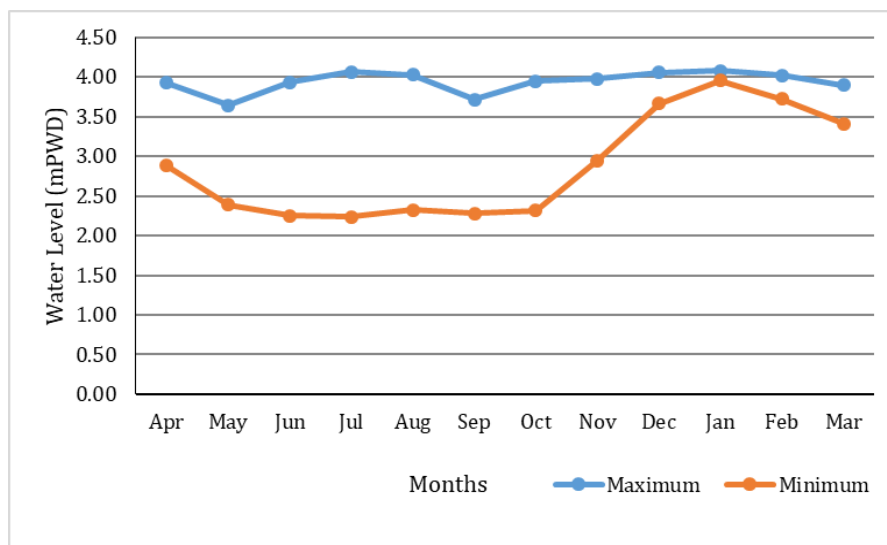


Figure 4.15: Monthly Maximum and Minimum Water Level of Feni River at Sonapur Station during High Tide (from the Year 1990 to 2023)

During Low tide it is observed from **Figure 4.16** that maximum water level during low tides varies from 3.53 to 4.08 mPWD and the minimum water level varies from 1.67 to 3.85mPWD. The water level drops in the wet season, and the highest level is observed in January. This deviation in water level observed, is due to the Muhuri Project's sluice gate in the upstream, where the water is stored during dry season.

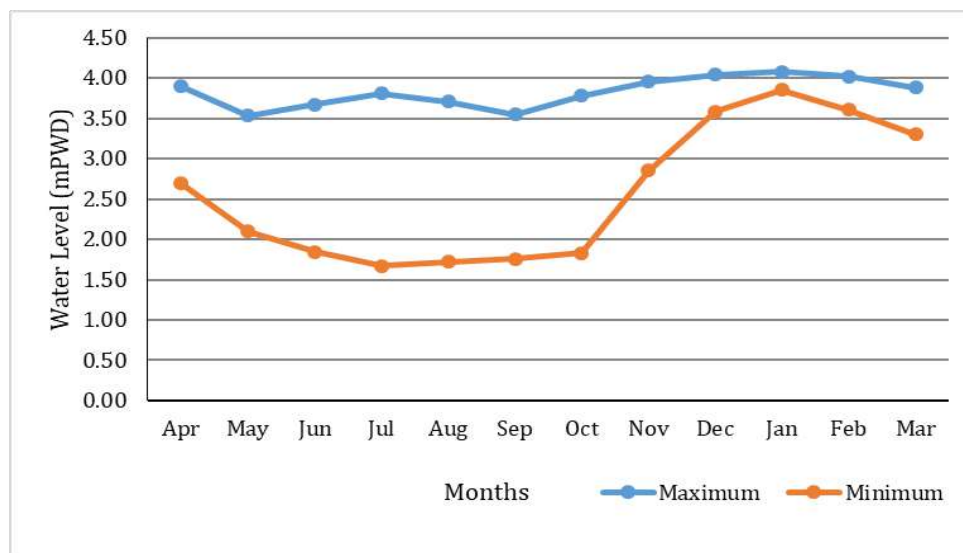


Figure 4.16: Monthly Maximum and Minimum Water Level of Feni River at Sonapur Station during Low Tide (from the Year 1990 to 2023)

4.2.5.5.2 Little Feni River

During High Tide the Surface water data of the Little Feni-Dakatia River at BWDB observation Station Companiganj, Noakhali (SW-182), was collected for the period from 1990 to 2023, analyzed and plotted in **Figure 4.18**. It is observed from the figure that the maximum water level increases in the monsoon. On the other hand, the water level drops in the dry season, and the lowest level is observed in February. The monthly maximum and minimum water level during high tide ranges between 2.69 and 3.79mPWD and from 0.92 to 2.32mPWD respectively.

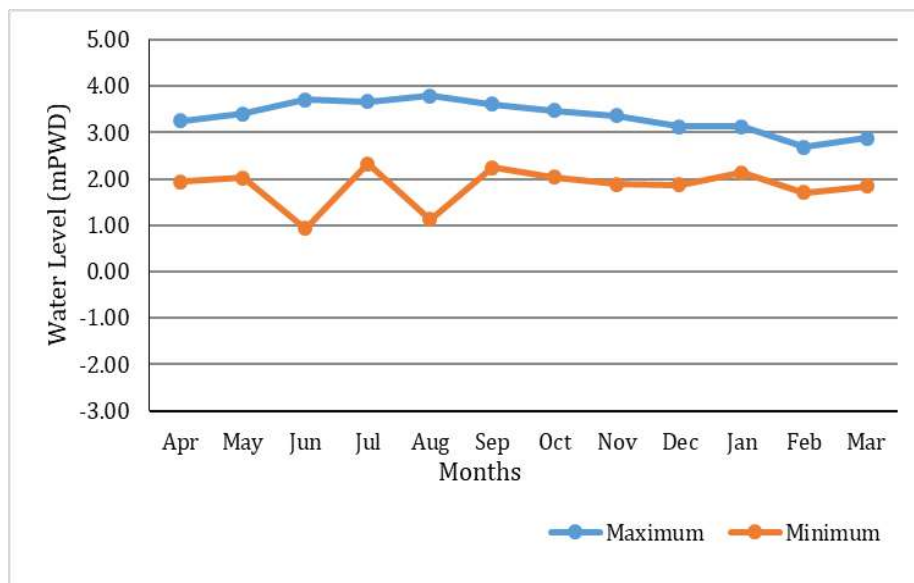


Figure 4.17: Monthly Maximum and Minimum Water Level of Little Feni-Dakatia River at Companiganj Station during High Tide (from the Year 1990 to 2023)

During Low Tide It is observed from **Figure 4.19** that maximum water level during low tides varies from 1.35 to 1.99mPWD and the minimum water level varies from 0.39 to 0.88mPWD. The water level drops in the dry season, and the lowest level is observed in November.

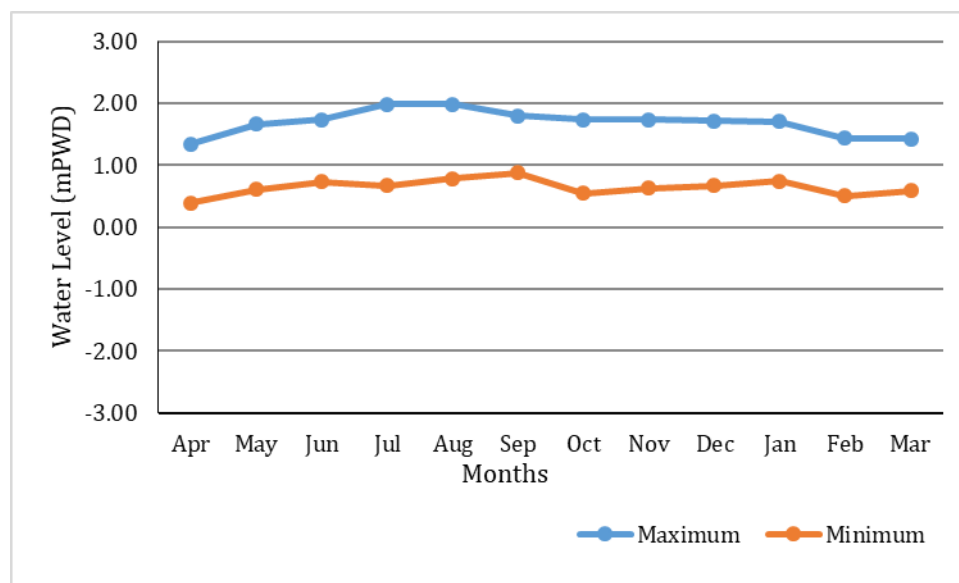
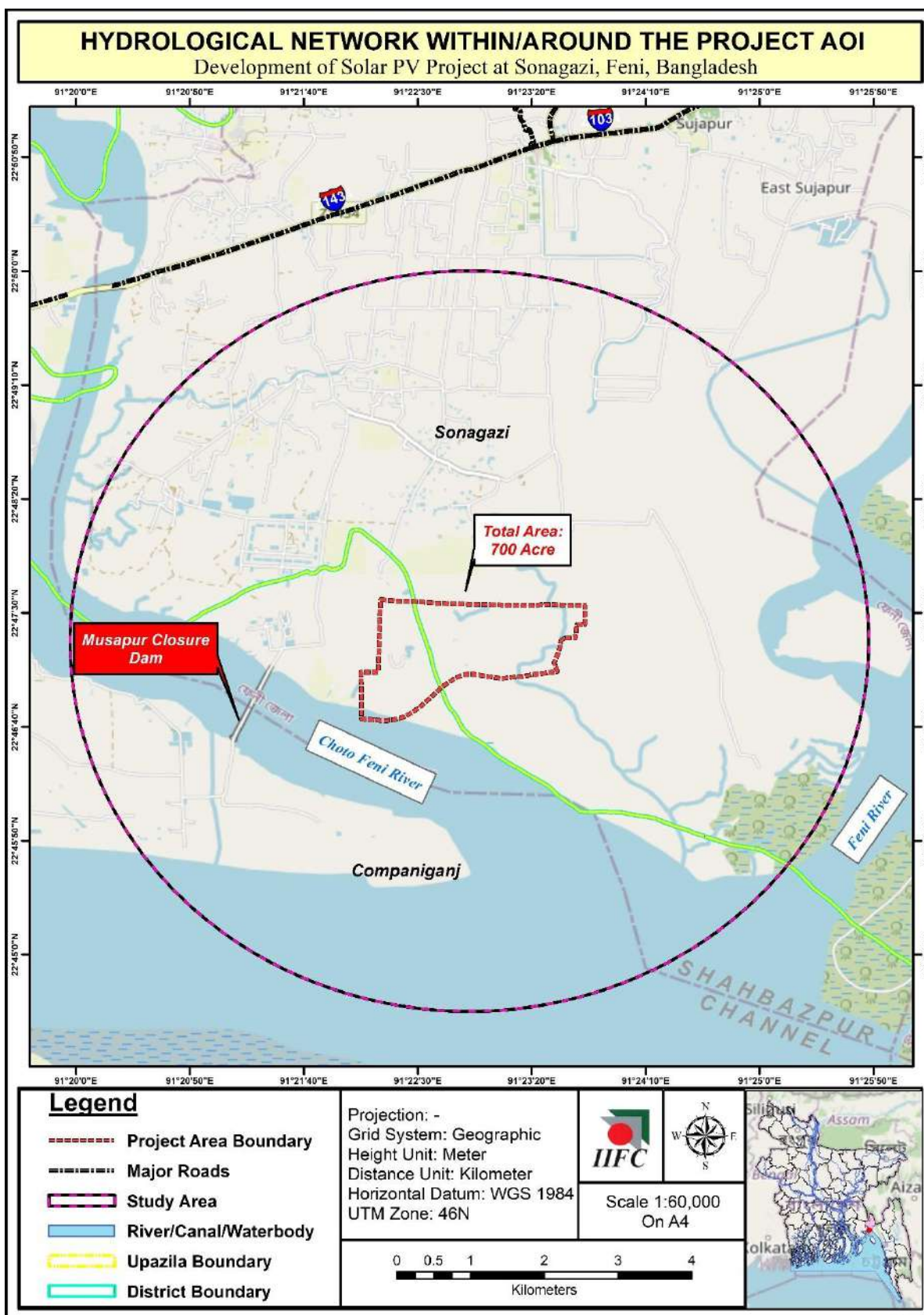


Figure 4.18: Monthly Maximum and Minimum Water Level of Little Feni-Dakatia River at Companiganj Station during Low Tide (from the Year 1990 to 2023)



4.2.6 Flooding

The main cause of floods in the area is rainfall, storm surges and river flow. Heavy rainfall inundates the study area during the wet season to some extent but does not stay for long time. The depth of inundation is also not much, as about 80% of the land is Medium Highland (F1), with flood depth ranging from 30 to 90cm. The flood water is normally conveyed through the canals/khals and river to the Bay of Bengal. Flood water during the monsoon is drained easily due to the connectivity of the existing khals/canals with the two major rivers. In every two to three years' interval, from July to September, the project area is affected by flooding. Flooding depths range from 0.6-1.2m, and in some of the areas, this range varies between 1 to 1.8m. During August-October, the project area experiences spring tides, when the water depth in the khals/canals rise up to 2-2.5m, where the average water depth during dry seasons varies from 0.6 to 1m, and from 1.2 to 1.8m during wet seasons.

However, the project area experiences flooding during cyclones and major floods. All of the major flood events, including 1988, 1998, 2007, and others, had an impact on the project area. Riverine flooding is governed by the Little Feni River and the Feni River. Except for a few years, most of the time, riverine flooding is mitigated by the existing water management measures such as the Musapur regulator on the Little Feni River, the Musapur Closure Dam, sluice gates on Masjid Khal, and so forth. The water level of the Feni River was observed to have several peaks but flowed below its danger level (Danger Level of the Feni River: 17.35mPWD) during the cyclones- Sitrang and Bulbul in the years, 2021 and 2019 respectively. But during the historic flood in 1998 the Feni River flowed above the danger level and caused massive destruction.

Flooding in the area has been less frequent for two major reasons: proximity of the khals/canals to the peripheral rivers and a declining tidal prism in the area. Due to the deposition of silts and accretion in the southern part of the study area, along the Shahbazpur Channel, the naturally formed creeks have increased. Therefore, the tidal effect cannot reach further upstream as it used to, before accretion.

4.2.6.1 Flood Frequency Analysis

Flood frequency analysis was done for the two peripheral rivers in the study area- Feni River and Little Feni River. For frequency analysis, surface water level data were collected from BWDB stations at Sonapur, Feni (Station ID: SW-87) and Companiganj, Noakhali (Station ID: SW-182). General Extreme Values (GEV), Gumbel Max, Log-Pearson III (LP3), Lognormal (3P) Normal and Weibull distributions were carried out for the analysis and best fitted. For the Feni River, Gumbel Max Distribution and for the Little Feni River, Log-normal Distribution exhibited the best fits for analysis. Flood frequency analysis of maximum water level at the Feni and the Little Feni River, for various return periods are shown below:

4.2.6.1.1 Flood Frequency Analysis of Feni River

Historical water level of the Feni River was collected from BWDB station at Sonapur (Station ID-87) for the period of 1958 – 2023. Gumbel Max distribution was best fit for Kolmogorov and ranked second in Anderson Darling whereas, for Chi-Squared test Weibull (3P) was best fit and Gumbel Max was ranked 4th. On the other hand, General Extreme Value was ranked one for Anderson Darling Test. Hence, frequency analysis of maximum water level for various

return periods using Gumbel Max Distribution was carried out to assess the corresponding probable flood level, shown in **Table 4.14**. The analysis shows that the flood levels for 25-, 50- and 100-year return periods are 6.75m, 7.22m and 7.69 mPWD respectively.

Table 4-14: The Goodness of Fit Test for five Different Probability Distribution

SL	Distribution	Kolmogorov Smirnov		Anderson Darling		Chi-Squared	
		Statistic	Rank	Statistic	Rank	Statistic	Rank
1	Gen. Extreme Value	0.05394	2	0.13481	1	2.5259	5
2	Gumbel Max	0.0529	1	0.13803	2	2.5043	4
3	Log-Pearson 3	0.05967	4	0.13855	3	2.5421	6
4	Lognormal	0.08529	6	0.31167	6	1.7958	2
5	Lognormal (3P)	0.05521	3	0.14025	4	2.487	3
6	Normal	0.12025	8	0.7552	7	4.403	7
7	Weibull	0.1129	7	1.7325	8	5.229	8
8	Weibull (3P)	0.07198	5	0.20841	5	1.5759	1

Table 4-15: Frequency Analysis of Annual Maximum Water Level at Feni River BWDB Station (Sonapur, Feni)

Return Period (T)	River Water level (mPWD)	Return Period (T)	River Water level (mPWD)
2	4.86	25	6.75
2.33	5.00	50	7.22
5	5.62	100	7.69
10	6.12	-	-

4.2.6.1.2 Flood Frequency Analysis of Little Feni River

Historical yearly maximum water level of the Little Feni River was collected from BWDB station at Companiganj (Station ID-182) for the period of 1968 – 2023). Gen Extreme Value was best fit for Kolmogorov whereas Normal distribution was best for Chi-Squared test. On the other hand, Lognormal (3P) was ranked fifth for Anderson Darling test and ranked second for Chi-squared test. Hence, frequency analysis of maximum water level for various return periods using Log-Normal (3P) Distribution was carried out to assess the corresponding probable flood level, shown in **Table 4.16**. The analysis shows that the flood levels for 25-, 50- and 100-year return periods are 7.25m, 7.72m and 8.14 mPWD respectively.

Table 4-16: The Goodness of Fit Test for Five Different Probability Distribution

SL	Distribution	Kolmogorov Smirnov		Anderson Darling		Chi-Squared	
		Statistic	Rank	Statistic	Rank	Statistic	Rank
1	Gen. Extreme Value	0.14599	1	8.6759	8	N/A	N/A
2	Gumbel Max	0.27388	8	5.0435	7	8.7266	5
3	Log-Pearson 3	0.19673	3	1.7797	2	29.033	7
4	Lognormal	0.24486	7	3.0435	6	3.3052	3
5	Lognormal (3P)	0.21957	6	2.2348	5	1.3911	2
6	Normal	0.21351	5	2.0653	4	1.2352	1
7	Weibull	0.20093	4	1.8619	3	7.6122	4
8	Weibull (3P)	0.15941	2	1.3436	1	9.8794	6

**Table 4-17: Frequency Analysis of Annual Maximum Water Level at Little Feni River
BWDB Station (Companiganj)**

Return Period (T)	River Water level (mPWD)	Return Period (T)	River Water level (mPWD)
2	4.67	25	7.25
2.33	4.93	50	7.72
5	5.89	100	8.14
10	6.55	-	

4.2.7 Drainage

In the study area, monsoon flooding governed by monsoon rainfall has a greater influence than riverine flooding. Heavy rainfall creates slight water congestion in the study area during the wet seasons. Although the study area is prone to less extensive water congestion issues, and in a close proximity to the major rivers- Feni and Little Feni, and the Bay of Bengal,

As mentioned above, the majority (about 80%) of the study area falls under the land type of Medium Highland (F1), with flood depth ranging from 30 to 90cm. The study area experiences high tides and low tides twice in day, and due to the tidal characteristics of the rivers, siltation is observed in the khal/canal beds. The study area doesn't suffer from prolonged waterlogging issues, as it lies in the close proximity of the major rivers- Feni and Little Feni, and the Bay of Bengal. The natural canals/khals are sufficient for water storage and drainage to the above rivers and finally to the Bay of Bengal during flood events, despite trivial water congestion issues.

Major hydraulic structures in the study area include the Musapur Closure Dam and the Musapur regulator on the Little Feni River. But during the last years flood in August 2024 the Musapur regulator of Feni River has been broken and needs reconstruction.

The Musapur regulator served to regulate the supply of water of the Little Feni River's offtake to the Bay of Bengal.



Figure 4.20: Damaged Musapur Regulator.



Figure 4.21: Musapur Closure Dam



Figure 4.22: Sluice Gate on Masjid Khal, Purbo Baradhali mauza, Char Chandia.

Figure 4.23: Sluice Gate on an Excavated Khal in the Existing 75MW Solar Power Plant Project Area.

There is only one irrigation (IR 7A) canal of the Muhuri Irrigation Project as well as the Masjid Khal within the study area that serves the drainage purpose in the study area. The excavated canals are also influenced by the tidal effect due to their connection with the Shahbazpur channel in their outfalls.

4.2.8 Flood Risk Assessment

The proposed project site is situated between two tidal rivers that discharge into the Bay of Bengal, making it vulnerable to tidal flooding, tropical storms, and cyclones. According to the Bangladesh Meteorological Department (BMD), thirty-three major cyclones have struck the Bangladesh coast, with approximately eighty-five percent (twenty-five cyclones) impacting the South- East coast, particularly the Chattogram area. In the study it has been illustrated that the distribution of these 33 cyclones along different parts of the Bangladesh coast. Additionally, seawater flows upstream through the khals during high tides, a phenomenon expected to worsen with future climate change and rising sea levels. Consequently, a flood risk assessment and management study were conducted for the proposed project site using advanced water resource modelling tools and techniques.

4.2.9 Climate Change and Disaster Risk

The study area is highly prone to cyclones, storm surge, sea level rise, salinity, shoreline and riverbank erosion as the study area located in the coastal belt.

4.2.9.1.1 Existing Disaster Profile and Risk Analysis at the Project location

The information tabulated below was gathered from the **Disaster and Climate Risk Information Platform (DRIP)** web tool for the Feni District. In DRIP database, all data related to natural disaster vulnerability are represented at the district level aggregation. The DRIP web tool represents hazard, exposure and risk level on a scale of 1 to 5 where the levels are very low, low, medium, high, and very high.

Table 4-18: hazard, exposure and risk level of the project area

Disaster	Hazard Level	Exposure Level	Risk Level
Cyclone	Very High	High	Very High
Erosion	Very Low	Very High	Very Low
Salinity	High	Very High	Very High
Sea Level Rise	High	Very High	Very High
Storm Surge	Very High	High	Very High

The study area is prone to cyclones and storm surge as the area is exposed to the sea due to its geographic location. Hence the hazard levels for these disasters are very high. The risk levels are very high due to the absence of adequate necessary infrastructures. Hazard levels for Salinity and Sea level rise is also very high, as the area is located near meghna estuary.

4.2.9.1.2 Climate Change Risk Analysis

Climate change is responsible for rising temperatures, changing precipitation patterns, sea level rise and intensifying extreme events, such as cyclonic storms and droughts. The climate change risk analysis for the study has been carried out following several activities, which are trend analysis of recent climate, hydrologic condition, future climate Projection, potential Impacts of climate change.

Climate Resilience and details Disaster Impact Assessment (DIA) has been provided in **Appendix VI**.

4.3 Biological Environment

4.3.1 Land Resources

4.3.1.1 Agro-ecological Zone

Thirty Agro-ecological Zones (AEZs), 88 sub-regions and 536 units have been identified by adding successive layers of information on the physical environment which are relevant for the land use and assessing agricultural potential in Bangladesh (BARC, 2018). The Power plant with 5 km buffer study area comprises one AEZ namely Young Meghna Estuarine Floodplain (AEZ- 18). Description of the AEZ is presented below and shown in **Figure 4.24**.

4.3.1.1.1 Young Meghna Estuarine Floodplain

This region occupies young alluvial land in and adjoining the Meghna Estuary. It is almost level with very low ridges and broad depressions. Major characteristics of this region are grey to olive, deep, calcareous silt loam and silty clay loams and are stratified either throughout or at shallow depth. Calcareous Alluvium and Non-Calcareous Grey Floodplain soils are the dominant General Soil Types. The soil in the south becomes saline in dry season. Topsoils are slightly acidic to slightly alkaline and sub-soils of the area are slightly alkaline. General fertility is medium, but the N status is very low, and organic matter is medium to optimum.

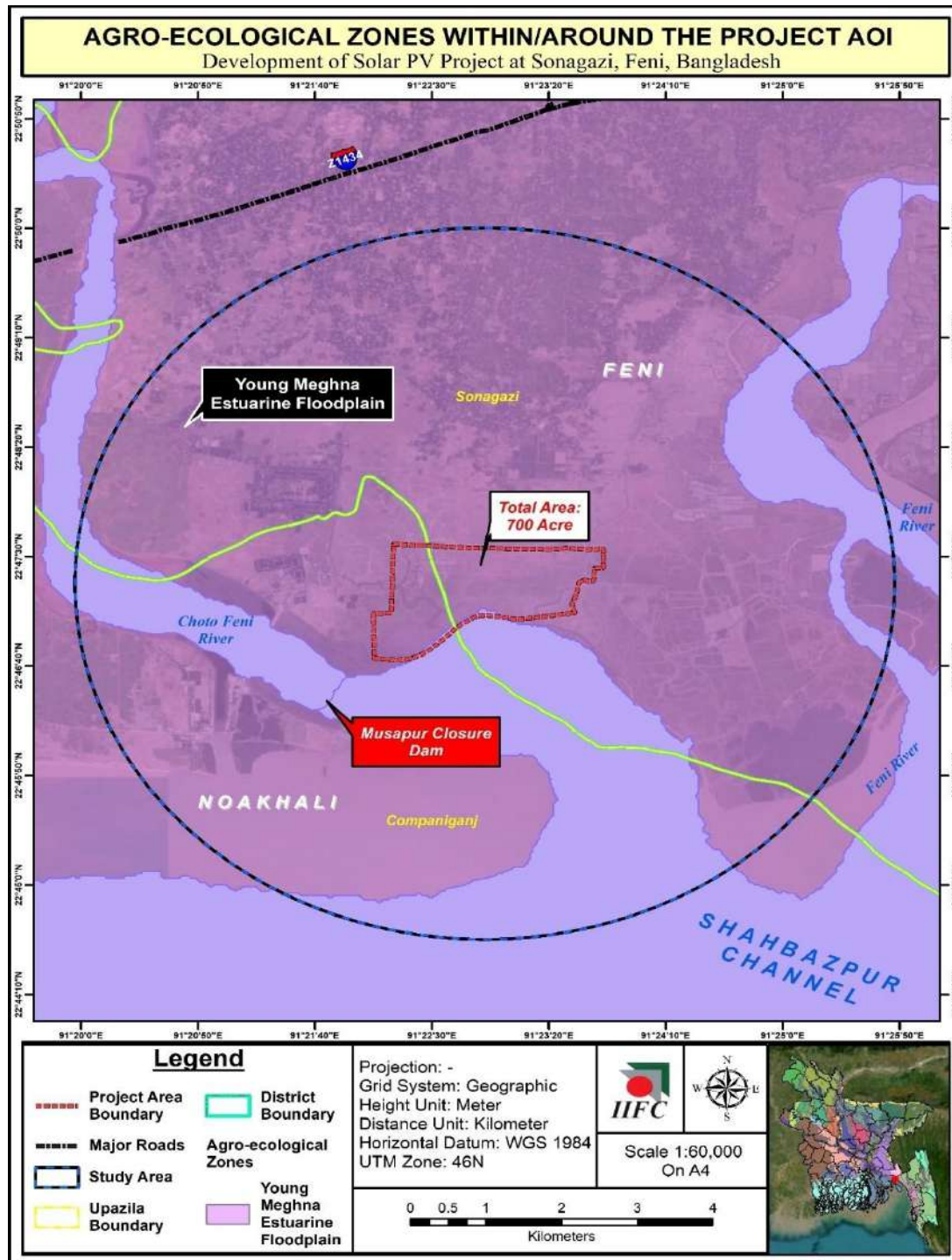


Figure 4.24: AEZ of Power Plant Area

4.3.1.2 Land use

The gross study area is about 700 Acre and all of it is fallow land, there are no trees, or small bushes present in the study area.

4.3.1.3 Land Type

Land type classification is based on depth of inundation during monsoon season due to normal flooding on agriculture land. According to Soil Resource Development Institute (SRDI, 1988), five land types (Highland, Medium Highland, Medium Low Land, Low land and Very Lowland) have been classified in terms of depth of flooding. However, only one class of land type (medium high land) has been found in the study area. Details land type is presented in **Figure 4.25**.

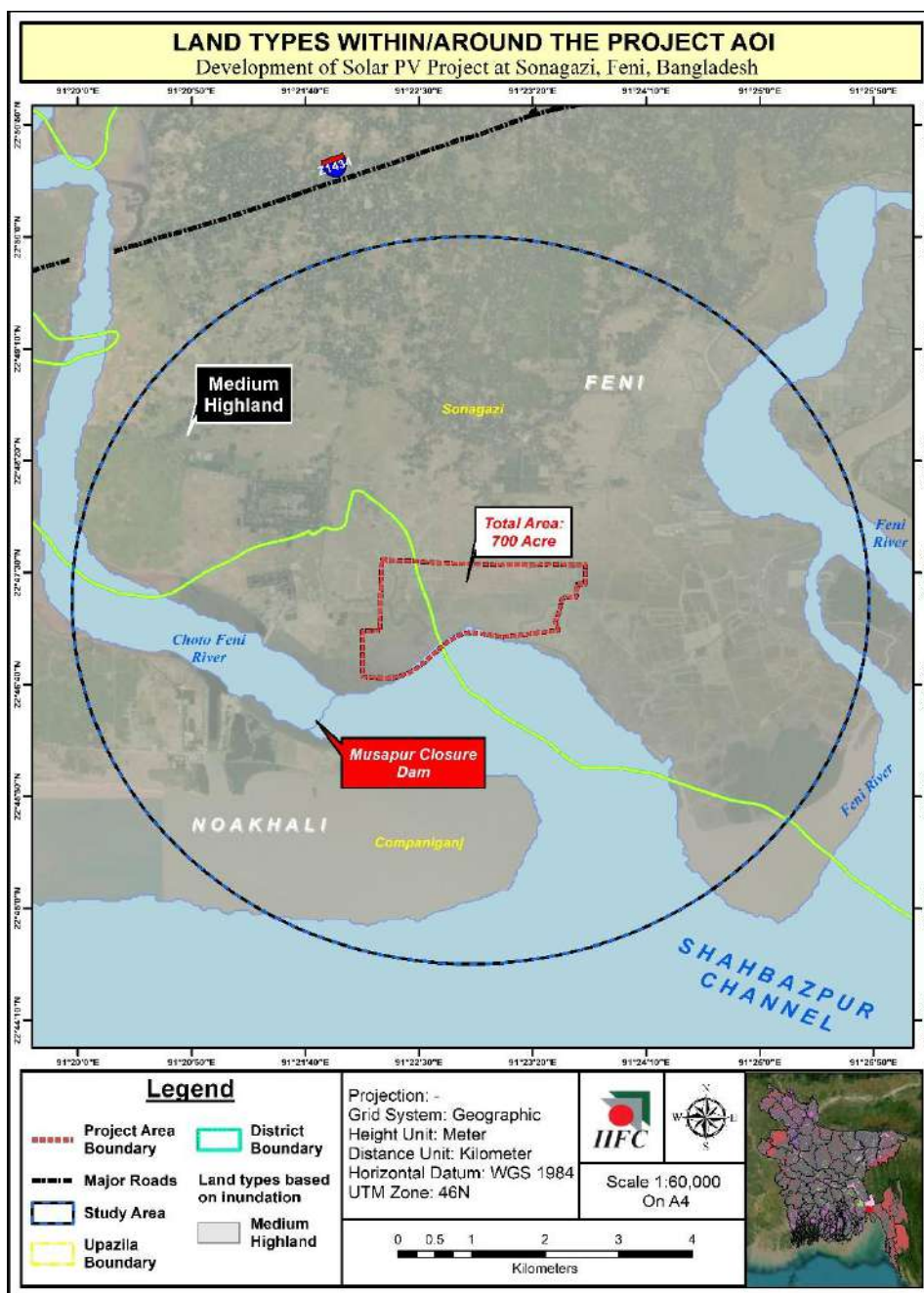


Figure 4.25: Land Type of the Study Area

4.3.1.4 Soil Texture

Soil texture is the relative proportions of sand, silt and clay. It is an important soil characteristic that guides crop selection, crop production and also field management. Entire power plant, TL and study area is covered by loamy soil texture (100%) only (Source: SOLARIS, SRDI, 2006). Details soil texture is presented in **Figure 4.26**.

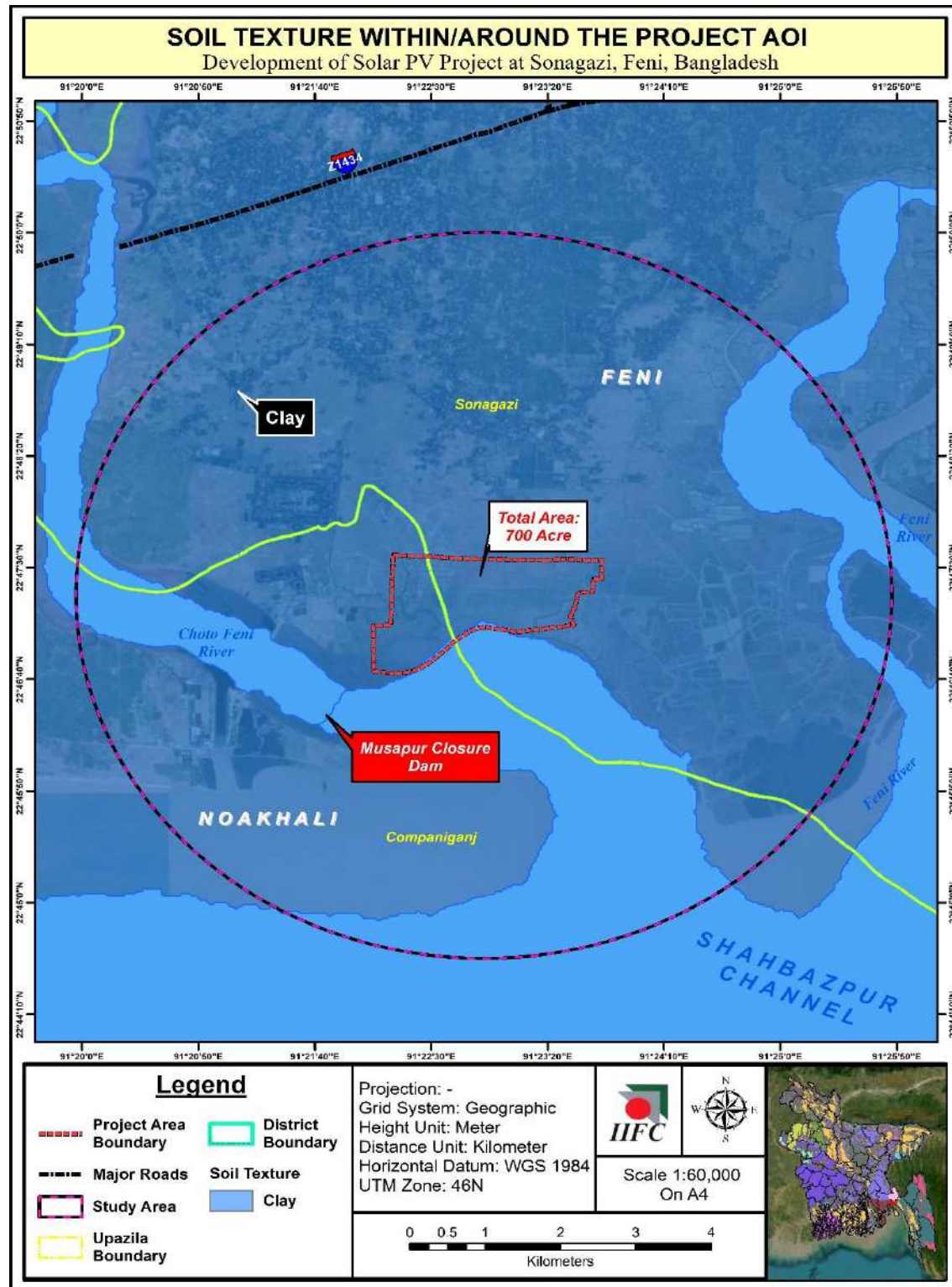


Figure 4.26: Soil Texture of the Study Area

4.3.2 Agricultural Resources

The study area is a fallow land and is not suitable for agricultural practice, however, local cattle use the open land to be grazing in the area.

4.3.3 Livestock Resources

Livestock information was collected from the study area. According to the farmers of the study area, about 40% of households in the study area are rearing cattle, 5% of households are rearing buffalo, 5% of households are rearing goats, 5% of household are rearing sheep, 60% of household are rearing chicken and 40% of household are rearing duck. Detailed information is presented in **Table 4.19**.

Table 4-19: Number of Livestock and Poultry in the Study Area

Name of Livestock and Poultry	% of HH having Livestock/Poultry in the Study Area	Average number of livestock per household	Total number of populations
Cattle/Bullock	40	4	1,787
Buffalo	5	2	894
Goat	5	3	1,341
Sheep	5	5	10,724
Duck	40	4	21,449
Chicken	60	5	26,811

Sources: IIFC ESIA Study, August, 2024

4.3.4 Ecological Resources

This section discusses both the biotic and abiotic factors of the study area that build a limited variety of ecosystems with a limited number of goods and services. The landforms of the area with varied plant patterns support a moderate variety of biodiversity. The study area possesses a few patches of natural forest with a large quantity of homestead backyard vegetation covers. Plant resources of the area constitute both wild and cultivated plants. The wild plant resources are rich in diversity and usually found in the natural and semi-natural forests of the area. The homestead vegetation covers also support a wide variety of wildlife.

4.3.4.1 Bio ecological Zone

The study area lies under two Bio-ecological Zones (BEZs), such as (a) Meghna Estuarine Floodplain; and (b) Coastal and Marine Waters. The features of the BEZs are attributed in **Table 4.20** below.

Table 4-20: Features of the Study Area Bio-ecological Zones

BEZ Name	Area (Ha)	Description
Meghna Estuarine Floodplain	4233.327	A huge newly accreted mudflat characterized by tidal flooding primarily on land margins during exceptionally high tides during wet season. Flooding inundation further progresses during storm surges with tropical cyclones. On the other hand, seasonal flooding, usually by rainwater, or non-saline river water, is mainly shallow, but fluctuate tidally. The study area contains both terrestrial and aquatic habitats and ecosystems, including mangrove forest, mudflat, offshore, salt pan, cropland, freshwater aquaculture pond, estuary, settlements, rivers, etc. The terrestrial ecosystems support the plant species, such as betel nut (<i>Areca catechu</i>), coconut (<i>Cocos nucifera</i>), date palm (<i>Phoenix sylvestris</i>), banyan (<i>Ficus bengalensis</i>), Gab (<i>Diospyros peregrina</i>), Khudi Jam (<i>Syzygium fruticosum</i>), Tamarind (<i>Tamarindus indica</i>), wood apple (<i>Aegle marmelos</i>), Jalpai (<i>Elaeocarpus robustus</i>), etc. The inter- tidal area of this zone is significant for wintering grounds for migratory waterfowls. The globally threatened shore birds that roost over this area include Eurasian Spoonbill (<i>Platela leucorodia</i>), Common Sandpiper (<i>Actitis hypoleucos</i>), Spotted Redshank (<i>Tringa erythropus</i>), Greenshank (<i>T. guttifer</i>), Indian Skimmer (<i>Rhynchops albigollis</i>), etc. Among the faunal species bats, snakes, lizards, raptorial birds are important. The aquatic habitats of the area are dominated by rivers having the occurrence of dolphins (<i>Platanista gangetica</i>), an aquatic mammal. Note: The project site is a dried, barren charland which will be filled with soil/sand to 1 meter height. Currently, the abundance of biodiversity is at a lowest level and many of them are not observed in this area now-a-day.
Coastal and Marine Waters	3613.221	This zone contains a vast portion of the Sothern Bangladesh containing a complex delta of the Ganges-Brahmaputra-Meghna river system, with immense biological resources. Some of the aquatic fauna, which are known to occur in this zone include Fin whale (<i>Balaenoptera physalus</i>), dolphins (<i>P. gangetica</i>), Irrawaddy dolphin (<i>Orcaella brevisrostris</i>), marine turtles, such as Loggerhead turtle (<i>Caretta caretta</i>), Green turtle (<i>Chelonia mydas</i>), Olive ridley turtle (<i>Lepidochelys olivacea</i>), snakes, migratory waterfowl, marine fishes, etc. Note: The project site is a dried, barren charland which will be filled with soil/sand to 1 meter height. Currently, the abundance of biodiversity is at a lowest level and many of them are not observed in this area now-a-day.

4.3.4.2 Ecosystem

The overall ecosystems of the study area can be divided into the following two categories:

- Terrestrial Ecosystem:** The major portion of the study area consists of terrestrial ecosystem, which is a land-based community of organisms having interactions of biotic and abiotic components. The major terrestrial ecosystems of the area can be defined as natural and anthropogenic. The natural ones include forest patches along the sandy beach while the anthropogenic ones are agriculture land, homestead vegetation, social forestation, etc. These ecosystems are elaborated in the following sections.
- Aquatic Ecosystem:** The aquatic ecosystems having natural connotations include riverine and estuarine ecosystems while having anthropogenic connotation include homestead pond ecosystems having influence on the local biodiversity. These ecosystems are elaborated in the following sections.

4.3.4.2.1 Terrestrial Ecosystem

The land use data and field investigation reveal that the dominating terrestrial ecosystem of the study area comprises mainly agricultural lands, homestead plantations and strip plantations etc.

a) Flora in crop lands and Fallow Lands and Associated Fauna

Crop land ecosystem wide area of grazing and feeding habitats for numerous local birds, indigenous fishes during monsoon and small mammals. Betel (*Piper betle*) is another important species in cropland. Wild species such as keya kata (*Pandanus odorifer*), Hergoja (*Acanthus ilicifolius*), Dhol Kolmi (*Ipomoea carnea*), Durba Gash (*Cynodon dactylon*), Thankuni (*Centella asiatica*), Akand (*Calotropis procera*), Vaant/Bhat (*Clerodendron viscosum*), Bagha Jongla (*Borreria articularis*) are present there. Birds like Munia, sparrow, starling, myna, bee-eater got more opportunities for their livelihood in this type of habitat.

b) Flora in Homestead Plantation and associated fauna

Homestead plantation was observed on marginal and fallow lands by the local villagers e.g. homestead, roads, embankment, canal banks and fallow agriculture land. Species observed are *Samanea saman*, *Acacia auriculiformis*, *Acacia manjiam*, *Azadirachta indica*, *Eucalyptus* sp., *Pongamia pinnata*, *Acacia nilotica*, *Ziziphus mauritiana*, *Leucaena leucocephala*, *Switenia mahogani*, *Tectona grandis*, *Casia siamea*, *Gmelina arborea*, *Casuarina equisetifolia*, *Phoenix sylvestris*, *Bambusa* sp., *Cocos nucifera*, *Mangifera indica*, *Tamarindus indica*, *Areca catechu*, *Borassus flabellifer*, *Artocarpus heterophyllus* etc. Tree species observed near agricultural lands are *Azadirachta indica*, *Cocos nucifera*, *Eucalyptus* sp., *Acacia auriculiformis*, *Phoenix sylvestris*, *Bambusa* sp., *Areca catechu*, *Borassus flabellifer* etc. In the study area the homestead forest is playing a significant role by holding different group of fauna. The frugivore, insectivore and carnivore wildlife species are major faunal species in the study area. Squirrels, bats, rat, jungle cat, are the major mammalian species. Passerine birds like robin, sunbird, orial, myna, starling, coacal are the major bird group of the homestead forest. Different lizards, monitor and non-venomous snakes are the major reptiles' species. Besides, amphibians also get opportunities from here.

c) Strip Plantation and associated fauna

To address the need for wood resources, the Forest Department is executing a participatory replanting effort along roads, link roads, and embankments as part of the social forestry program. Some significant species, such as *Samanea saman*, *Acacia auriculiformis*, *Swietenia mahogani*, *Tectona grandis*, and *Artocarpus heterophyllus*, have also been planted. This plantation supports different types of lizards, snakes, tree frogs, passerine birds (sunbirds, minivets, tits etc.), coacal, roller etc.

4.3.4.2.2 Aquatic Ecosystem

The information of the aquatic ecosystem was obtained by direct field observation, questionnaire survey and literature review.

a) Flora in Coastal area and associated fauna

Coastal ecosystems in the study area comprise of *Casuarina* plantation area, sandy beach areas and muddy areas. The Chattogram Coastal Forest Division began planting mangroves

on this area. *Sonneratia apetala* and *Excoecaria agallocha*, *Avicennia officinalis* and *Avicennia marina* are the species most frequently utilized in plantations. The coastal ecosystem of the study area plays a significant role as an important habitat for wildlife and biodiversity. Sea snakes are also an important snake species in this habitat. Though no species mentioned on the project site were observed during the field investigation.

Open water in the coastal area and associated mudflat of the coast is important for Migratory birds to occupy a special position in this type of habitat for their higher number of abundances during the winter season. Larger flocks of bird species are observed during the winter season from the study area. Wild duck and migratory duck species (eg. Shelduck, gadwall, pochard, teal etc.), waders (plover, sandpiper, gull, tern, shank, snipe etc.) wagtail, cormorants, heron, egret, bittern, kingfisher, was observed from the study area.

Mangrove forest plays an important role as a habitat of different types of bird like kingfisher, heron, egret, bitter, wagtail, ibis etc. Besides minivet, tits, sparrows are other important birds of this habitat. This habitat provides supports for livelihood for different types of reptiles species. An individual of Spotted deer also observed from here. Different species of Bat, Rat, Small carnivore also used this habitat.

b) Flora in Sandy Beaches

Major floral species are generally absent from the sand beaches along coast. *Ipomoea pes-caprae*, often known as beach morning glory, is the main type of native vegetation on these sandy beaches. It was also noted that some beach agriculture was being done in small spots.

c) Flora in Riverside Habitat and Faunal diversity associated with this

River side habitat specially mudflat provide support for different groups of bird species, like plovers, waders, sandpipers, gulls, herons, bittern, egret etc. Besides different groups of raptorial birds, kingfishers are also present here.

A list of dominated flora of the study area has been provided below (Table 4.21)

Table 4-21: A List of Flora in the Study Area

No.	Local name	Scientific Name	Family	Usage
01.	Modnapata	<i>Borreria sp</i>	Rubiaceae	NA
02.	Palash	<i>Butea monosperma</i>	Febaceae	Wood
03.	Kolaboti	<i>Conna indica</i>	Kalabati	Flower
04.	Indian Mangrove	<i>Avicennia officinalis</i>	Acanthaceae	Wood
05.	Lebu	<i>Citrus aurantiifolia</i>	Rutaccae	Fruit
06.	Sishu	<i>Dalbergia sissoo</i>	Febaceae	Wood
07.	Mandar	<i>Erythrina sp.</i>	Febaceae	Wood
08.	Pakur	<i>Ficus sp.</i>	Moraccae	Wood
09.	Mehedi	<i>Lawsonia sp.</i>	Lythraccae	Leaf
10.	Amra	<i>Spondias pinnata</i>	Anacardiaceae	Fruit and fuel wood
11.	Narikel	<i>Cocos nucifera</i>	Palmae	Fruit and fuel wood

No.	Local name	Scientific Name	Family	Usage
12.	Keowra	<i>Sonneratia apetala</i>	Lythraceae	Fruit
13.	Jhau	<i>Casuarina</i>	Casuarinaceae	Fuel wood
14.	Sundari	<i>Heritiera fomes</i>	Malvaceae	Fuel wood
15.	Geowa	<i>Excoecaria agallocha</i>	Euphorbiaceae	Fuel wood
16.	Shimul	<i>Bombax ceiba</i>	Malvaceae	Cotton product
17.	Jambura	<i>Citrus maxima</i>	Rutaceae	Fruit
18.	Aam	<i>Mangifera indica</i>	Anacardiaceae	Fruit and timber
19.	Akashmoni	<i>Acacia sp.</i>	Mimosaceae	Timber and fuel wood
20.	Bansh	<i>Bamboosa sp.</i>	Poaceae	Thatching
21.	Mahagoni	<i>Swietenia mahagoni</i>	Meliaceae	Timber and medicine
22.	Sirish	<i>Albizia lebbek</i>	Leguminosae	Timber and fuel wood
23.	Taal	<i>Borassus flabellifer</i>	Palmae	Fruit and timber
24.	Khajur	<i>Phoenix dactylifera</i>	Arecaceae	Fruit and fuel wood
25.	Supari	<i>Areca catechu</i>	Palmae	Timber and fuel wood
26.	Tatul	<i>Tamarindus indica</i>	Leguminosae	Fruit
27.	Silkoroi	<i>Albizia procera</i>	Leguminosae	Timber and fuel wood
28.	Kanthal	<i>Artocarpus heterophyllus</i>	Moraceae	Fruit and timber
29.	Amra	<i>Spondias mombin</i>	Anacardiaceae	Fruit
30.	Payera	<i>Psidium guajava</i>	Myrtaceae	Fruit
31.	Pitali	<i>Trewia nudiflora</i>	Euphorbiaceae	Timber and fuel wood
32.	Boroi	<i>Ziziphus mauritiana</i>	Rhamnaceae	Fruit
33.	Deshi Neem	<i>Azadirachta indica</i>	Meliaceae	Timber and medicine

Source: Direct Field Survey, April, 2024

4.3.4.3 Field observation

- Designated protected area and Important Biodiversity area around the study Site

No designated protected areas are present inside the project area but there are some areas near to the project site of the study area.

Table 4-22: Status of Protected Area and the Hotspots from the Study Site

Name of the Area	Type	Impact	Distance
Muhuri Dam	IBA(A4i)	No effect	7 Km.
Ganges-Brahmaputra-Meghna delta	IBA (A1, A4i, A4iii)	Close to the project site. Biodiversity could be affected if proper precautions are not taken.	Study area slightly covers the IBA
Baraiyadhala National Park	National Park	No effect	10 Km+

4.3.4.4 Ecologically Critically Areas and Ramsar Site

No Ecologically Critical Area (ECA) or Designated RAMSAR site are located inside or near to the study area. **Figure 4.27** Shows the nearest ECA and Designated RAMSAR site distance from the study area.

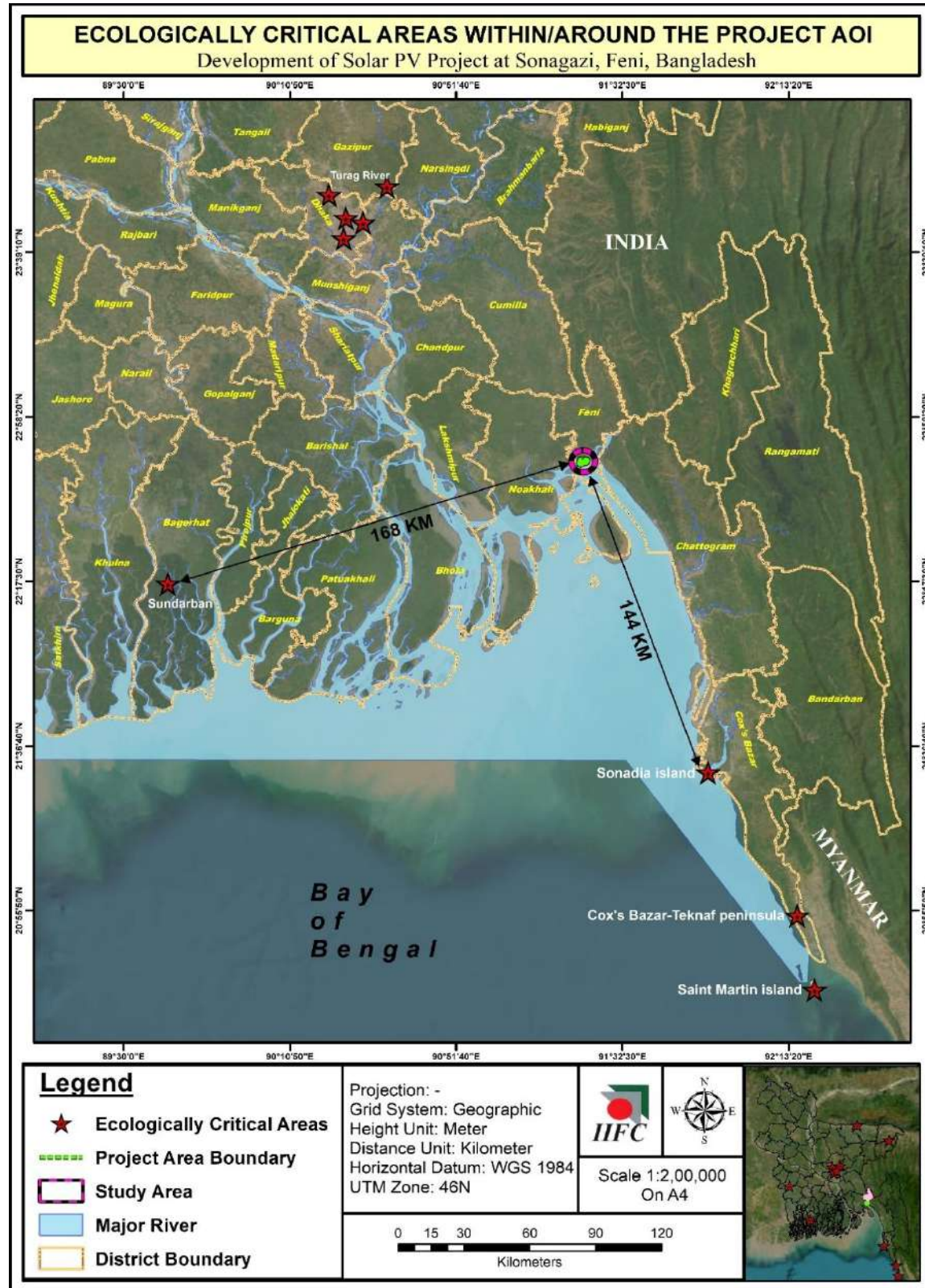


Figure 4.27: Nearest ECA and Designated RAMSAR Site from the Study Area

Besides, according to the literature review, expert judgment, field investigation and comments of the local people, this area is no presence of threatened wildlife in the study area.

4.3.4.5 Faunal Survey

From the study, a total of 94 species of wildlife observed among the four (n=15) were Mammals, 82 (n=1569) were bird species, five (n=32) amphibian species and three (n=7) reptile's species (Source: Direct Field Survey and recent observation as a bird observer)

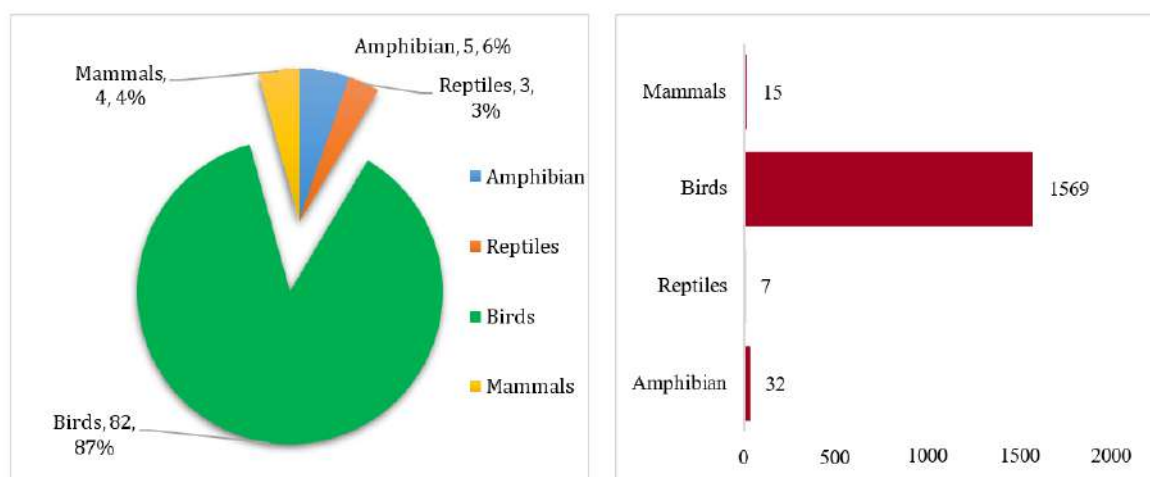


Figure 4.28: Composition of Species Richness and Abundance in the Study Area

The 82 species of bird were under 15 orders and 30 families, and the four species mammals were under three orders and three families. Under the order Passeriformes the highest number of bird species (22 species) observed which is followed by the order Charadriiformes (22 species) (Figure 4.29). The highest number of bird population (n=576) observed which is followed by Anseriformes (n=247) (Figure 4.29 B). Among the 30 families the highest number of bird species was under the order Scolopacidae (n=380). (Source: Information Gather from the birdwatchers and Direct field survey).

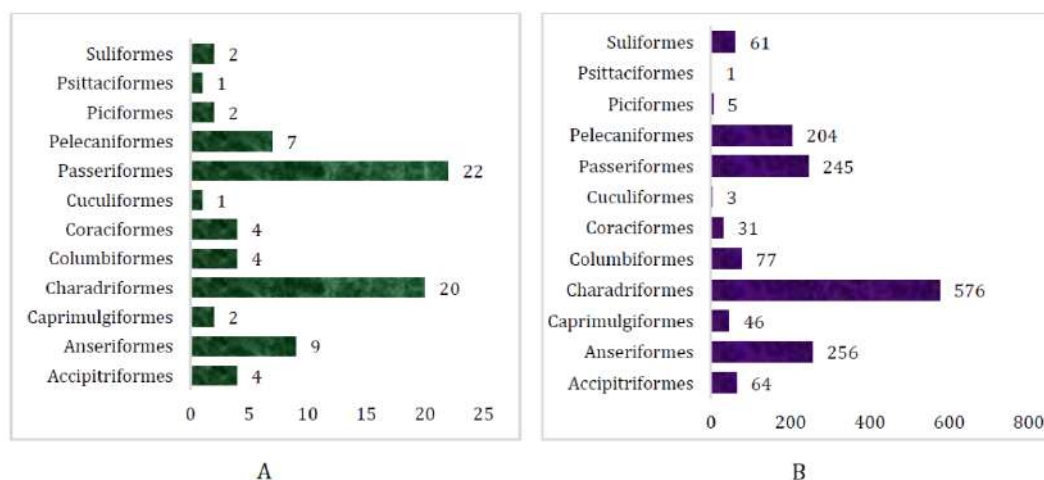


Figure 4.29: Order wise Species (A) Richness and (B) Abundance in the Study Area

Among the six observed site, site Coastal habitat has the highest number of species richness and abundance (Figure. 4.30). The lowest species richness and abundance was found in Fallow land. Diversity index also showed the highest diversity value for the site Coastal areas.

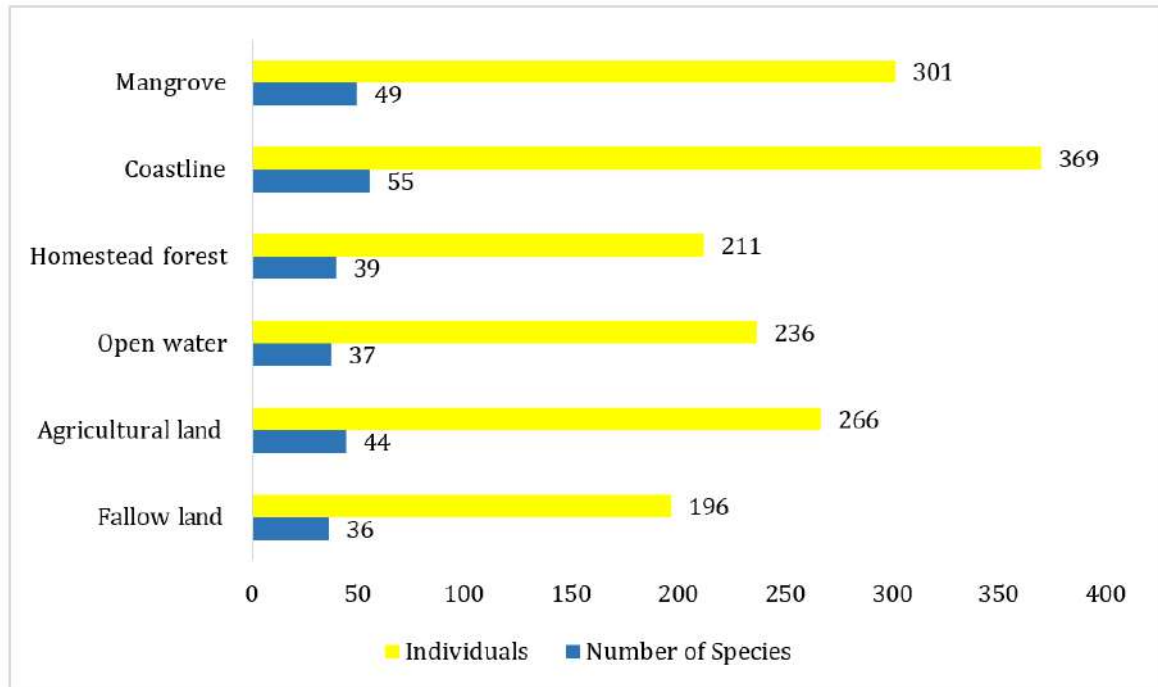


Figure 4.30: Site wise Species Richness and Abundance

Table 4-23: Species Richness, Abundance and Diversity Indices in Different Study Site

Site	S	A	Ds	H	E
Fallow land	36	196	0.9653	3.494	0.9142
Agricultural land	44	266	0.966	3.605	0.8359
Open water	37	236	0.9556	3.396	0.8069
Homestead forest	39	211	0.9628	3.516	0.8628
Coastline	55	369	0.9715	3.777	0.7943
Mangrove	49	301	0.9633	3.628	0.7681

[Note- Species richness (S), Abundance (A), Simpson's Index (Ds), Shannon-Weiner Index (H), Evenness (E)]

Among the recorded 82 observed faunas, *Larus brunnicephalus* was the mostly abundant bird species (n=106, 6.7%). The ten most abundant species constituted 41.27% of total individuals whereas 40 least abundant species held only 10.1%. This signifies highly uneven distribution of species in the community, which is explained in the rank abundance plot (**Figure. 4.31**). The wetland specialist bird species ranked highest in the rank abundance curve (*Larus brunnicephalus*, *Mareca strepera*, *Mareca Penelope*, *Charadrius alexandrinus*).

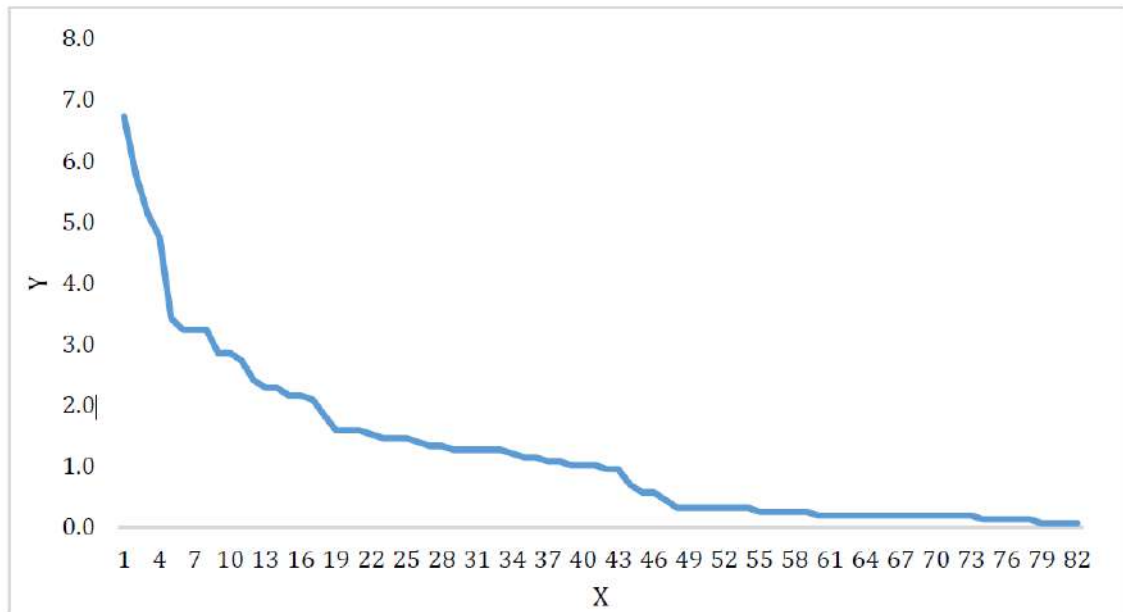


Figure 4.31: Rank Abundance Plot for Species Recorded from the Study Site

The y-axis shows the relative abundance, and the x-axis ranks the species in order of their abundance from the highest to the lowest.

Among the six-study habitat Coastline habitat and mangrove forest share more similar type of species among all study sites (Figure 4.33). This site shares a more similar type of species with Agricultural land and homestead forest. The remaining three study sites share different type of species. Also, the same result was found in the correlation matrix plot. (Source: Field Survey).

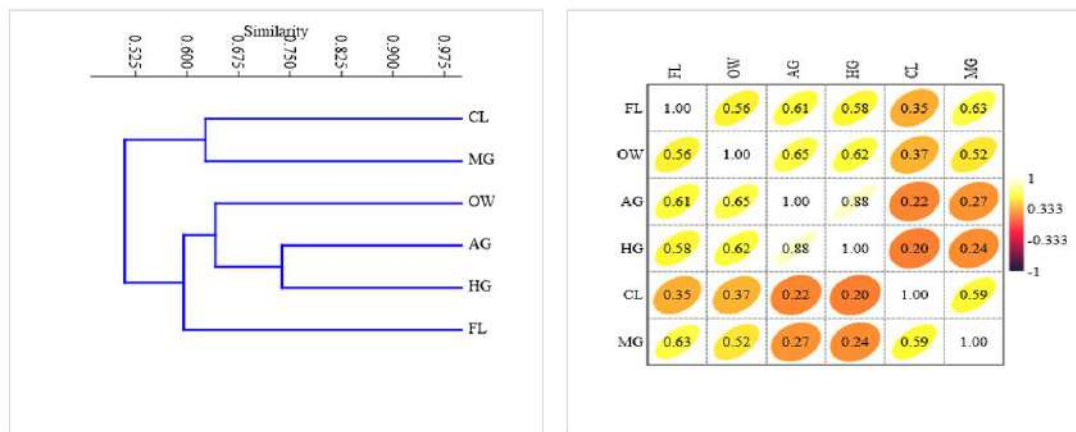


Figure 4.32: Similarity Profile Test among Different Study Site using Bray-Curtis Index and Person Correlation Plot

Among the observed bird species 38 species (52%) were migratory and rest were resident. Among the observed wildlife relative abundance shows that 31 species (37.80%) was very common, 7 (8.53%) species common, 3 (3.65%) species uncommon and 41 species (50%) was few.


Table 4-24: List of Recorded Wildlife from the Study Area during the Study Period

Order	Family	Species	Common Name	Status	RA	IUCN BD 2015	Number of Individual
Accipitriformes	Accipitridae	<i>Elanus caeruleus</i>	Black Winged Kite	M	F	LC	2
		<i>Haliastur indus</i>	Brahminy Kite	R	VC	LC	15
		<i>Milvus migrans</i>	Black Kite	R	VC	LC	26
	Pandionidae	<i>Pandion haliaetus</i>	Osprey	M	VC	LC	10
Anseriformes	Anatidae	<i>Anas acuta</i>	Northern Pintail	M	C	LC	26
		<i>Anas crecca</i>	Common Teal	M	VC	LC	38
		<i>Anas poecilorhyncha</i>	Indian Spot-billed Duck	R	UC	LC	6
		<i>Mareca penelope</i>	Eurasian Wigeon	M	VC	LC	71
		<i>Mareca strepera</i>	Gadwall	M	VC	LC	121
		<i>Spatula clypeata</i>	Northern Shoveler	M	F	LC	16
		<i>Spatula querquedula</i>	Garganey	M	VC	LC	3
		<i>Tadorna ferruginea</i>	Ruddy Shelduck	M	F	LC	15
		<i>Tadorna tadorna</i>	Common Shelduck	M	F	LC	23
Caprimulgiformes	Apodidea	<i>Apus nipalensis</i>	House Swift	R	VC	LC	15
		<i>Cypsiurus balasiensis</i>	Asian Palm Swift	R	VC	LC	54
		<i>Charadrius alexandrinus</i>	Kentish Plover	M	VC	LC	45
		<i>Charadrius dubius</i>	Little Ringed Plover	M	VC	LC	36
		<i>Vanellus cinereus</i>	Grey-headed Lapwing	M	C	LC	17
		<i>Vanellus indicus</i>	Red-wattled Lapwing	R	C	LC	18
		<i>Recurvirostra avosetta</i>	Pied Avocet	M	VC	LC	45
		<i>Actitis hypoleucos</i>	Common Sandpiper	M	C	LC	32
		<i>Calidris minuta</i>	Little Stint	M	C	LC	12



Order	Family	Species	Common Name	Status	RA	IUCN BD 2015	Number of Individual
		<i>Chlidonias hybrida</i>	Whiskered Tern	M	F	LC	4
		<i>Larus brunnicephalus</i>	Brown-headed Gull	M	VC	LC	106
		<i>Larus ichthyaetus</i>	Pallas's Gull	M	F	LC	3
		<i>Larus ridibundus</i>	Black-headed Gull	M	F	LC	3
		<i>Limosa limosa</i>	Black-tailed Godwit	M	UC	NT	9
		<i>Numenius arquata</i>	Eurasian Curlew	M	F	NT	5
		<i>Numenius phaeopus</i>	Whimbrel	M	VC	LC	36
		<i>Sterna albifrons</i>	Little Tern	M	F	LC	5
		<i>Tringa glareola</i>	Wood Sandpiper	M	F	LC	20
		<i>Tringa nebularia</i>	Common Greenshank	M	F	LC	51
		<i>Tringa stagnatilis</i>	Marsh Sandpiper	M	F	LC	16
		<i>Tringa totanus</i>	Common Redshank	M	F	LC	20
Columbiformes	Columbidae	<i>Columba livia</i>	Rock Dove	R	UC	LC	16
		<i>Spilopelia chinensis</i>	Eastern Spotted Dove	R	VC	LC	54
		<i>Streptopelia decaocto</i>	Eurasian Collared Dove	R	F	LC	4
		<i>Streptopelia tranquebarica</i>	Red Turtle Dove	R	F	LC	3
Coraciformes	Alcedinidae	<i>Alcedo atthis</i>	Common Kingfisher	R	F	LC	3
		<i>Ceryle rudis</i>	Pied Kingfisher	R	VC	LC	19
		<i>Halcyon pileata</i>	Black-capped Kingfisher	M	F	LC	7
	Meropidae	<i>Merops orientalis</i>	Asian Green Bee-eater	R	F	LC	2
Cuculiformes	Cuculidae	<i>Eudynamys scolopaceus</i>	Western Koel	R	F	LC	3
Passeriformes	Aegithinidae	<i>Aegithina tiphia</i>	Common Iora	R	F	LC	3
	Artamidae	<i>Artamus fuscus</i>	Ashy Woodswallow	R	F	LC	2



Order	Family	Species	Common Name	Status	RA	IUCN BD 2015	Number of Individual
	Campephagidae	<i>Pericrocotus cinnamomeus</i>	Small Minivet	R	F	LC	2
	Corvidae	<i>Corvus leuallantii</i>	Jungle Crow	R	VC	LC	15
		<i>Corvus splendens</i>	House Crow	R	VC	LC	29
	Dicruridae	<i>Dicrurus macrocercus</i>	Black Drongo	R	VC	LC	11
	Herundinidae	<i>Hirundo rustica</i>	Barn Swallow	M	C	LC	4
	Motacillidae	<i>Motacilla alba</i>	White Wagtail	M	VC	LC	20
		<i>Motacilla cinerea</i>	Grey Wagtail	M	F	LC	5
		<i>Motacilla citreola</i>	Citrine Wagtail	M	VC	LC	25
		<i>Motacilla flava</i>	Yellow Wagtail	M	C	LC	21
	Muscicapidae	<i>Copsychus saularis</i>	Oriental Magpie Robin	R	VC	LC	23
		<i>Ficedula albicilla</i>	Taiga Flycatcher	M	F	LC	5
	Nectarinidae	<i>Nectarinia asiatica</i>	Purple Sunbird	R	F	LC	3
	Oriolidae	<i>Oriolus xanthornus</i>	Black-hooded Oriole	R	F	LC	1
	Passeridae	<i>Passer domesticus</i>	House Sparrow	R	VC	LC	24
	Pycnonotidae	<i>Pycnonotus cafer</i>	Red-vented Bulbul	R	F	LC	3
	Sturnidae	<i>Acridotheres fuscus</i>	Jungle Myna	R	F	LC	5
		<i>Acridotheres tristis</i>	Common Myna	R	VC	LC	17
		<i>Sturnus contra</i>	Asian Pied Starling	R	F	LC	22
		<i>Sturnus malabaricus</i>	Chestnut-tailed Starling	R	F	LC	4



Order	Family	Species	Common Name	Status	RA	IUCN BD 2015	Number of Individual
	Sylviidae	<i>Orthotomus sutorius</i>	Common Tailorbird	R	F	LC	1
Pelecaniformes	Ardeidae	<i>Ardea alba</i>	Great White Egret	R	VC	LC	25
		<i>Ardea cinerea</i>	Grey Heron	R	VC	LC	34
		<i>Ardea intermedia</i>	Intermediate Egret	R	VC	LC	25
		<i>Ardeola grayii</i>	Indian Pond Heron	R	VC	LC	34
		<i>Bubulcus ibis</i>	Cattle Egret	R	VC	LC	45
		<i>Egretta garzetta</i>	Little Egret	R	VC	LC	38
Piciformes	Picidae	<i>Dendrocopos macei</i>	Fulvous-breasted Woodpecker	R	F	LC	2
		<i>Dinopium benghalense</i>	Black-rumped Flameback	R	F	LC	3
Psittaciformes	Psittacidae	<i>Psittacula krameri</i>	Rose-ringed Parakeet	R	F	LC	1
Suliformes	Phalacrocoracidae	<i>Microcarbo niger</i>	Little Cormorant	R	VC	LC	43
		<i>Phalacrocorax carbo</i>	Great Cormorant	M	F	LC	18
		<i>Mus musculus</i>	House Mouse		F	LC	3

(Note: RA- Relative abundance; OS- Observation Status; VC- Very Common, C-Common, UC- Uncommon, F- Few; LC- Least Concern, VU- Vulnerable, NT- Near threatened; M-Migratory, R-Resident). Source: Field Survey and Record from Bird Watchers

4.3.4.5.1 Literature Review

Coastal areas of Bangladesh are enriched with different types of natural resources and the biodiversity of this area get some exceptional characteristics. The mudflat, coastline, coastal sandbars open water bodies supports a wide range of bio-resources in this area. Though no scientific publication does not exist particularly for the study area but there is some field report on biodiversity in this area. Besides, some research work also present on some location around the area (Jaman et al. 2023, Khan 2015, Khan 2018). Totally two species were nationally vulnerable (*Clanga clanga*, *Threskiornis melanocephalus*) two species was near threatened (*Limosa limosa*, *Numenius arquata*) according to IUCN Bangladesh 2015 and they could be present in the study area.

According to different literature reviews, the following amphibian species exist in the study area.

Table 4-25: Existing Amphibian Species in the Study Area according to the Literature Review

Class	Order	Family	Scientific Name	English Name	Local Status	Relative Abundance
Amphibia	Anura	Bufonidae	<i>Duttaphrynus melanostictus</i>	Asian Common Toad	LC	VC
Amphibia	Anura	Dicroglossidae	<i>Euphlyctis cyanophlyctis</i>	Skipper Frog	LC	VC
Amphibia	Anura	Dicroglossidae	<i>Euphlyctis kalasgramensis</i>	Kalasgram Skipper Frog	LC	VC
Amphibia	Anura	Dicroglossidae	<i>Fejervarya asmati</i>	Asmat's Cricket Frog	LC	VC
Amphibia	Anura	Dicroglossidae	<i>Fejervarya cancrivora</i>	Crab-eating Frog	LC	C
Amphibia	Anura	Dicroglossidae	<i>Fejervarya pierrei</i>	Pierre's Cricket Frog	LC	C
Amphibia	Anura	Dicroglossidae	<i>Fejervarya syhadrensis</i>	Syhadra's Cricket Frog	LC	C
Amphibia	Anura	Dicroglossidae	<i>Fejervarya teraiensis</i>	Terai Cricket Frog	LC	C
Amphibia	Anura	Dicroglossidae	<i>Hoplobatrachus tigerinus</i>	Indian Bullfrog	LC	VC
Amphibia	Anura	Microhylidae	<i>Microhyla sp.</i>	Narrow mouthed Frog	LC	VC
Amphibia	Anura	Ranidae	<i>Hydrophylax leptoglossa</i>	Cope's Assam Frog	LC	UC
Amphibia	Anura	Ranidae	<i>Hylarana tytleri</i>	Yellow Striped Frog	LC	UC
Amphibia	Anura	Rhacophoridae	<i>Polypedates leucomystax</i>	Common Tree Frog	LC	C
Amphibia	Anura	Rhacophoridae	<i>Polypedates maculatus</i>	Maculated Tree Frog	LC	C

Table 4-26: List of Reptiles Species Found in Study Area according to the Literature Review

Class	Order	Family	Scientific Name	English Name	Local Status	Relative Abundance
Reptilia	Squamata	Elapidae	<i>Hydrophis fasciatus</i>	Stripped Sea Snake	LC	F
Reptilia	Squamata	Agamidae	<i>Calotes versicolor</i>	Oriental garden lizard	LC	C
Reptilia	Squamata	Colubridae	<i>Atretium schistosum</i>	Olive Keelback	LC	UC
Reptilia	Squamata	Colubridae	<i>Ptyas mucosa</i>	Indian Rat Snake	LC	F
Reptilia	Squamata	Colubridae	<i>Xenochrophis piscator</i>	Chekered Keelback	LC	C
Reptilia	Squamata	Geckkonidae	<i>Hemidactylus brookii</i>	Brooke's house gecko	LC	C
Reptilia	Squamata	Geckkonidae	<i>Hemidactylus flaviviridis</i>	Yellow bellied house gecko	LC	VC
Reptilia	Squamata	Geckkonidae	<i>Hemidactylus frenatus</i>	Common house gecko	LC	VC
Reptilia	Squamata	Homalopsidae	<i>Cerberus rynchops</i>	Dog-faced water snake	LC	UC
Reptilia	Squamata		<i>Enhydrius enhydrius</i>	Smooth Scaled Water snake	LC	UC
Reptilia	Squamata	Scincidae	<i>Lygosoma albopunctata</i>	White-spotted supple skink	LC	UC
Reptilia	Squamata	Varanidae	<i>Varanus bengalensis</i>	Bengal Monitor	NT	VC
Reptilia	Squamata	Varanidae	<i>Varanus flavescens</i>	Yellow Monitor	NT	UC
Reptilia	Squamata	Varanidae	<i>Varanus salvator</i>	Ring Lizard	VU	UC
Reptilia	Squamata	Gekkonidae	<i>Gekko gekko</i>	Tokay Gecko	LC	UC
Reptilia	Squamata	Elapidae	<i>Hydrophis schistosus</i>	Hook-nosed Sea Snake	LC	UC
Reptilia	Squamata	Elapidae	<i>Naja naja</i>	Binocellate Cobra	NT	UC
Reptilia	Squamata	Elapidae	<i>Naja kaouthia</i>	Monocled Cobra	NT	UC
Reptilia	Squamata	Elapidae	<i>Bungarus fasciatus</i>	Banded Krait	LC	UC

Table 4-27: List of Birds Species Found in Study Area according to Literature Review

Row Labels	Order	Family	S. Name	C. Name	Local Status	RA
Aves	Anseriformes	Anatidae	<i>Anser indicus</i>	Bar-headed Goose	LC	F
Aves	Anseriformes	Anatidae	<i>Anser anser</i>	Greylag Goose	LC	F
Aves	Anseriformes	Anatidae	<i>Nettapus coromandelianus</i>	Cotton Pygmy-goose	LC	UC
Aves	Anseriformes	Anatidae	<i>Netta rufina</i>	Red-crested Pochard	LC	UC
Aves	Anseriformes	Anatidae	<i>Aythya ferina</i>	Common Pochard	LC	F
Aves	Anseriformes	Anatidae	<i>Aythya nyroca</i>	Ferruginous Duck	LC	F
Aves	Anseriformes	Anatidae	<i>Aythya fuligula</i>	Tufted Duck	LC	F
Aves	Cuculiformes	Cuculidae	<i>Cacomantis merulinus</i>	Plaintive Cuckoo	LC	VC
Aves	Cuculiformes	Cuculidae	<i>Hierococcyx varius</i>	Common Hawk Cuckoo	LC	VC
Aves	Ciconiformes	Ciconidae	<i>Anastomus oscitans</i>	Asian Open bill	LC	VC

Row Labels	Order	Family	S. Name	C. Name	Local Status	RA
Aves	Charadriiformes	Charadriidae	<i>Pluvialis fulva</i>	Pacific Golden Plover	LC	C
Aves	Charadriiformes	Charadriidae	<i>Charadrius mongolus</i>	Lesser Sandplover	LC	UC
Aves	Charadriiformes	Charadriidae	<i>Charadrius leschenaultii</i>	Greater Sandplover	LC	UC
Aves	Gruiformes	Rallidae	<i>Zapornia pusilla</i>	Baillon's Crake	LC	UC
Aves	Charadriiformes	Scolopacidae	<i>Arenaria interpres</i>	Ruddy Turnstone	LC	UC
Aves	Charadriiformes	Scolopacidae	<i>Tringa ochropus</i>	Green Sandpiper	LC	C
Aves	Charadriiformes	Scolopacidae	<i>Sterna aurantia</i>	River Tern	NT	UC
Aves	Strigiformes	Srtigidae	<i>Athene brama</i>	Spotted Owlet	LC	C
Aves	Accipitriformes	Accipitridae	<i>Elanus caeruleus</i>	Black-winged Kite	LC	C
Aves	Accipitriformes	Accipitridae	<i>Pernis ptilorhynchus</i>	Oriental Honey Buzzard	LC	F
Aves	Accipitriformes	Accipitridae	<i>Spilornis cheela</i>	Crested Serpent Eagle	LC	F
Aves	Accipitriformes	Accipitridae	<i>Clanga (Aquila) hastata</i>	Indian Spotted Eagle	EN	F
Aves	Coraciiformes	Alcedinidae	<i>Todiramphus chloris</i>	Collared Kingfisher	LC	F
Aves	Falconiformes	Falconidae	<i>Falco chicquera</i>	Red-headed Falcon	LC	F
Aves	Falconiformes	Falconidae	<i>Falco tinnunculus</i>	Common Kestrel	LC	F
Aves	Passeriformes	Lanidae	<i>Lanius cristatus</i>	Brown Shrike	LC	VC
Aves	Passeriformes	Lanidae	<i>Lanius schach</i>	Long-tailed Shrike	LC	VC
Aves	Passeriformes	Motacilidae	<i>Anthus rufulus</i>	Paddyfield Pipit	LC	VC
Aves	Passeriformes	Motacilidae	<i>Anthus hodgsoni</i>	Olive-backed Pipit	LC	C
Aves	Passeriformes	Motacilidae	<i>Motacilla madaraspatensis</i>	White-browed Wagtail	LC	C
Aves	Passeriformes	Estrilidae	<i>Lonchura malabarica</i>	White-throated Munia	LC	C
Aves	Passeriformes	Estrilidae	<i>Lonchura punctulata</i>	Scaly-breasted Munia	LC	C
Aves	Passeriformes	Ploceidae	<i>Ploceus philippinus</i>	Baya Weaver	LC	VC
Aves	Passeriformes	Nectarinidae	<i>Nectarinia zeylonica</i>	Purple-rumped Sunbird	LC	C
Aves	Passeriformes	Chloropsidae	<i>Chloropsis hardwickii</i>	Orange-bellied Leafbird	LC	UC
Aves	Passeriformes	Muscicapidae	<i>Saxicola leucurus</i>	White-tailed Stonechat	LC	C
Aves	Passeriformes	Muscicapidae	<i>Saxicola torquatus</i>	Common Stonechat	LC	C
Aves	Passeriformes	Zestropodidae	<i>Zosterops palpebrosus</i>	Oriental White-eye	LC	C
Aves	Passeriformes	Timalidae	<i>Malacocincla abbotti</i>	Abbott's Babbler	LC	C

Table 4-28: List of Mammals Species Found In Study Area according To Literature Review

Order	Family	S. Name	C. Name	Local Status	RA
Cetartiodactyla	Delphinidae	<i>Orcaella brevirostris</i>	Irrawaddy Dolphin	NT	F
Chiroptera	Pteropodidae	<i>Pteropus giganteus</i>	Indian Flying Fox	LC	F
Rodentia	Muridae	<i>Bandicota bengalensis</i>	Lesser Bandicoot Rat	LC	F

4.3.4.6 Ecosystem service

The Ecology, Economy and the cultural sector of the study area is largely influenced by coastal biodiversity and bio resources. In the economic and agricultural sector birds are playing an important role in seed dispersal and creating the land more fertile every year. Insectivore birds are playing an important role in insects' control and protecting the crops from the insects. The raptor plays an important role in vertebrate pest control. The wetland bird species like heron, egret, bittern, stork, waders, wild duck species is playing an important role in the agricultural sector of the area by providing fertilizer from their feces materials. Besides they play an important role in ecotourism. The carnivore mammalian species are playing an important role by consuming the rodent species as well as disease carrying fish and ultimately protect the fisherman from economic loss. Amphibians and reptiles are important insecticide which controls insects and protects the croplands from pests. The plant species also play a significant role in providing livelihood material to humans.

4.3.4.7 Status of Benthic species within the Waterbodies

4.3.4.7.1 Benthos

A total of three benthos species have been detected from the two different locations. *Paramecium* and *Chironomid* larvae are the common species found in both sites. *Paramecium* was abundant, of which density above 900 and 1,200 individuals/cubic meter at the peripheral canal and inner canal of the project site respectively (Table 4.29 and Figure 4.33).

Table 4-29: Status of Benthic Species Lotic Water Systems at the Proposed Project Area

Sl. No.	Group	Species Name	Abundance (Individuals/unit volume)	
			Location 1	Location 2
			Canal Near Project Site, Running water	Canal Inside the Project Area, Running water
1	Benthos	Paramecium (Protozoan)- 3	915 protozoans/ cubic meter	-
2	Benthos	Chironomid larva (Insecta)-1	305 insect larva/ cubic meter	-
3	Benthos	Paramecium (Protozoan)- 4	-	1220 protozoans/ cubic meter
4	Benthos	Chironomid larva (Insecta)-1	-	-
5	Benthos	Copepoda (Broken parts), (Crustacean)- 1	-	610 aquatic arthropods/ cubic meter
6	Phytoplankton	-	-	-

7	Zooplankton	Paramecium (Protozoan)-8	900 indiv. /L	-
8	Zooplankton	Diaptomous (Crustacea)- 1	900 indiv. /L	-
9	Zooplankton	Paramecium (Protozoan)- 12	-	1400 indiv. /L
10	Zooplankton	Cyclops (Crustacea)-2	-	1400 indiv. /L

4.3.4.7.2 Phytoplankton

None of the phytoplankton has been detected in any of the sampling sites.

4.3.4.7.3 Zooplankton

Three zooplankton species have been recorded from the same sampling locations and *Paramecium Protozoans* is the common species in both places. The outer site canal possessed *Diaptomus* Crustacean with a density of about 900 individuals/liter. The *Cyclopes crustacea* were abundant in the inner site canal and its density was 1,400 individuals/liter (**Table 4.29**).



Paramecium Protozoans



Chironomid Larvae



Copepoda



Cyclopes

Figure 4.33: Available Benthic Species within the Proposed Project Site

4.3.5 Fisheries Resources

The proposed project area is in Feni Coast near the confluence of three rivers such as the Little Feni, the Feni and the Shahbazpur Channel. Being located in the coastal belt and traversed by three river systems, the study area has much potential in fisheries and aquaculture resources. The rivers and channel have tidal influence with saline/brackish water, which provide opportunities in extending the shrimp farming around the project area. The community living around the site is largely dependent on coastal or marine artisanal fishing and shrimp farming.

4.3.5.1 Habitat Description

The study area is rich in fisheries and aquaculture habitats. The area has both inland and marine fisheries habitats, which include channel, rivers, mudflats, small canals, tidal floodplains and aquaculture habitats, which include culture fishponds. The peripherally located rivers (the Little Feni and Feni) and estuary (Shabazpur Channel), which act as essential breeding, nursing, refuge areas (pool areas) and migration gateway for various riverine and estuarine migratory fish species. The canal of the project area receives tidal floods and discharges during ebb tide. These waterways become operational during the wet season (2-3 months), connecting to the rivers and acting as temporary fish habitats.

4.3.5.2 Fisheries Management

Within the proposed project area, there is no designated fish sanctuary. However, approximately 18 kilometers southeast of the project site, in Mirsharai at Mayani Point, there exists a Hilsha spawning ground spanning an area of 125 km². The Department of Fisheries (DoF) regulates activities near this spawning area, implementing conservation protocols for Hilsha.

4.4 Socio-economic Environment

This section provides an overview of the socio-economic landscape surrounding the proposed 220 MWac Solar PV Power Plant. It examines the conditions of social and economic resources within a 5 km radius of the power plant, offering insights into the socio-economic status of the local people.

The information presented here is derived from a combination of primary and secondary data sources. Primary data collection methods included sampled socio-economic household surveys, Rapid Rural Appraisal (RRA), Key Informant Interviews (KII), Informal Group Discussions (IGD), and direct observations. Thus, a structured questionnaire was employed for the socio-economic survey, data collection facilitated through the online Kobo Toolbox software.

Additionally, secondary data was obtained from the Population and Housing Census 2011, published by the Bangladesh Bureau of Statistics (BBS), with projections made for 2024 to establish various socio-economic indicators. The socio-economic baseline conditions considered a wide array of factors including population demographics, literacy rates, occupational patterns, migration trends, income and expenditure profiles, poverty status, employment figures, and livelihood patterns.

In conducting the socio-economic survey, unions were designated as Primary Survey Units (PSU), and stratified sampling techniques were employed within the study area. The sample size determination followed the Cochran formula (1953), with parameters set as follows:

$$n = p (1 - p) \left(\frac{Z}{E} \right)^2$$

[n = sample size, p= Proportion of beneficiaries = 0.50]

Z=1.96 (at 95% confidence level, standard in application)

E = Standard error = 0.05 (or 5% is considered as standard margin of error)

Considering the relatively small number of households residing within the 5 km radius of the project area, a pragmatic approach was taken. It was decided to survey 5% of the population, not exceeding 100 households, within this demarcated study area. Thus, the total sample size is 99.

4.4.1 Administrative Area and Location

As part of the Environmental and Social Impact Assessment (ESIA) study, the geographical boundaries of the "study area". The proposed power plant, based on a 5 km radius site, is physically located within the "study area." The ESIA has a focus on the area where the physical effects of the activity are likely to be felt.

A general socio-economic profile has been prepared for the administrative units within the unions/paurashava where the proposed interventions will soon be implemented. The study area primarily consists of five unions under Sonagazi and Companiganj upazilas of Feni and Noakhali Districts, respectively. The area coverage of these unions is presented in **Table 4.30**.

Table 4-30: Administrative Boundary of the Study Area

Districts	Upazila	Unions	Union Coverage (%)
Feni	Sonagazi	Char Chandia	70.0
		Char Darbesh	29.5
		Sonagazi	22.7
Noakhali	Companiganj	Char Fakira	1.3
		Musapur	22.7

Source: IIFC ESIA Study, 2024

4.4.2 Demography

Based on linear population projection⁸, the estimated present (2024) population in the study area of the power plant is 56,493, according to the Census 2011 Report of BBS, (published in 2012) and considering the national overall population growth rate of 1.22% for 2022. The sex ratio of the overall study area is 92 males per 100 females. In the study area, the average household size is 5.1, and the projected total number of households is 8,937. **Table 4.41**

⁸ Projected Population= Present Population* (1+ growth rate) ^n, where n= number of years

presents the demographic characteristics of the study area, including the total number of households, population by gender, male-to-female ratio, and household size.

The latest BBS data (Census 2022) indicates that there are 1,648,896 people living in the entire Feni district and 3,625,252 people living in the Noakhali district. The average household sizes in the districts of Feni and Noakhali are 4.37 and 4.67, respectively. The average density of population is 560 people per sq. km, which is much lower than the national level population density of 1,015 persons per sq. km. During the field visit, no households were found in the project area, as the land is entirely owned by the government and operated by EGCB.

Table 4-31: Demographic Data of the Study Area

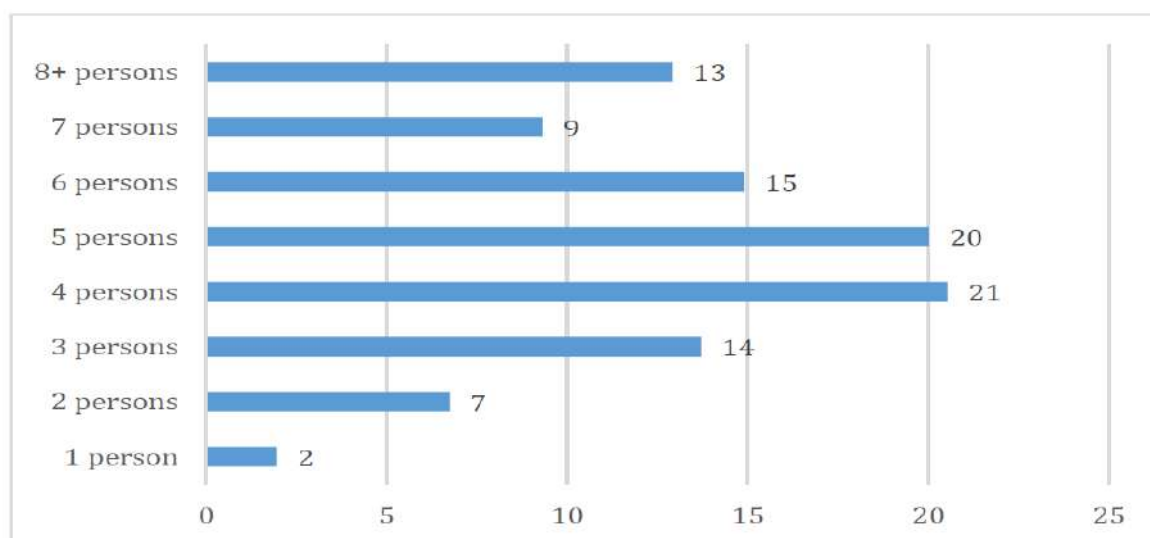
Study area	Households (nos.)	Population			Household size	Sex ratio	Population density [sq. km]
		Total	Male	Female			
	8937	48254	23171	25083	5.1	92	560
Projected population for 2024		56493	27128	29366	-	-	

*Population and Housing Census 2011, BBS, 2012 *Estimated for 2024*

Survey data confirms that out of a total of 99 households comprising 395 individuals, there are 171 males and 224 females. All households are Muslim, with only one household identified as Hindu.

4.4.3 Household Size

The average household size in the study area is 5.1, which is higher than that of national average of 4.4 (BBS, 2012). In the study area it is found that most of the households (21%) are comprised of 4 people, while 20% households are comprised of 5 people. Distribution of people per household in the study area is shown in detail in **Figure 4.51**.



Population and Housing Census 2011, BBS, 2012

Figure 4.34: Distribution of Household by Size

4.4.4 Age Composition

In the study area, 39.5% of the total population are children, who belong to the age category up to 14 years, about 52.7% of population belong to age category ranges from 15 to 59 years and they are considered as the potential workforce. On the other hand, about 7.8% belong to age category above 59 years and are considered as elderly people (**Table 4.32**).

According to the Population and Housing Census 2011, dependency ratio refers to the ratio of dependent population (population aged up to 14 years and above 59 years) to the working age population (population aged between 15 to 59 years). Considering dependency ratio in the study area, it is found that 47.3% of people are depending on 52.7% population. It is also found that the dependency rate⁹ is 90 in the study area, which is that almost 90 persons are dependent on 100 working people.

Table 4-32: Dependency Ratio according to Age

Dependent	Age group	0-4 Years	5-9 Years	10-14 Years	60-64 Years	65+ Years	Dependency ratio*
	Population %	11.5	14.4	13.6	2.8	4.9	
Work force	Age group	15-19 Years	20-24 Years	25-29 Years	30-49 Years	50-59 Years	90
	Population %	10.6	9.0	8.3	19.4	5.4	

Population and Housing Census 2011, BBS, 2012

4.4.5 Literacy Rate

Literacy rate is typically characterized in terms of the ability to read and write. At present, Bangladesh has a literacy rate of 74.22% (BBS, 2022). However, when compared to the Census 2011, the literacy rate in the study area was much lower than the national average literacy rate in 2022, which was 48%

- literacy rate of male population was 49% and female was 47%. The literacy rate of the study area by union is presented in **Table 4.33** below.

Table 4-33: Union wise Literacy Rate in the Study Area

Unions	Both	Male	Female
Char Chandia	47.8	50.7	45.2
Char Darbesh	46.3	48.0	44.9
Sonagazi	46.4	46.1	46.6
Char Fakira	51.0	50.8	51.1
Musapur	49.7	50.3	49.1
Average	48.2	49.2	47.4

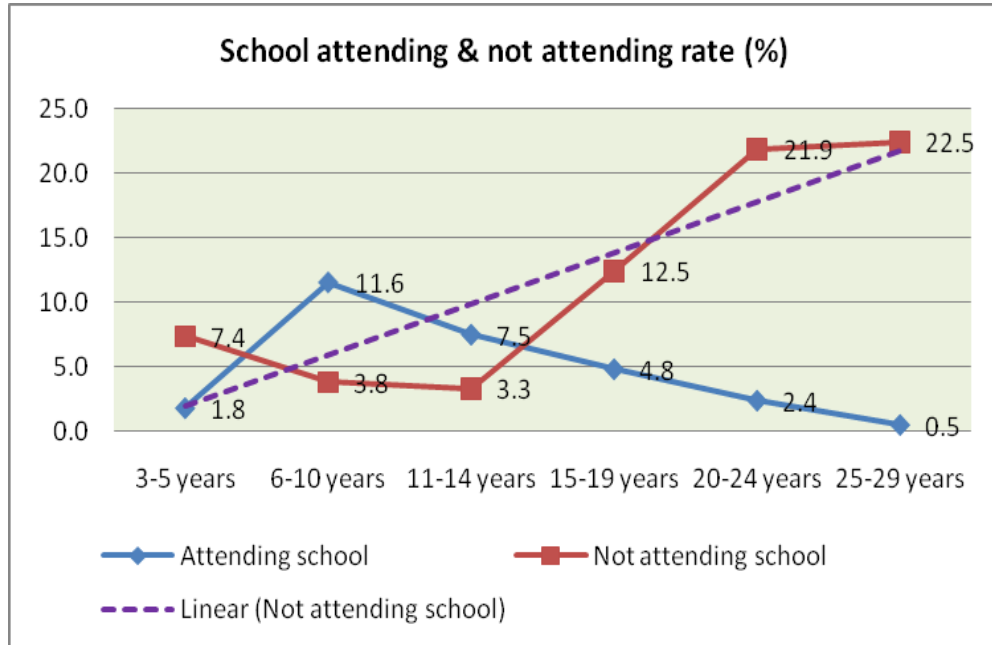
Population and Housing Census 2011, BBS, 2012

School attendance rate is measured by BBS from 3 years to 29 years by six clusters of age groups. Three (3) to 5 years is defined as preschool attendance, 6 to 10 as primary, 11 to higher secondary and finally 20 to 29 years as higher as well as advanced level attendance

⁹ Dependency ratio: A measure of the portion of a population which is composed of dependents (people who are too young or too old to work). The dependency ratio is equal to the number of individuals aged below 15 or above 59 divided by the number of individuals aged 15 to 59, expressed as a percentage.

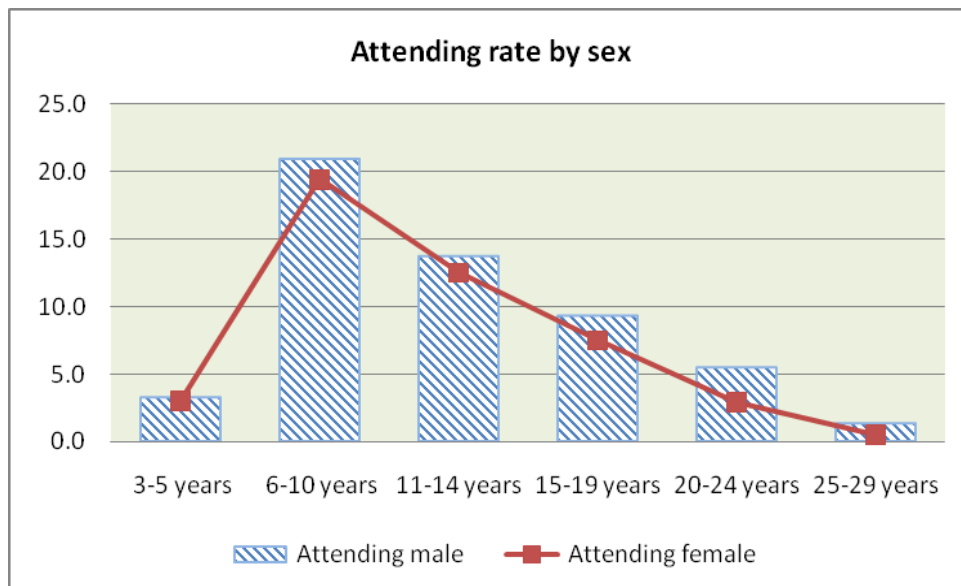
*[Using the formula: Dependency ratio DR = Number of dependent (age 0-14 and 60+) / Workforce (age 15-59) x100]

at educational institutions. Comparative picture of attending and not attending rate shows that net attendance rate is the highest (11.6%) at primary level then the rate starts declining. The secondary level shows the threshold point from which not attending rate moves upward and the attendance rate starts declining. This trend is true for higher as well as advanced level studies (Figure 4.35 & 4.36).



Population and Housing Census 2011, BBS, 2012

Figure 4.35: Portrayal of School Attending and Not Attending Rate by Age Groups



Population and Housing Census 2011, BBS, 2012

Figure 4.36: Comparative Picture of Male- Female Attendance Rate

Male-female attendance ratio is almost equal with a little difference at primary level in which female attendance is comparatively higher than that of males. Field findings confirm that

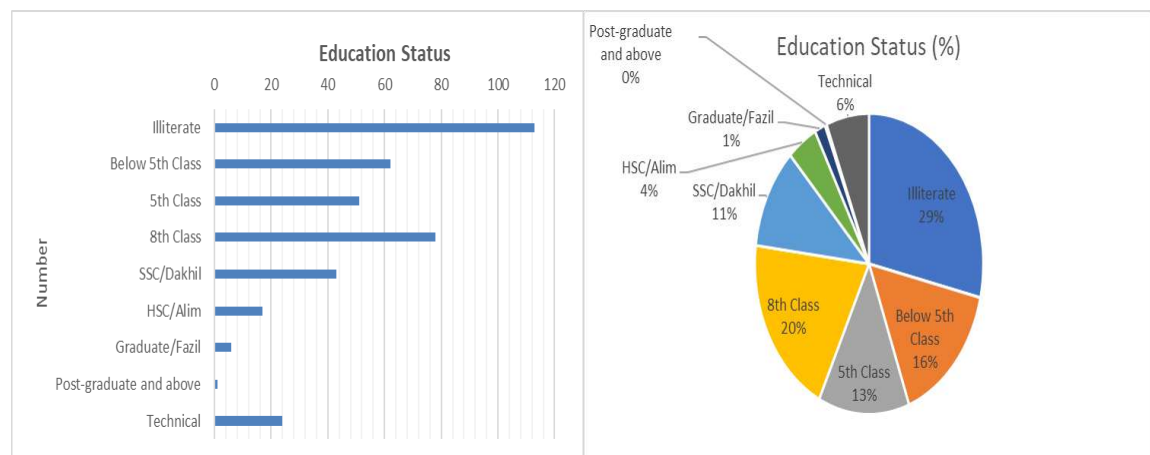
female attendance at this stage is higher because of existing scholarship program of the Government, and the parents also consider this basic schooling as an investment for securing a good marriage of their girl child. It is also observed, and data confirms that after completion of primary education, most of the girls get married and therefore, the attendance rate gradually starts decreasing. However, male attendance rate also starts decreasing due to their involvement in income generating activities.

There are about 10 privately owned preschool facilities located mostly in municipal areas. These schools are expensive and largely unaffordable for the poorer classes of people. Data confirms that preschool attendance rate is 1.5%, whereas attendance rate is 6.5% (3 to 5 years), which suggests a class bias.

Most urban institutions and a limited number of rural institutions are assisted with technology (computer and internet facilities) by the Government. However, these facilities are inaccessible to the students, as in most of these institutions there is no suitable operator to orient the students on the use of these modern technologies.

The survey also confirms the same scenario and 29% of people (highest in percentage) are still illiterate. Those who have passed class eight constitute 20%, while the remaining 16% are below class five, 13% have completed class five, and 11% have studied up to SSC level.

Figure 4.37 shows details of educational status of the studied unions.



Source: CEGIS Socio-economic Household Survey, 2024

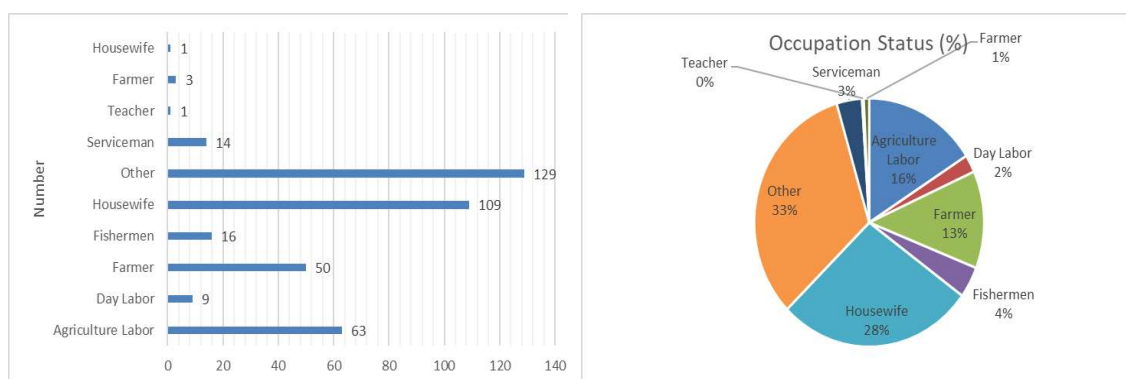
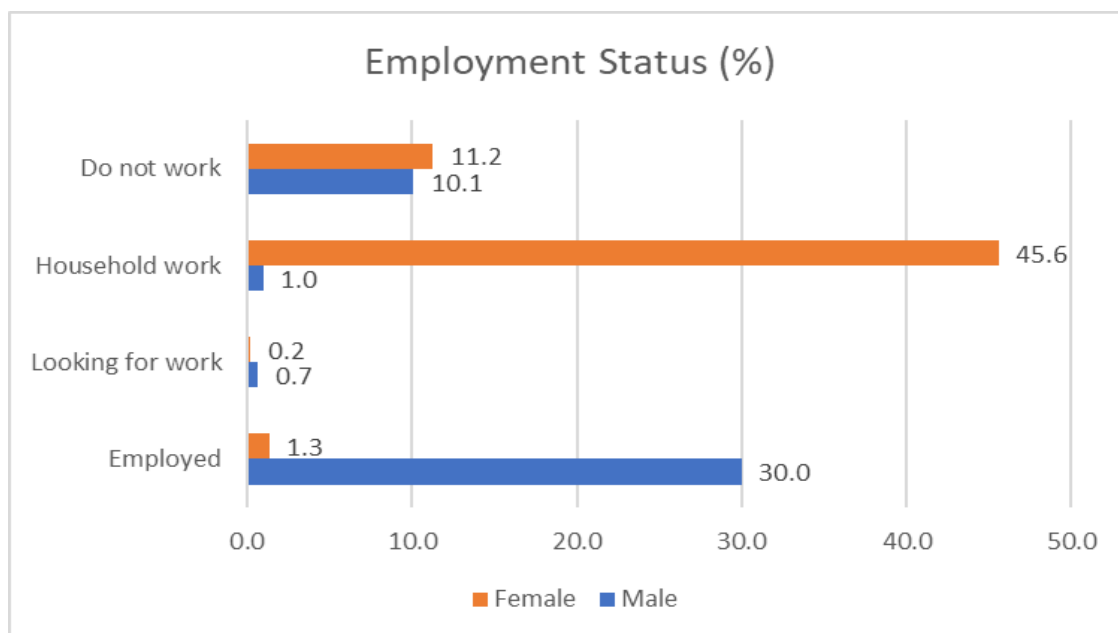
Figure 4.37: Educational Status in the Studied Unions

4.4.6 Employment Status

Data shows that about 31.3% of the population (aged 7+ not attending school) is employed in different sectors of which 30% are male and 1.3% are female. Similar way, about 46.5% of population are doing household work and majority of them are female. Women's involvement in different sectors is very poor. Due to cultural restriction women are less like to expose themselves. They are mostly involved in household activities. A large number of people still remain unemployed (21.3%) and dependent on the members of their household. The employment status of the study area is presented in **Figure 4.38**.

According to the survey data, 33% of respondents (the highest in percentage) are engaged in other occupations such as running small shops, businesses, or various types of work. A

significant portion of women (28%) are identified as housewives. Additionally, 16% are involved in agriculture as laborers, 4% are fishermen, and 13% are farmers.



Population and Housing Census 2011, BBS, 2012

Figure 4.38: Employment Status of the Studied Population

4.4.7 Labor Availability and Wage Rate

The agricultural land in the study area is reducing day by day. As a result, a few number of people are engaged in farming activities and most of the laborers are engaged in non-farming activities, such as earth work, masonry. The availability of non-farm laborers is medium. Male laborers get more wages than the female laborers.

In agriculture sector the wage rate varies from BDT 500 to BDT 700/day for males, whereas wage rate in non-farming sector varies from BDT 800 to BDT 1000 for working 6 hours in a day. Women's participation in agriculture or any other occupation is negligible. They only work at household level due to necessity (**Table 4.34**).

Table 4-34: Labor Availability and Wage Rate in the Study Area

Type of Activity	Male Labor Availability*	Wage Rate (TK)	Female Labor Availability*	Wage Rate (Tk)
Agriculture	L	550-650	-	-
Non-agriculture	M	800-1000	L	600-650

*L –Low; M-Medium

Source: IIFC ESIA Study, 2024

4.4.8 Income and Expenditure

Household income and expenditure are important indicators to measure the socio-economic condition of people. It was found in the study area that most of the income and expenditure varies from BDT 5,000 to BDT 20,000/month. Here, range between 5000 to 9000 is very much significant in terms of income and expenditure. In the study area a large portion of people's main income is service. It is also found that the expenditure of people with monthly income within the range of 5000-9000 is higher than income.

According to the field findings (**Table 4.35**), there are eight categories of sources of income in the study area. The major source of income is farming (37%) followed by business (18%), fishery (13%) and working in a foreign country (10%). Due to the growing impact of urbanization, agricultural land is reducing day by day, so, a small portion (7%) of the working force is involved in the service sector.

Table 4-35: Distribution of Households by Income Sources in the Study Area

Sources of Income	Working Household (%)
Farming	37
Fishery	13
Business	18
Foreign currency	10
Service	7
Transportation	5
Day labor	10
Total	100

Source: IIFC ESIA Study, 2024

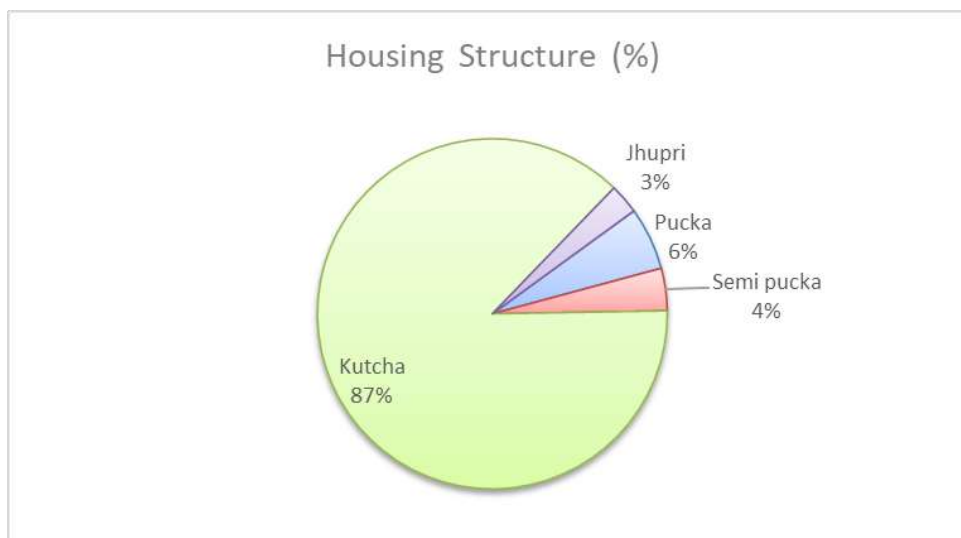
4.4.9 Standard of Life Indicators

The household patterns, sanitation facilities, drinking water status, electricity coverage, fuel consumption and telecommunication access are representing quality of life, details are presented below.

4.4.9.1 Housing Condition

There are no dwellings or settlements within the project area, and no residences are nearby. Most houses in the study area are in poor condition. Most households (87%) live in kutcha houses, while only 6% households have pucca houses, and 4% have semi-pucca houses. Additionally, 3% of households live in jhupri houses. Char Chandia Union has the highest percentages of pucca houses (8%), whereas Char Fakira Union has the most kutcha houses

(92%). Overall, housing conditions are very poor, but there is gradual modernization happening across the area (**Figure 4.39**).

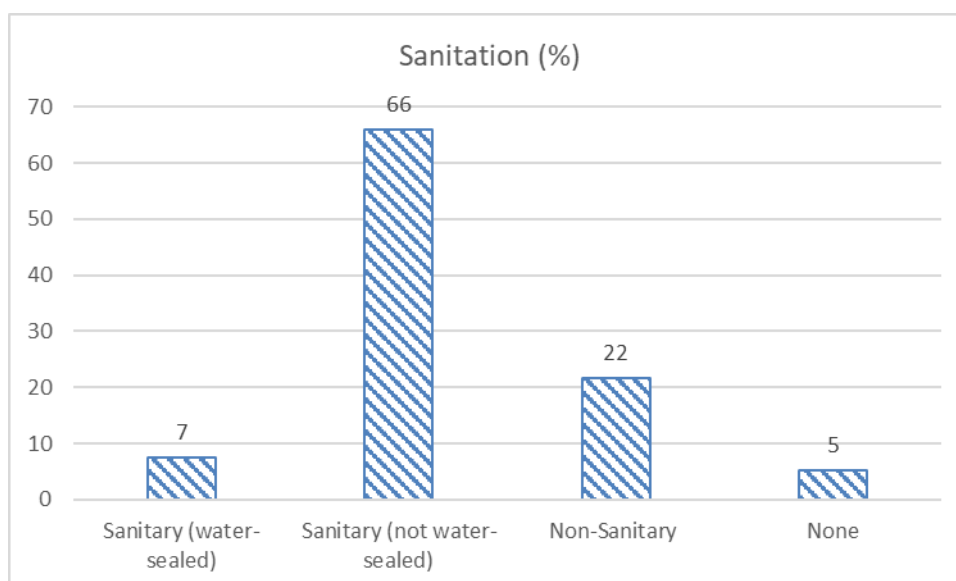


Source: Population and Housing Census 2011, BBS, 2012

Figure 4.39: Type of Housing Structure in Study Area

4.4.9.2 Sanitation Condition

Sanitation facilities in the study area show that about 22% of households use non-sanitary latrines, 66% use non-water-sealed sanitary latrines and 7% use sanitary water-sealed latrines. Field findings confirmed that non-water-sealed sanitary latrines are predominant among semi pukka houses; they contain the highest coverage. Water-sealed sanitary latrines are available predominantly in pukka houses. However, there are 5% of houses which have no sanitation facilities but tend to use sanitary facilities on shared basis and in some cases use open spaces (**Figure 4.40**).



Source: Population and Housing Census 2011, BBS, 2012

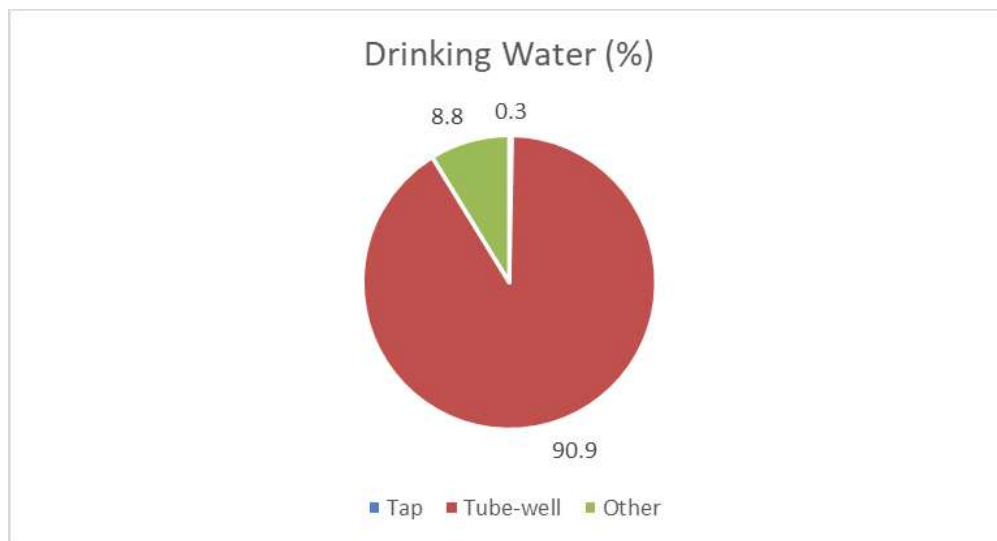
Figure 4.40: Sanitation Facilities in the Study Area

Survey data confirms that sanitation conditions in this area are improving. About 98% of households have toilets, 61% of them are hygienic/sanitary and 39% are unhygienic. The situation is getting better day by day.

4.4.9.3 Drinking Water

Collection of drinking water from tube well is predominant (90.9%) throughout the study area. Supply of “tap water” is mainly found in municipal areas on rental basis. This supply system depends on the abstraction of groundwater. However, 8.8% of households still depend on open water bodies like ponds, canals for drinking and other purposes. These households are basically poor and live in the rural areas having no access to tube-wells.

Figure 4.41 shows the drinking water status of the study area.



Source: Population and Housing Census 2011, BBS, 2012

Figure 4.41: Distribution of Drinking Water Facility in the Study Area

According to the household survey, 64% of local people believe they know about arsenic in tube well, 14% have no idea, and 21% have never heard of it. This indicates that many people are not aware of the dangers of drinking water.

4.4.9.4 Electricity Coverage

Upazila-wise electricity coverage data is not available in the 2022 BBS census data. However, district-wise data indicates that 99.65% of households are under electricity coverage, showing significant improvement compared to 2012 data, which was 37.5%. The distribution of this coverage is as follows: 99.40% from the national grid, 0.19% from solar power, 0.17% from other sources, and 0.24% without any electricity connection. Overall, Feni district is now in a very good condition regarding electricity connections, suggesting a homogeneous distribution of electricity coverage across the entire study area.

4.4.9.5 Fuel Consumption

The households of the study area use wood, cow dung sticks and dried up water hyacinths (Kochuripana) as fuel and a few households use liquefied petroleum gas (LPG) gas in cylinder to meet their daily needs of fuel consumption.

4.4.9.6 Telecommunication

The telecommunication sector system in the study area has spread quickly like other part of Bangladesh. People of the study area use different operating system of telecommunication service providers like Grameen Phone (GP), Banglalink, Teletalk, Airtel, and a very few use TNT. People's preference of selection of telecommunication system depends on low cost of talk time. The area has good internet facility under "Digital Bangladesh" initiative of the Government.

4.4.10 Vulnerability of People

Vulnerable people in this area include those who are disabled, landless, or living in female-headed households. Due to natural calamities and river erosion, many have relocated here in search of suitable shelter. During the field survey, numerous cyclone-affected individuals were found, struggling with income, which hampers their efforts to overcome poverty. Additionally, there are physically challenged individuals who receive an allowance from the upazila office, but it is insufficient to meet their needs. These factors contribute to the ongoing struggle of vulnerable populations in the area.

4.4.11 Labor Migration

Considering better employment opportunities, both permanent and temporary migration are found in the study area. People usually migrated to different districts like Dhaka, Chattogram, Feni, Noakhali, Mymensingh, Sylhet and Comilla search for better working opportunities. Some of them permanently migrated while some others seasonally migrate from this area. Mainly laborers tend to seasonal migration, they migrate during the month of Ashwin/Kartik to Chaitra for cultivating, harvesting of crops, and working in brick fields. Conversely, a number of people tend to migrate to foreign countries; preferably to Middle East countries and Malaysia (Table 4.46).

Table 4-36: Migration Status in the Study Area

Type of Migration	Out Migration		In Migration	
	Place of destination	% of total population	Place of origin	% of total population
Seasonal migration	Dhaka, Chattogram, Feni, Noakhali, Mymensingh, Sylhet and Cumilla	10-15	Adjacent area (unions)	1-2 from total laborer migration
Permanent household migration	Dhaka, Chattogram	2	-	-

Source: IIFC ESIA Study, 2024

4.4.12 Land Price

The land prices vary across the research region. Land prices range from BDT 30,000.0 to 40,000.0 per decimal. Near the Char Chandia Government Primary School, the cost is BDT 45,000.0 (forty-five thousand) per decimal. Agricultural land prices fluctuate between BDT 20,000.0 to 30,000.0 per decimal, while commercial land price in the area is more than or equal to BDT 1 lakh.

4.4.12.1.1 Infrastructure Resource

The study area encompasses two upazilas: Sonagazi and Companiganj. However, the project area is specifically within Sonagazi Upazila. According to upazila government data, Sonagazi Upazila has three RHD highways of 664 km in total. The area also includes 700 mosques, 25 temples, 18 growth centers, 57 cyclone centers (of which 43 are usable), 10 sluice gates, and 1 flood shelter. Companiganj Upazila, located in the Feni district, has 254 mosques, 31 temples, 61.72 km of paved roads, 17 growth centers, 3 rehabilitation projects, and 3 shelter projects (Ashroyon) for landless people.

4.4.13 Cultural Heritage

No significant cultural heritage sites are found in the study area.

4.4.14 Gender Issues

4.4.14.1.1 Education Enrolment

Enrolment in education shows the difference regarding attending and not attending school for both sexes. In terms of attending school both male and female rate of education for 6 to 10 years and 11 to 14 years is almost similar while this situation is very awful for higher studies. It is clear that women are still backward than the male counterpart to become educated. This tradition has now been changing, and people of the area are now concentrating on female education

4.4.14.1.2 Health Conditions

About 18% of women are in good health, while the rest suffer from various conditions such as low blood pressure, hypertension, and premature delivery. Approximately 15% of women receive proper nutrition, and around 10% have access to health centers. The mortality rate of pregnant women during delivery has decreased over time, primarily due to increased awareness among local people and the health services provided by public and other health centers, including NGO programs.

4.4.14.1.3 Employment

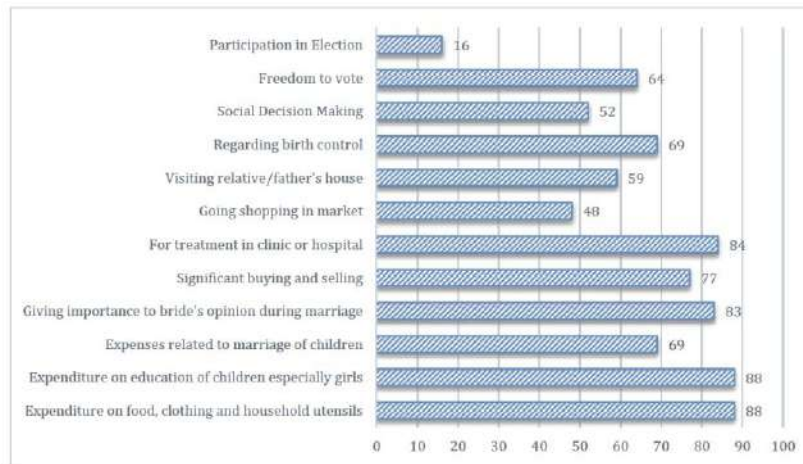
Female participation is negligible compared to male participation in the study unions. Among the employed population, only 1% are female, and they are predominantly from Hindu families. Women are mainly involved in seasonal earthwork, household-level handicrafts, poultry farming, and similar activities.

4.4.14.1.4 Empowerment

In the study unions, the status of women has changed significantly over the last few decades. Many Hindu women have moved beyond traditional roles and are now working alongside men in various fields, including earthwork, tailoring, and teaching. However, Muslim women remain more restricted to household duties and typically stay at home, except for medical visits, fetching water, and visiting relatives.

During the household survey, it was found that participation in elections is very challenging for women, as it is not a common practice in the area, with only 16% expressing a willingness to participate. Social decision-making and activities like visiting relatives, going to their

father's house, and shopping at markets are also uncommon, with participation rates of 52% and 59%, respectively. However, women have significant influence in decisions making regarding birth control, medical treatment, and buying or selling goods. **Figure 4.42** illustrates the distribution of women's decision-making in everyday life.



Source: IIFC ESIA Study, 2024

Figure 4.42: Division of Decision-Making among Women in the Family

4.4.15 Transportation & Communications

The people in the surrounding area primarily relies on CNG-powered auto-rickshaws, electric rickshaws, and minibuses for transportation, with a network of roads spanning 520 kilometers throughout Sonagazi Upazila. Feni District is strategically located along the Dhaka–Chittagong transportation corridor. A highway from Chandpur to Chittagong, passing through Comilla and Feni, was constructed to enhance connectivity within the region, with a significant portion incorporated into the Dhaka–Chittagong Trunk Road.

4.4.16 Economic Conditions

Agriculture constitutes a significant portion of the sources of income for Sonagazi, contributing approximately 36.40% to the economy. The primary crop cultivated in the upazila is rice (paddy).

Other major sources of income include commerce (12.67%), services (15.62%), rent and remittance (14.04%), and various other activities such as non-agricultural labor (3.35%), industry (1.58%), transport and communication (4.40%), construction (2.11%), and religious services (0.56%). Some important marketplaces in Sonagazi include Kuthirhaat, Bektarmunshi Bazar, Mongolkandi, Olama Bazar, Saudagar Haat, Bhairab Chowdhury Bazar, Mongazi Bazar, Sonagazi Bazar, Amirabad Bazar, Nababpur, Bhorbazar, Kazir Haat, Naar Miar Haat, Bagher Haat, Koramia Haat, Motiganj Bazar, Kashmir Bazar etc.

In the coastal "char" areas surrounding the expansive Feni River, agriculture, fish farming, and harvesting marine fish from the river constitute the primary livelihood sources for the local populace. Additionally, residents engage in raising cattle, buffaloes, and sheep in the grazing lands. Buffalo milk and cow's milk from these areas are distributed to other regions.

5 IMPACT PREDICTION EVALUATION AND MITIGATION MEASURES

The intervention(s) of any development work may have adverse or beneficial impacts on the physical, biological and socio-economic environment. The impacts can also be temporary, reversible or permanent that may appear at different phases of the project like during pre-construction, construction and operation. **Table 5.1** shows the potential impacts and corresponding mitigation measures in different phases of the power plant and a 10 km access road. **Table 5.2** shows specific impacts of the power plant and access road.

5.1 Physical Environment

5.1.1 Ground Water Availability Assessment

Analysis of groundwater level in the study area and an assessment of groundwater recharge within the project area were done, using the Potential Recharge data of National Water Management Plan (NWMP).

The groundwater data of BWDB observation well around Sonagazi, Feni (Station FEN008) was collected from NWRD-CEGIS database archives for the period of 1978 to 2007. The average of 30 years' data shows that the depth of groundwater level from the ground surface sinks in the dry season up until July, with the highest average groundwater depth in March. Conversely, the water table rises during monsoon due to recharge by rainwater and peripheral river water. Consequently, the lowest, shallowest depths of groundwater can be observed from July to November. The monthly maximum and minimum depth of groundwater from the ground surface during this period are also shown in **Figure 5.1**

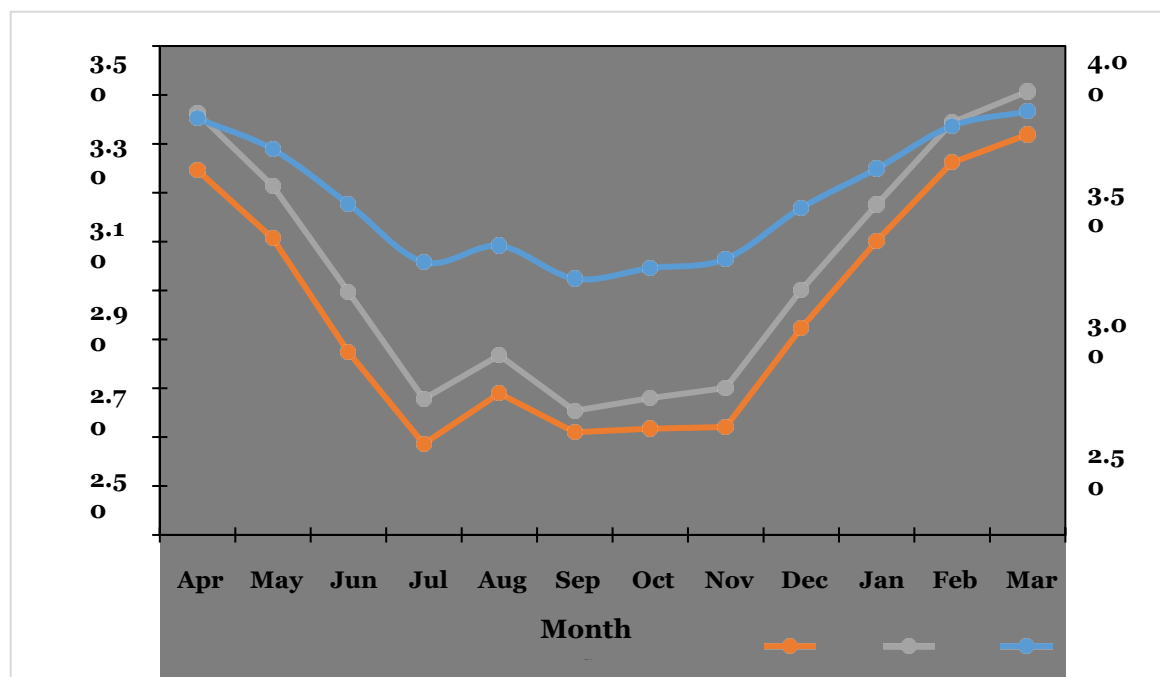


Figure 5.1: Depth of Groundwater Near Sonagazi, Feni at FEN008 Station

The above graph illustrates the seasonal variation in groundwater levels from April to March, based on data collected over a 30-year period from the BWDB observation well near Sonagazi, Feni. The graph features three color-coded curves that represent different groundwater depth levels. The blue curve shows the maximum groundwater depth, which deepens during the dry months, peaking in March, reflecting the lower availability of water. The grey curve represents the average depth of groundwater throughout the year, generally following the same trend as the blue curve, but it remains slightly higher, indicating a more stable level compared to the extremes. The orange curve depicts the minimum groundwater depth, which is at its shallowest during the monsoon months (July to November), when groundwater is recharged by rainfall and river water inflows. Overall, the graph reveals that groundwater levels are deepest during the dry season and shallowest during the monsoon, as the groundwater is replenished by seasonal rainfall and surrounding rivers.

Potential Recharge Data of National Water Management Plan Project: According to Draft Development Strategy, Volume 4, Annex C: Land and Water Resources, 2004,

The Potential Recharge for Sonagazi Upazila, Feni are: PR1- 1483mm (on F3 and F4 land) and PR2- 1607mm (on F2 to F4 land). Since 80% of the Study area is under the classification of F1 land type, i.e., Medium Highland, therefore, PR2-1607mm is used to determine the Recharge Availability of the Project area.

Recharge Availability

$$= 75\% \text{ of Potential Recharge (PR) Recharge Availability} = 75\% \text{ of } 1.607 \text{ m}$$

$$= 1.2075 \text{ m}$$

$$1 \text{ Acre} = 4,046.86 \text{ sq.m}$$

$$\text{Project area: } 700 \text{ acres } (2,832,802 \text{ sq.m})$$

The volume of recharged water (available water) within the Project area

$$= \text{Area of the project area} \times \text{recharge availability}$$

$$= 2,832,802 \times 1.2075 \text{ m}^3/\text{year}$$

$$= 3,418,738.92 \text{ m}^3/\text{year}$$

$$\sim 390.61 \text{ m}^3/\text{hr}$$

This means the volume of available recharged groundwater within the 700-acre project area is approximately $390.61 \text{ m}^3/\text{hr}$, which represents the safe yield for this area.

5.1.2 Drainage Condition

The Project area is intercepted by two (02) narrow drainage canals (khals). The EGCB is planning to dredge the canal to increase its water holding capacity and also making it straight.

Since there are two canals inside the project area, which is connected to the Feni River, it could be a good alternative for water sources for panel cleaning. But due to its saline nature, it is not possible to use the water for panel cleaning. The impact could be corrosion in

metallic structure, reducing capacity, Mineral deposition on panel etc. The water quality data is shown on **Table 4-8**.

However, the water can be used after removing saline and other dissolved solids by water treatment plants. Removing salinity from river water needs technology like reverse osmosis which is costly and not feasible for this project.



Figure 5.2: Existing Canals inside the project Area

The drainage networks are connected directly to the Feni River, and since the land will be elevated by 1.0 Meter so, issues like waterlogging will not occur in the project area.

Moreover, construction works of the Power Plant might pose a substantial adverse impact on the drainage system of the project area as well as the study area. For this, to mitigate the impact, an adequate number or capacity box culverts/sluice gates should be constructed to facilitate efficient drainage in the project area. Alongside, water regulation structures, drainage pump(s) should be installed to combat the emergency when gravity drainage system is failed. Also, to improve and smooth the drainage system and associated inundation risk, re-excavation of the internal and external connecting canals is suggested and disposing of the excavated materials in a manner not slide back to the canal. It is suggested to use the excavated materials for filling the land, road or dike construction of the project site.

The available surface water as having salinity cannot be used for cleaning purposes of the solar panels. Because it may corrode the panel structures and can create a thin film over the panel surface, which would reduce their efficiency in absorbing sunlight and converting it into electricity. Constraining by salinity in surface water, three alternatives have been discussed in this regard. These alternatives are:

- Ground water
- Ponding water

- Rainwater Harvesting

Groundwater with due assessment can be used for panel cleaning. Use of groundwater for panel cleaning in the dry season (November to May) might result in a drawdown effect in the groundwater table, which may cause shortfall in hand tubewell withdrawal for potable purposes of the local people. Extraction of groundwater over a long period might cause depletion of the source if not recharged from either rainfall events or from the peripheral rivers.

Besides, rainwater harvesting can be implemented using solar panels as the collectors and the existing canal for reservoir as a supplementary option to reduce pressure on groundwater.

Mitigation Measures for Water Quality and Resources, Flooding and Waterlogging

Mitigation Hierarchy	Measures
Avoid	• No khals or creeks should be negatively disturbed from their natural structure • No storing the construction materials near the waterbodies and community area.
Minimize	• Internal khals should be kept unobstructed, and their connectivity with other khals or rivers should be maintained.
Mitigate	• Construction of peripheral dike from South West to South East corner and from South east to North East portion toward the Feni River. • Marginal dike construction to reduce the risk of tidal river flooding from the Feni River and the Little Feni River from North East corner to North West Corner and North West Corner to South West direction. • New Land Formation to avoid flooding issues due to extreme flood events. Considering average formation level at 5mPWD, 1.0m elevation of land on average is recommended. • Elevated solar panels are recommended to avoid damaging them during flooding conditions. • Two culverts (5 Vent at Inlet-1, 3 vent at inlet-2) to facilitate efficient drainage from the project area. • Two regulators (5 Vent and 3 Vent, with 1.5mX2m Size) at Southern Boundary to manage water levels and ensure effective drainage. • Flood water and rainwater reservoir to store excess water and prevent flooding • Establish grass carpeting in the unpaved area where possible • Re-excavation of IR-7A and 8B khals to improve water flow and reduce flood risk. • Avoid spillage of oil or chemical directly to soil to avoid groundwater pollution • Avoid overextraction of groundwater which will eventually cause the water table to deplete as well as chance of saline water intrusion will be higher • Avoiding waste & wastewater (Construction water) dumping into nearest canals and rivers to avoid surface water pollution • Rainwater collecting pipes & storage facility should be cleaned regularly to avoid pollution
Compensation/Offset	N/A

5.1.3 Water Requirements

5.1.3.1 Water requirements for panel cleaning

Considering 2 liter/m² and two cleanings per month an average requirement of about 50,73,476 liters of water will be required for the panel cleaning activity. It is mentioned

previously that 9.8 months, rain took place so it can be concluded that, in that time manual washing is not required.

The rest of the month (2.2 Months) is needed for panel washing, so $(50,73,476 \times 2) =$ Around 1,11,61,647 Liters of water is required for washing purposes (For whole Year).

However, only 80,45,157 Liters of Water will be accumulated via the rainfall as calculated on 3.11.1. Besides, about 400 acres of land is needed for a pond to be developed with a water dept of 5 meters to gather all the water which is not feasible.

So, the modified canal can hold rainwater during rainy season and later can be used for panel cleaning. Excessive water can be drained through sluice gate or pump during rainy season to avoid waterlogging. During the end of dry season, sluice gate should be closed at the end of the canal so that, during rain only the rainwater will accumulate in the canals which will be used during the dry season when rain is unavailable.

However, it is becoming good practice to dry-wash solar panels with automated cleaning robots which also run in solar power. Additionally, manual cleaning with brush can be a good alternative instead of using water.

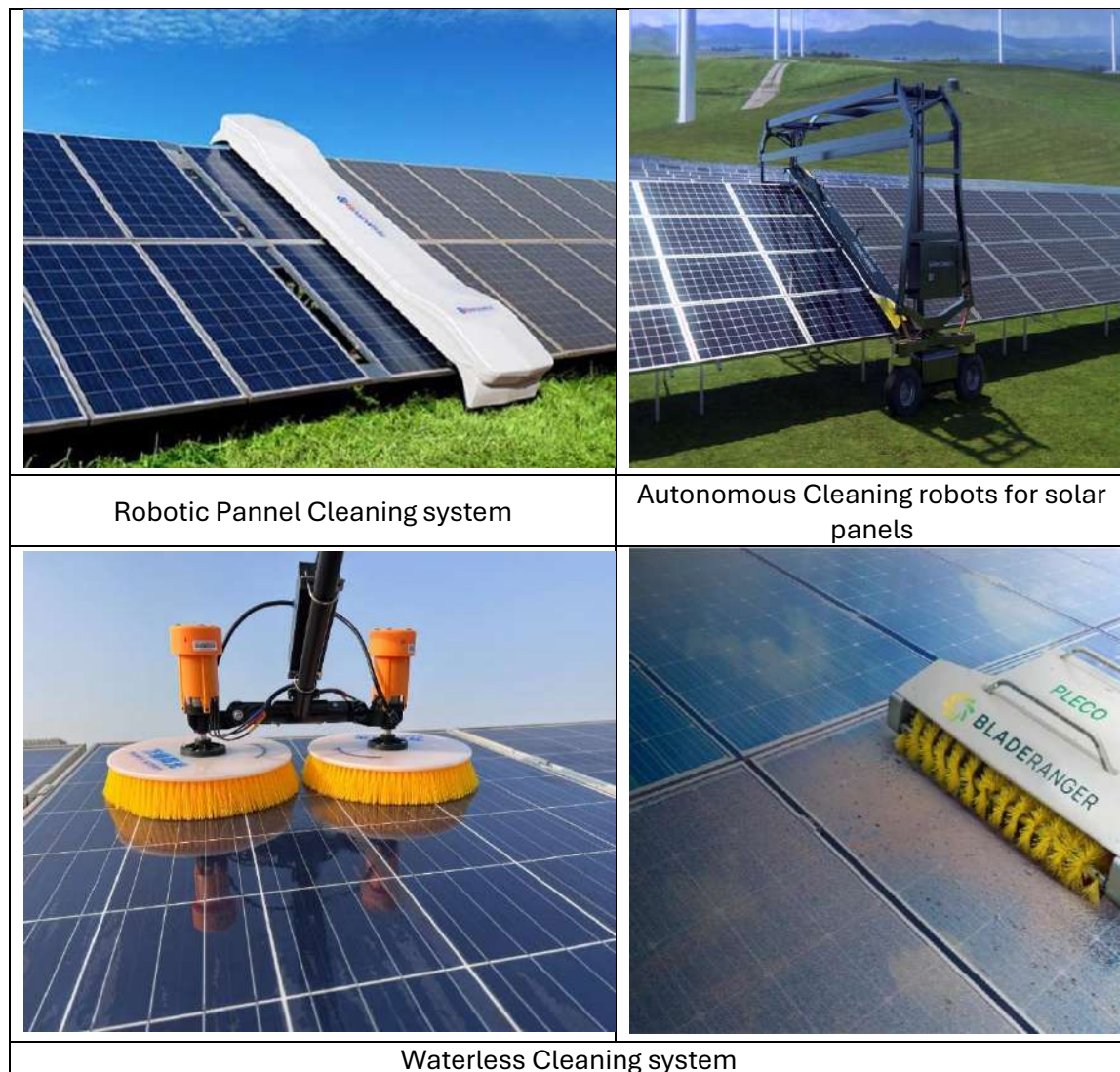


Figure 5.3: Waterless Solar Panel Cleaning System

Since, only 2.2 to 3 months the dry washing will be applicable (rest of the month is rainy period) so, it should be good alternatives, However, If dry cleaning won't work or where water seems to be the only option, then the harvested rainwater from the canal can be used.

This will save groundwater extraction for solar panel cleaning, but can be used for drinking, cooking and other household purposes of the workers of the plant area.

5.1.4 Water requirements for household purposes

During Construction period, considering maximum 100 People and average water use of 60¹⁰ Liter per day per person about 6,000 Liter of total water is required for drinking, bathing, cooking sanitation and other household purpose.

For **One year of construction phase**, it is: **21,90,000 Liters of water**

During **Operation period**, considering maximum 60 people and average water use of 60 liters per day per person about 3600 Liters of water is required.

Considering the **operation period of 20 years** about **2,62,80,000 Liters of water will be required.**

Table 5-1: Comparison between Groundwater Recharge and Extraction Rate

Ground Water Recharge Rate	Water Extraction Rate
– 390.61 m ³ (Liter) per hour	– 2,84,70,000 Liters for 21 Years
– 9,375 Liter Per Day	– 13,55,714 Liter per Year
– 34,21,875 Liter Per Year	– 3714 Liter per Day
– 6,84,37,500 Liter in 20 Years	– 154 Liter per Hour

Although the “Ground Water Availability Assessment” finding shows that it will not affect the groundwater table, but it is suggested to install rainwater harvesting system in the building roof to meet some of the requirements like bathing, cloth washing, sanitation etc.

5.1.5 Landfilling

The project area does not experience prolonged drainage congestion, waterlogging, or frequent flooding. But even a low level of flooding of 0.1-0.2m depth could inundate the panel premise and damage the solar panels, due to their sensitivity to tidal flood water having a salinity front. Therefore, the project area is proposed to be elevated by 1.0m considering the average formation level at 5mPWD. Furthermore, to reduce the substantial risk of tidal river flooding from the Feni and the Little Feni Rivers, a peripheral dike with 9.5mPWD and 8mPWD crest level and 6.5m width is provisioned under the project.

Besides, due to the proneness of experiencing cyclones and extreme natural hazards of the area due to its proximity to the Bay of Bengal, it is likely to experience storm surges and rising sea levels. These may raise substantial risks of flooding and drainage congestion in the area. To protect the areas from such extreme events, sea dike construction in the southern

¹⁰ According to the Bangladesh National Building Code (BNBC) 2020, domestic water requirements for cities and large district towns range between 40 to 260 liters per capita per day (lpcd) for residential buildings, 35 to 70 lpcd for educational facilities, 70 to 180 lpcd for institutional facilities, 135 to 340 lpcd for health facilities, 45 to 70 lpcd for business establishments, and 25 to 40 lpcd for industrial buildings. In rural areas, studies indicate an average daily water consumption of approximately 62.5 lpcd.

boundary is proposed. The sea dike height is also calculated to be at the level of 9.5mPWD with 6.5m width.

5.1.5.1 Landfilling material requirements (mostly sand):

For project area with 700-acre land,

$$700 \text{ Acre} = 700 \times 4046.86 \text{ m}^2 [\text{1 Acre} = 4046.86\text{m}^2]$$

$$= 2,832,802 \text{ m}^2$$

$$\text{Required Height} = 1 \text{ meter}$$

$$\text{Soil Requirements} = \text{Volume} = \text{Area} \times \text{Height}$$

$$= 2,832,802 \text{ m}^2 \times 1 \text{ Meter}$$

$$= 28,32,802 \text{ m}^3$$

For Dyke construction,

$$\text{Estimate Total Perimeter for the 700-acre land,} = 6728 \text{ Meter (Approximately)}$$

$$\text{Considering 6 Meter Width and 9.5 Meter Height the area} = 9.5 \times 6$$

$$= 47.5 \text{ m}^2$$

$$\text{Total sand requires} = 6728 \times 47.5$$

$$= 3,19,580 \text{ m}^3$$

5.1.5.2 Material (Sand) Source

The sand required for landfilling and dyke construction will be collected from “Urirchar area” where sand will be extracted from ocean floor and then will be carried out by Large Barge to feni river. The location is approximately 8-10 Kilometers away from the project location.

Sand deposition occurs in this area due to oceanic activity and Sand will be extracted from this area without affecting any landmass and environmentally sensitive features.



Figure 5.4 : Potential Source of Landfilling Material (Sand) for the Project area

The Barge will travel as close to the project area by Feni River, and from the barge, the sand will be transported with pipe suction method to the filling area.

5.1.5.2.1 Expected Impact and Mitigation measures

Since the sand will be collected from ocean floor (unstable charlandd) and away from stable landmass it is expected to have the least environmental and social impacts from the extraction. However, the machinery used by the extraction process, Barge movements and suction process can cause air, noise and water pollution. Besides, occupation, health, safety and risk are also involved in the process. Here is the list of mitigation measures that should be followed during the land filling activity

- Good Quality Engine should be used to operate the machinery to avoid air pollution
- Engine oil, waste product should not be directly through away to the water
- Life jackets, emergency boats, rescue teams contact number, and techniques should be available on the extraction platform as well as Moving Barges.
- Workers working near the suction engine should wear protective measures like noise mufflers to save themselves from additional noise impact.

The above method is more appropriate than transporting material by road. So, this process has the least environmental impact compared to any other technique.

5.1.6 Environmental Quality

5.1.6.1 Water Quality

Oil from construction machineries/transformers/ oil and chemical storage area, bentonite slurry from boring piles and other construction waste might significantly change the water quality and amount of minerals along with other components which are needed to keep within certain level for the survival of aquatic plants. Groundwater is also a potential source for panel cleaning activity; the water quality test results (**Table 4-9**) also show optimum quality in salinity and other parameters that can be used for panel cleaning (Although it is not recommended, rather rainwater harvesting and dry cleaning method should be introduced, details are in drainage condition subsection). Moreover, for construction work, groundwater could be extracted for which there might be contamination of groundwater. Thus, the significance of the impact is identified as Moderate (**Table 5-3**) and mitigation measures are given in following table:

Table 5-2: mitigation measures are given in following table:

Mitigation Hierarchy	Measures
Avoiding	No discharge of any bilge water and any construction waste and wastewater into the intervened river.
Minimizing	Optimize use of resources (oil, fuel, water etc.)

Mitigation	• Proper excavation and boring methods for piling should be followed. • Oil spillage should be controlled and minimized by applying regular management. • Construction wastewater should be discharged into the open water body with due treatment like creating a settling pond. • Construction materials to be kept in a safe place to avoid mixing with water before casting. • Over-extraction of Groundwater for construction purposes should be avoided and the canals inside the project area should be used for surface water collection, storage and use.
Compensation/Offset	N/A

5.1.6.2 Air Quality

The environmental and social impact assessment study has anticipated quite a few impacts of air quality that may occur due to different project activities at the construction phase that may negatively affect ambient air shed. During Construction stage of the power plant and access road, dust generation caused by construction activities as well as vehicular movement in the project site & access road may pollute the ambient air quality. Surrounding community and households also may be affected due to air pollution/dust pollution due to vehicles movements. In addition to this, minor emission of criterial pollutants from machinery and vehicles used in the project site during this phase may also deteriorate the ambient air shed. Apart from polluting the ambient air shed, emissions of these pollutants may have an adverse health effect on the workers and people living in the study area. It is to be mentioned here that, impacts of both the components of the proposed project are more or less same but the magnitude is much lower than the power plant. In order to address the impact some mitigation measures have been prescribed in the table below:

Mitigation Measures for Air Quality

Mitigation Hierarchy	Mitigation measures
Avoid	• Incineration of any waste must be avoided • No unfit vehicle, vessels or machine should be allowed to move
Minimize	• Construction waste should be moved immediately to the designated site • Workers should be provided with proper protective gears such as mask. • Low emission fuel should be used for operating all kinds of engines • Stockpiles should be placed away from sensitive receptors • Excavated soil should be covered during non-working period
Mitigate	• Regular monitoring of the concentration of air pollutants • Dust suppression by spraying water should be done at a regular interval • Construction materials like cement, sand, brick chips, stone chips etc. should be well covered with tarpaulin or other covering sheets. • The peripheral dike should be planted with long root leafy plant species, which function as a natural air purifier by arresting dust and balancing oxygen and carbon dioxide in the atmosphere. • Ensure that all equipment is in good shape and operated in the correct manner • Use non-toxic solvents and other non-hazardous materials for construction, wherever possible • Modern and energy efficient machinery should be used in the construction site. • Temporary Boundary along the road side should be developed to reduce spread of dust/air pollutants to surrounding community.
Compensation/Offset	N/A

5.1.6.3 Acoustic noise

In this section, sources of noise and vibration and their impacts in different phases of the proposed project have been identified and assessed. The noise generated and vibration from stationary and mobile sources may have an impact on the existing acoustic environment. Noise generation from vehicles movements on access road (Highway to project area) during project construction phase will have impact on the local community. Mitigation measures should be taken so that, local community does not get affected. Prolonged exposure to such high noise construction workers, site engineers, residents, close to the construction site may feel disturbances. This may also cause negative health impact on them like hearing difficulties, discomfort, loss of concentration, high blood pressure, etc. the impacts during construction phase of both the transmission line and power plant are more or less same but the magnitude of the impact is much lower in case of transmission line than that of power plant. It is to be mentioned here that there will be no impact of noise and vibration during the operation stage of the power plant but there may be a very negligible amount of noise generated from transformers during the said phase of the substation. To address the impacts some mitigation measures have been prescribed in the table below:

Mitigation Measures for Acoustic Noise

Mitigation Hierarchy	Mitigation measures
Avoid	• Avoid construction work during the nighttime as much as possible • High noise generating machines and unfit vehicles should not be allowed in the project area
Minimize	• Vehicles and machines that are not in use should be switched off • Limiting the arbitrary whistle or honking from the vehicles • Providing a temporary noise barrier along the access road to reduce noise impact to the surrounding community.
Mitigate	• Demarcate the noise prone construction area with proper signage and poster. • Proper sites should be selected for construction of buildings, labor shed, stockyard etc. • Vehicles having fitness should be used for project activities and use of whistles should be as little as possible • Less sound producing methods should be applied • Regular monitoring of the ambient noise level • Heavy construction equipment and vehicles should be moved with care and will use whistle as little as possible • Vehicles and equipment should have proper mufflers and silencers • Using earplugs, earmuffs must be ensured by the workers while working in the noise-oriented construction activities. • Workers and nearby community should be aware prior to commence the noise related activities.
Compensation/Offset	Prolonged noise exposure might cause health hazards like nausea, vomiting, deafness, etc. to the workers who should be compensated appropriately.

5.1.7 Solid Waste

Solid Waste will be generated during different phases of the project. The amount of kitchen and sewage waste that will be generated under this project has been quantified in **Section**

3.19. Apart from the wastes that have been quantified in the said section, different types of construction wastes would also be generated during construction phase. The potential hazard of solid waste on the environment and human health has been detailed out in the **Table 5.1** and prescribed mitigation measures in order to address the impacts are given in the Table below:

Mitigation Measures for Solid Waste Generation

Mitigation Hierarchy	Measures
Avoid	A good housekeeping of kitchen waste collection and disposal system should be adopted
Minimize	- The aim should be the reduction of waste generation - The Guidelines for Sludge Management 2015 should be consulted while cleaning the tank - Source segregation of wastes generated from proposed project must be ensured and disposed at separate bins
Mitigate	- A good housekeeping of kitchen waste collection and disposal system should be adopted - There should be a designated site for kitchen waste disposal with an adequate number of waste bins with different colors indicating disposal of degradable and non-degradable wastes. Scattered throwing and burning of waste should be prohibited - Splinter or scrap of iron sheet, wire, nails, bamboo slits etc. should be collected carefully and disposed of at safe place - Camp site must be equipped with proper latrine like Ventilated Improved Latrine (VIP) which should be filled up by earth after finishing the construction work - Bottom of the pit of latrine should be at least 2m above ground water table at wet season and should be 10m away from tube well location - Separate bins should be used for disposing both biodegradable and non-biodegradable waste. - ESCOP 1, 2, 15, 17 may be followed for the mitigation of the impacts.
Compensate/Offset	N/A

5.2 Biological Environment

5.2.1 Land Use

A total of 700-acre land has been acquired by the EGCB for project implementation purposes. This land is characterized as a fallow land. A part of the land parcel might be converted to structural intervention as control room and sub-station of solar power plant.

5.2.2 Avian Fauna

The project site is characterized by a relatively low number of species and reduced levels of biological diversity compared to other areas around it. The site is dominated by a small number of avian species, such as Mayna, Sparrow, Dove, Egret, Crow, Kite and some grassland birds (e.g., Pipit, Munia, Cisticola, etc.). During the study period, it is being used as a pastureland. Soil of the southmost part of the site is found to be relatively moist than that of the north part. The moist land gives support to insects and arthropods that attract

small and wading birds. The insects and arthropods loving birds that roam over there and feed on them include resident birds, such as Red Wattle Lapwing (Hottiti), Cattle Egret (Gobok), etc. and migratory birds, such as Common Sandpiper (Pati Batan), Grey Headed Lapwing (Metematha Titi), Wood Sandpiper, etc.

The coastline and associated mudflats support a wider variety of coastal biota, which are connected with habitats located in and around the project site.

The aquatic habitats in the study area support different groups of aquatic fauna. Among them bird species like heron, egret, bittern, waders, etc. may be affected more than other groups of fauna.

The major countable impacts of the project on the avian fauna may be as follows:

- Disturbances to the avian fauna, which were roaming and roosting habitually in and adjacent to the project site during construction phase.
- Movement of birds (e.g., Kite, migratory birds, etc.) which fly for long distance and cross the project site during operation phase may be disguised by the glare of the solar panel, dived on the panel and got injured or died.
- Glare of the solar panel may impede the movement of birds fly over the solar panel.
- Some species of bird like Kite, Heron, etc. may lose their roosting places in the site and may shift to other suitable places available around the site.
- Bird species like cattle egret will lose their feeding habitat on the cattle as grazing land will turn into solar power plant and marginalize to the mudflat or moist land areas.

Mitigation Measures for Avian Fauna

Mitigation Hierarchy	Mitigation measures
Avoid	• Avoid construction work in the early morning and at night (in winter) • High noise generating machines and unfit vehicles should not be allowed in the project area • The adjacent natural habitat of fauna should be protected carefully
Minimize	• Limiting the arbitrary whistle or honking from the vehicles
Mitigate	• Fencing the construction area for protecting the mammals during the construction • Proper site should be selected for construction of buildings, labor shed, stockyard etc. • Vehicles having fitness should be used for project activities and use of whistle should be as less as possible • Vibratory piling method should be followed instead of impact piling method using hammer • Modern and fuel-efficient heavy construction equipment and vehicles should be used and abstained from honking • Construction equipment and vehicles should maintain the speed limit (8-10 km/hr) in the project site • Throttle down the machinery and equipment if it is not in use. • Bird deterrent may be used repel the bird from the solar panel glare and abstain from crossing over the solar panel area to avoid

	accidental casualty.
Compensate/Offset	- Awareness creation among the local people for conservation of birds - Reshaping of the canal to make the habitat associated with water-bird suitable for them

5.2.3 Fisheries Resources

Power Plant Construction activities may cause soil erosion, leading to increased sedimentation in the canal of project area. This sedimentation may temporarily degrade water quality by increasing turbidity, which may negatively impact fish health. Runoff from chemical storage area may carry pollutants such as oils, chemicals, and debris into the canal, adversely affecting aquatic life.

The method decided to be applied is the overhead cable duct/trunking system for crossing the transmission line through the canal. Applying of this method would save the project from exerting adverse impacts on fish and other aquatic organisms of the canal rather than applying trenching method.

In the Operation Phase, solar panel wash water may contaminate the receiving canal water with water pollutants, virus and bacteria. For fish habitats, the runoff may contain sediments which can temporarily affect fish gill function, reduce light penetration necessary for photosynthesis, and disrupt the food chain by impacting primary producer (phytoplankton) and zooplankton populations.

Probable Mitigation and Measures for Fisheries Resources

Mitigation Hierarchy	Measures
Avoid	Avoid the critical periods such as fish spawning seasons. Construction activities should be done in the dry season, i.e. November to March;
	Constructing an overhead cable duct/trunking system for carrying cables over the canal may be an effective solution. If poles are set into the canal, they should be placed far from the bank to minimize habitat disruption.
Minimize	N/A
Mitigate	- Implement sedimentation control measures (e.g., Silt Fences, erosion control by matting, sediment traps, gravel bags) during construction to minimize sedimentation in water bodies. - Install water filtration systems at the points where cleaning water is discharged into the canal. Filters out sediments and contaminants before they enter the canal, protecting water quality. - Panel washing should avoid the high tide period and scheduling should consider the tide table of this area. - Ensure that the machineries are properly maintained to prevent oil and lubricant leaks, which can deteriorate water quality.
Compensate/Offset	N/A

5.3 Socio-Economic Resources

5.3.1 Occupational Health and Safety

OHS during the construction and operation phase of any development project, there will be potential occupational threat to the worker's health and safety if the worker doesn't follow the health and safety protocols and the suggested mitigation control measures properly.

An Occupational Health and Safety (OHS) Framework has been developed (**Appendix-I**) which should be followed during the project activity to maintain proper health safety guidelines. Risk ranking matrix has been also prepared to identify and assess all potential work-related hazards and their severities and eventually propose controls to reduce the risks of injuries and illness. Along with the workers' Code of Conducts (CoCs), the risk can be abated by establishing processes (PRO) and standard operating procedures (SOPs) in accordance with good international industry practice (GIIP). Based on the risk matrix, hazards are graded from "warning" to "serious" to "catastrophic". The OHS plan has listed all the identified impacts and their mitigation measures, will be prepared by the assigned EPC contractor that will be monitored by the PIU. As the OHS plan has been prepared separately, the impacts/risks will not be included in the Impact matrix.

After the award of any given contract and before mobilization, the Contractor awarded the work will prepare and submit two separate plans (Site specific Environmental and Social Management plan and site-specific Health, safety plan for Occupational Health and safety of labor and community health) in compliance with ESMP, WBG EHS Guidelines and NEQS and in accordance with international best practice. The preparation and their revisions and updates will also be quantified and presented as line items in the Contract.

EPC will bear the cost of personal protective equipment (PPE), first-aid boxes, ambulance, and health care facility with Bangladesh Medical Association licensed doctors and nurses, will also be included in the bidding document.

5.3.2 Community Health and Safety

Community related hazards will result from project construction activities and operation. Such risk generally includes health, safety, and security risks and impacts on project-affected communities. However, given the nature of the Project, the Community Health and Safety (CHS) risks are mostly associated with the construction phase of the Project. A risk ranking matrix has been prepared to identify associated construction and operation related hazards with their likelihood and magnitude to set the appropriate preventive measures to reduce or lessen the impacts on nearby communities.

To reduce or control the possibility of injuries and fatalities associated with potential hazards to project-affected communities, a CHS Plan will be prepared for the Project. Project management will establish a Health and Safety Committee to monitor and supervise the implementation of measures set by the authority. In addition to the CHS Plan, the Contractor will develop an Emergency Preparedness and Response Plan (EPRP). To guide the Contractor in preparing the detailed CHS Plan, an outline of a CHS Plan that includes impact and risk mitigation measures, has been prepared and is included as an annex to the ESIA.

Appendix-II is being referred for the detailed and informative Community Health and Safety (CHS) plan and further associated information.

5.3.2.1 Road and Traffic Level

During the construction material transportation, heavy truck movements using roadways may raise the risk of traffic disruption and disturbance to local vehicle movement as well as drivers and pedestrians (i.e., Feni to Sonagazi road). There aren't many options for communication facilities in reach the Sonagazi and Sonagazi to power plant area. The traffic survey results (refer to section 4.4.18) reveals that even in the off-peak day traffic flow is significant. So, the additional vehicles may create the scenario worst.

5.3.2.2 Sexual Exploitation and Abuse (SEA)/Sexual Harassment (SH)

SEA / SH risks are related to the laborer influx, induced development, Community Driven Development (CDD) activities Corporate Social Responsibilities (CSR) activities within the communities etc. The highlights of the SEA / SH risk assessment are:

- The project will involve various kind of construction work like site clearance, land development, dyke construction, power plant construction, trench excavation & back- filling etc. Most of the laborer's demand recommended to meet locally. However, it may require hiring some skilled labor from outside of the program area. This labor influx may increase the demand for sex work, including the risk of trafficking of women for sex work, forced early marriage with construction workers as a livelihood strategy, and increase the demand for transactional sex.
- Community-women usually use the pond and other open water body for bathing and daily household chores. So, any sort of development work within the community will expose them to the workers and officials. Besides, the construction work of the program may occur near school routes or pedestrians that are frequently accessed by local women and girls which may increase their exposure to project workers and as a result, may increase the risk of SEASH. Women and girls in the community may experience eve-teasing, sexual abuse and harassment.
- There might have some project location isolated and in the remote areas, where legal and medical support barely reaches. Besides, low density of population and weak communication facility make those places favorable for different types of criminal offence including drug dealing, rape and other anti-social activities.
- The Program may/will employ women as laborers. If they work along with male laborers without proper labor management and gender strategy, they may face sexual abuse, harassment and violence.
- The SEA-SH risk associated with the rolling out of financial protection from disaster risk (e.g. crop insurance, community fund, etc.) along with the training sessions planned under this project is rated substantial risk.

Bangladesh government has an agency/cell under the Ministry of Women's and Children Affairs responsible to addressing SEA / SH related cases with aid and assistance from the police. Besides, different national and international organizations work to mitigate SEA/SH although most of these facilities are usually available in urban areas only.

All the identified risks and impacts have been evaluated based on their significance. The significance has been determined based on magnitude and sensitivity of the risk or impact. **Table 6.1** lists the identified risks and impacts and their significance. The following table identifies proposed mitigation measures.

Mitigation Measures to Manage Risk of SEA SH due to Project Activities

Mitigation Hierarchy	Mitigation measures
Rising Risk of SEA and SH of the local women due to Labor Influx	
Avoid	N/A
Minimize	- The Project will ensure a working environment where there is zero tolerance to SEA/SH. There will be an effective GRM which is well equipped to address SEA/SH complaints - Minimize the number of external laborers. - Ensure Codes of Conducts (CoCs) signed and understood by the contractor, labors and other project workers and officials. - Training on the zero tolerance of SEA/SH and other forms of GBV under the project.
Mitigate	- Awareness raising and sensitization on Gender Based Violence (GBV) for all stakeholders including the community and vulnerable populations, - GBV service provider mapping to refer incidents of GBV from the GRM or any other reporting mechanism that may be established through the project. - Establish an effective grievance redress mechanism (GRM) with multiple channels to complaints about SEA/SH and establish SEA/SH allegations reporting channels - Receive and refer SEA/SH complaints to SEA/SH service providers and check if the case is closed and/or follow up on action taken by the contractor against any worker who has violated the codes of conduct. - Take direct sanctions against perpetrator by the contractor and/or law enforcement agency - Refer victim/ survivor will to medical and legal service providers - Follow up registered cases and ensure safety of client - Relevant ESCOP will be implemented to mitigate the impact
Compensate/Offset	N/A
Rising the Risk of GBV, Child Marriage and Abandonment due to Presence of outsiders	
Avoid	N/A
Minimize	- Ensure Codes of Conduct in local languages are signed and understood by the contractor and construction workers. - Awareness raising for workers on zero tolerance to any form of SEA/SH including these mentioned forms of SEA/SH. - Engage local stakeholders (political, cultural, religious, health teams, local councils, social workers) in awareness raising activities.

Mitigation Hierarchy	Mitigation measures
Mitigate	- Establish an effective grievance redress mechanism (GRM) with multiple channels to complaint about SEA/SH and establish SEA/SH allegations reporting channels. - GBV complaints will be received and processed. - Direct sanctions against perpetrator will be taken. - Follow up the registered cases and ensure anomaly of clients. - Include registered cases and actions in program reports. - Awareness raising and sensitization on SEA/SH for all stakeholders. - Create separate pathway and space for community people.
Compensate/Offset	Not available
Risk of SEA-SH at project related work in the project area	
Avoid	N/A
Minimize	- The Project will ensure a working environment where there is zero tolerance to SEASH. There will be an effective GRM which is well equipped to address SEA/SH complaints. - Ensure Codes of Conduct signed and understood by the contractor and construction workers. - Preparation of gender inclusive labor management policy. - Build separate toilet and resting space for female labors which are further away from male toilets, have proper lighting and are properly constructed.
Mitigate	- SEA/SH complaints will be received and processed - Direct sanctions against perpetrator will be taken - If gender inclusive labor standards can't be maintained, cash compensation will be provided for affected female community members - Potential Alternative Income Generating Activities (AIGAs) could be introduced to affected female workers - Include gender desegregated data in M&E system and ensure regular reporting
Compensate/Offset	Not available
Access to SEA-SH Service Providers	
Avoid	Avoid exposing women to construction/work place
Minimize	- Mapping SEA/SH prevention and response actors at national and local levels - Develop a referral process to response SEA-SH cases - Disseminate information, in collaboration with SRA-SH service providers, on SEA/SH referral pathway and the importance of timely seeking services
Mitigate	- Support clients/ survivor/victim to access medical and legal support - Work with local health clinic and administration to facilitate support and services - Regular follow up of registered cases
Compensate/Offset	Not available

Table 5-3: Assessment of the Potential Impacts of Power Plant construction activity

Project Activities	Important Environmental and Social Component (IESC)	Impact/ Risk	Sensitivity	Magnitude						Significance (before Mitigation)	Mitigation Required in EMP
				Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Compliance	Magnitude		
Construction Phase											
Physical Environment											
Civil and structural work (piling work for PV panel and building foundation, RCC work, control building) Limited land filing, dyke construction.	Drainage	Water Congestion, distress to human lives and livestock.	M	2	3	3	3	2	S	M	Yes
- Limited land filing and dyke construction - Establishment of construction camps for workers - Establishment of temporary access Road(s) - Establishment of material storage areas and work site(s) - Clearing site - Civil and structural work (piling work for PV panel and building foundation, RCC work, control building installation) Testing and commissioning	Solid Waste	- Referring to section 3.19 114kg of kitchen waste, 32.4 m3 volume of sewage waste will be generated during the construction phase. In addition, Non-perishable solid wastes (like metal pieces, empty cartons, plastic materials, paper bags etc.) will also be generated during this phase of the project. - Indiscriminate dumping of such waste may create aesthetic tiring, bad odor and nuisance. - Improper management of domestic and sanitary wastes from labor shed may spread diseases and pollute the adjacent area. - Metal scrap, pins, wire, sharps generated from the construction activities may cause health hazard like cuts, infection. - If these wastes are not managed properly, they have a very high potential of polluting the adjacent water bodies through runoff/wash off.	M	2	3	2	3	3	S	M	yes
Environmental Quality											

Project Activities	Important Environmental and Social Component (IESC)	Impact/ Risk	Sensitivity	Magnitude						Significance (before Mitigation)	Mitigation Required in EMP
				Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Compliance	Magnitude		
- Limited land filling and dyke construction - Establishment of construction camps for workers - Establishment of temporary access road(s) - Establishment of material storage areas and work site(s) - Clearing site - Sourcing and transporting materials and equipment to site - Civil and structural work (piling work for PV panel and building foundation, RCC work, control building installation)	Water Quality	Risk of oil spillage from transformer	H	2	4	2	2	2	S	H	Yes
		Risk of Spilling concrete or concrete slurry during construction	M	3	2	3	4	2	S	M	Yes
		Contamination of water bodies by construction waste									
	Air Quality	Emission of Particulate Matters i.e. SPM, PM10 and PM2.5	M	2	2	2	4	2	S	M	Yes
		Emission of criteria pollutants SOx, NOx, CO	M	2	2	2	4	2	S	M	Yes
	Noise	may disturb the nearby local people and local fauna	M	2	2	2	3	2	S	M	Yes
		Prolonged exposure to noise may cause hearing impairment and other health problem to the workers.	M	2	2	2	2	2	M	M	Yes
	Soil	Soil pollution due to oil/chemical spillage, waste dumping	M	2	2	2	2	2	M	M	Yes
Biological Environment											
Land Use and Agriculture Resources											
- Limited land filling and dyke construction - Establishment of construction camps for worker - Civil and structural work	Land use change	About 143.3 ha non-agriculture land area would be converted to power plant.	L	1	1	1	1	1	L	L	No

Project Activities	Important Environmental and Social Component (IESC)	Impact/ Risk	Sensitivity	Magnitude						Significance (before Mitigation)	Mitigation Required in EMP	
				Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Compliance	Magnitude			
Ecological and Fisheries Resources												
Limited land filling and dyke construction (Land clearing and removal of vegetation and topsoil)	Fish habitat quality	The removal of vegetation and topsoil can lead to increased erosion and sedimentation in nearby water bodies, reducing water quality, affecting fish gills, and smothering fish eggs and larvae.	M	2	1	1	3	1	M	M	Yes	
Installation of equipment		Heavy machinery and construction activities may generate noise and vibrations, which can disturb fish, especially during breeding seasons, potentially reducing their reproductive success.	L	1	1	1	1	1	L	L	No	
Civil and structural work (Use of construction materials and chemicals)		Spills and leaks of oils, fuels, and chemicals used in construction can contaminate water sources, causing chemical toxicity that leads to health issues or mortality in fish and other aquatic organisms.	M	2	2	1	3	1	M	M	Yes	
- Limited land filing and dyke construction - Establishment of construction camps for workers - Establishment of temporary access road(s) - Establishment of material storage areas and work site(s) - Clearing site - Sourcing and transporting materials and	Fauna	- Loss of habitat for the aquatic birds	M	2	2	3	4	2	S	M	Yes	
		- Disturbance of Movement for the aquatic bird	M	2	1	1	2	2	M	M	Yes	
		- Temporarily loss of Amphibian habitat	L	1	1	1	2	1	M	M	Yes	

Project Activities	Important Environmental and Social Component (IESC)	Impact/ Risk	Sensitivity	Magnitude						Significance (before Mitigation)	Mitigation Required in EMP
				Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Compliance	Magnitude		
equipment to site											
Socio-Economic Resources											
All activities included in Construction Phase	SEA/SA (Labor Influx)	▪ Demand for sex by migrant workers will increase SEASH	M	2	3	2	4	2	S	M	Yes
		▪ Sexual harassment within the labour camp and nearby community	M	2	3	2	4	4	S	M	Yes
		▪ Force and early marriage by construction workers	M	2	3	2	2	2	S	M	Yes
		▪ Child labor or forced labor	M	2	1	2	3	3	S	M	Yes
	SEA/SA (Risk due to the presence of outsider)	▪ Community school or college girls may be harassed or sexually abused by the project workers	M	2	3	2	3	3	S	M	Yes
		▪ Presence of outsiders in the community and interaction with them may create stigmatization for women which may result in early marriage for adolescent girls and intimate partner violence/divorce/abandonment for married women.	M	2	2	1	1	2	M	M	Yes
		▪ Project workers may tempt the community women and girls to achieve a job in exchange of sexual activity	M	2	2	3	4	3	S	M	Yes
		▪ Salary discrimination of the female workers	M	2	2	2	4	3	S	M	Yes

Project Activities	Important Environmental and Social Component (IESC)	Impact/ Risk	Sensitivity	Magnitude						Significance (before Mitigation)	Mitigation Required in EMP
				Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Compliance	Magnitude		
Community health & Safety & Occupational Health & Safety	Accidents, disability or death	- Pannel mounting, working in height, working with electric Equipments, working with heavy machinery etc. can cause accidents, disability or death to workers - Surrounding community may be exposed to vehicle movement risk, object fallen from height etc. during construction phase of the project.	M	2	2	2	4	3	S	M	Yes
Operation Phase											
Operation and Maintenance (Washing of Solar Panels Using groundwater)	Groundwater	Water Table depletion	L	2	3	2	2	-	M	L	No
Operation and Maintenance (Panel cleaning and other maintenance activities)	Fish habitat quality	Panel cleaning water can also deteriorate canal water quality by increasing turbidity. It may affect shrimp farms which use canal water for their farming systems. This can lead to direct contamination of aquaculture ponds, resulting in poor water quality, disease outbreaks, and reduced yields.	L	1	1	1	1	1	L	L	No
Broken or damaged panel management	Water & Soil pollution	Solar panels if dumped in land and water can cause severe levels of pollution	M	2	2	1	2	1	M	M	Yes
Operation and Maintenance (O&M)	Fauna	Slightly the aquatic bird will face disturbance	L	1	1	1	1	1	L	L	No

Table 5-4: Specific Potential Impacts of the Access Road

Project Activities	Important Environmental and Social Component (IESC)	Impact/ Risk	Sensitivity	Magnitude						Significance (before Mitigation)	Mitigation Required in EMP
				Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Compliance	Magnitude		
Construction Phase											
Physical Environment											
Construction Work of Access Road	Drainage	Drainage problem during spring tide, and waterlogging scenarios	M	2	2	1	2	1	M	M	Yes
Ecological Resources											
Tree cutting and Trimming	Ecological condition	- Both sides will be removed to build the access road. - Can impact on bird’s habitat	L	4	1	4	2	1	S	L	Yes
Environmental Quality											
Construction/Repair of access Road for project vehicles movements	Water pollution, air pollution, community health and safety, oil spillage, etc.	- Risk of oil spillage, waste generation and dumping into water - Community health and safety issues due to accidents,	H	2	4	2	2	2	S	M	Yes
Operation Phase											
Material movements through traffic movements	Water pollution, air pollution, community	- Risk of oil spillage, waste generation and dumping into water - Community health and safety issues due to accidents	H	2	4	2	2	2	S	M	Yes

	health and safety, oil spillage, etc.											

Table 5-5: Specific Potential Impacts of the Transmission line

Project Activities	Important Environmental and Social Component (IESC)	Impact/ Risk	Sensitivity	Magnitude						Significance (before Mitigation)	Mitigation Required in EMP
				Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Compliance	Magnitude		
Pre-Construction Phase											
Land acquisition of transmission line route	Amount of Land	▪ Impact on Agricultural Land and socioeconomic issue	L	1	1	3	1	1	s		Yes
Construction Phase											
Physical Environment											
Site Clearance and site preparation)	Trees, bushes, and shrubs removal	▪ Small level plants removal	L	1	1	4	1	1	s		Yes
Minor excavation and levelling	Health Safety, Soil Pollution, Air pollution	▪ Workers Health and safety issues during work ▪ Air Pollution due to vehicles movements ▪ Soil pollution is due to construction material, dredging, oil spillage etc.	M	2	1	1	2	1	L		YES
Setting up of labor camp	Labour health and safety condition, Community health and safety, Waste	▪ Community health, safety & Workers Health and safety issues during work ▪ Waste pollution from Basecamps	M	2	1	1	2	1	L		YES

Project Activities	Important Environmental and Social Component (IESC)	Impact/ Risk	Sensitivity	Magnitude						Significance (before Mitigation)	Mitigation Required in EMP
				Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Compliance	Magnitude		
	Pollution										
Transportation of construction material and storage	Air Pollution, Traffic accidents,	- Air pollution from vehicle movements - Accidents in local community - Worker's health and safety	M	2	1	1	2	1	L		YES
Mechanical and electrical activities including Transmission tower installation and stringing of wire	Worker's safety, Fall from height etc.	- Labor's health and safety issues during work in height - Risk of fall and accident or injury	H	4	1	1	4	1	M		Yes
Operation Phase											
Repair and replace the tower, wire, conductor, electric shock , exposed to electromagnetic field etc.	Worker's health and safety issues, Community safety issues etc.	- Labor's health and safety issues during work in height - Community safety issue	L	1	1	1	1	1	L	L	Yes

5.4 Beneficial Impact

Aside from negative impacts, one of the beneficial impacts of the proposed project is employment generation. Moreover, construction and operation of this proposed Power Plant may play a vital role in industrial development. Industrial development would also lead to social development such as schools, colleges, communities, hospital, clinic etc. which would elevate human life style. These will further promote urbanization and industrialization with following proper guidance of the Government Plan. These will further promote urbanization and industrialization with following proper guidance of the Government Plan.

5.4.1 Impacts of Filling Earth Collection

The project site at places would be filled up to construct/install different facilities either earth collected¹¹ from the nearby river/channel or from other suitable places of the estuary by the carried earth. Collection of earth materials from the river through an organized earth collection means might pose a considerable number of beneficial impacts i.e., creation of more water room and retention period, and also the drainage capacity as the cross-sectional area would be increased. In turn, collection of earth materials from the river would facilitate fisheries and other aquatic animals in terms of movement and migration along with overwintering refuge area. In this study, the potential adverse impacts for this activity have been assessed in a limited fashion and illustrated as follows:

5.4.1.1 Bank Erosion

Unplanned earth material collection from the river might pose threat to riverbank from being erosion along the earth alignment.

5.4.1.1.1 Mitigation Measures

Before the operation of the earth collection activities, site assessment should be conducted to check the bank erosion potential and protective works at erosion prone area/vulnerable locations should be undertaken.

5.4.1.2 Fish Habitat and Health

Earth collection from the riverbed might increase turbidity, which can cause decrease of different pelagic, column feeder and even bottom dwelling fish species with decreasing zooplankton as well as phytoplankton. Moreover, increasing turbidity would create problems in respiration (suffocation) and vision of the aquatic organisms including fish. This impact may sustain for a temporary period.

While transportation of earth materials through the River to the site, discharge of bilge water (oil mixed water) might cause water pollution and degrade the habitat quality as well locally. Nest of some bottom dwelling fish species would also be destroyed.

Earth collection from the river/channel might cause release of heavy metals from the sand into water and bioaccumulation of heavy metals in fish may be occurred which would be the

¹¹ Earth collection from waterbody(ies) using dredger entails the requirements of conducting a separate ESIA Study and obtain necessary permission from the concerned authority(ies) as indicated in ECR 2023.

reason of health hazard. Moreover, fine particles can easily enter the fish respiratory tract in condition with high turbidity. Obstruction to photosynthesis of primary producers due to turbidity and causing water pollution might hamper food cycle and thus fish health might be affected. Thereby, increased turbidity and chemical pollution would result in decreasing the condition factor (fish weight/fish length) of fish species.

5.4.1.2.1 Mitigation Measures

- The Hessian barrier should be built around the dredging point to arrest turbid water with the dredging perimeter.
- Modern earth collection equipment should be used which have less turbidity generation potential.
- Bilge water should not be discharged into the open environment rather separate oil from water through an oil separator.

5.4.1.3 Wildlife and Benthic Habitat

Earth collection from the river/channel of riverbed might increase turbidity which can cause decrease of zooplankton as well as phytoplankton and thus photosynthesis might be impeded, and food chain may be broken down. This may result in a decrease of primary productivity and the habitat becomes unsuitable for the aquatic organisms.

5.4.1.3.1 Mitigation Measures

- The Hessian barrier should be built around the dredging point to arrest turbid water with the dredging perimeter.
- Modern earth collection equipment should be used which has less turbidity generation potential.

6 STAKEHOLDER CONSULTATION

6.1 Introduction

Stakeholder consultation (a two-way flow of information and exchange of opinion), or simply consultation, is a regulatory process by which the public's inputs on matters affecting them are sought. Its main goals are to improve efficiency, transparency and public involvement in large-scale projects or laws and policies. It usually involves notification (to publicize the matter to be consulted on) and consultation as well as participation (involving interest groups in the drafting of policy or legislation). Public consultation with respective stakeholders is mandatory by approaching people to engage them in the project and take their concerns about the impact and benefit of the project from their point of view.

The Islamic Development Bank (IsDB) requires clients to engage in meaningful stakeholder consultation during project preparation and implementation, ensuring it is commensurate with the risks and impacts on project-affected people, as outlined in its Environmental and Social Safeguards Policy.

It is a major focus of EGCB and IsDB to provide importance on the issue of effective stakeholder engagement in ESIA through consultations. The DoE of Bangladesh also encourages public consultation and disclosure throughout an EIA process. It has also set an elaborate guidance for social impact assessment for people to be affected by a project (Table 6.1).

Table 6-1: Public Consultation Spectrum (IAP2's¹² Spectrum)

Issues	Inform	Consult	Involve	Collaborate	Empower
Public participation goal	To provide the public with balanced and objective oriented information to assist it in understanding the problems, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives, and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.

¹² International Association for Public Consultation

Issues	Inform	Consult	Involve	Collaborate	Empower
Promise to the public	Keeping the public informed	Keeping the public informed, listen to them and acknowledge concerns and aspiration, provide feedback on how public input influenced the decision.	Working with the public to ensure that their concerns and aspirations are directly reflected in the alternatives developed and provided feedback on how public input influenced the decision.	Looking to the public for their advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	Will be implemented what the public decide.

6.2 Objectives of the Stakeholder Consultations

The objectives of the stakeholder consultations were to:

- Share information with local people and other stakeholders about the goal and objective of the proposed project and soliciting their views on the project and its potential or perceived impacts.
- Engage stakeholders to maximize the project benefits.
- Aware people about the issue that could be created from the proposed project.
- Know people's viewpoints, opinions, concerns, and perspectives about the project.
- Collect suggestions (mitigation measures, enhancement measures, contingency measures, compensation measures) to resolve those problems, if any; and
- Receive input on apparent issues in the implementation process, as well as mitigating/eliminating of negative impacts.

6.3 Consultation Methodology

A participatory approach was followed to conduct the stakeholder consultation meetings. The consultant team used a checklist for the consultation meetings. The issues of the overall project planning for intervention and probable impacts on socioeconomic, agricultural, hydrological, fisheries, and ecological issues were discussed in detail, including the potential impacts of the interventions on the environmental and social parameters. Institutional issues were also discussed, regarding which the participants provided their opinions and suggestions freely.

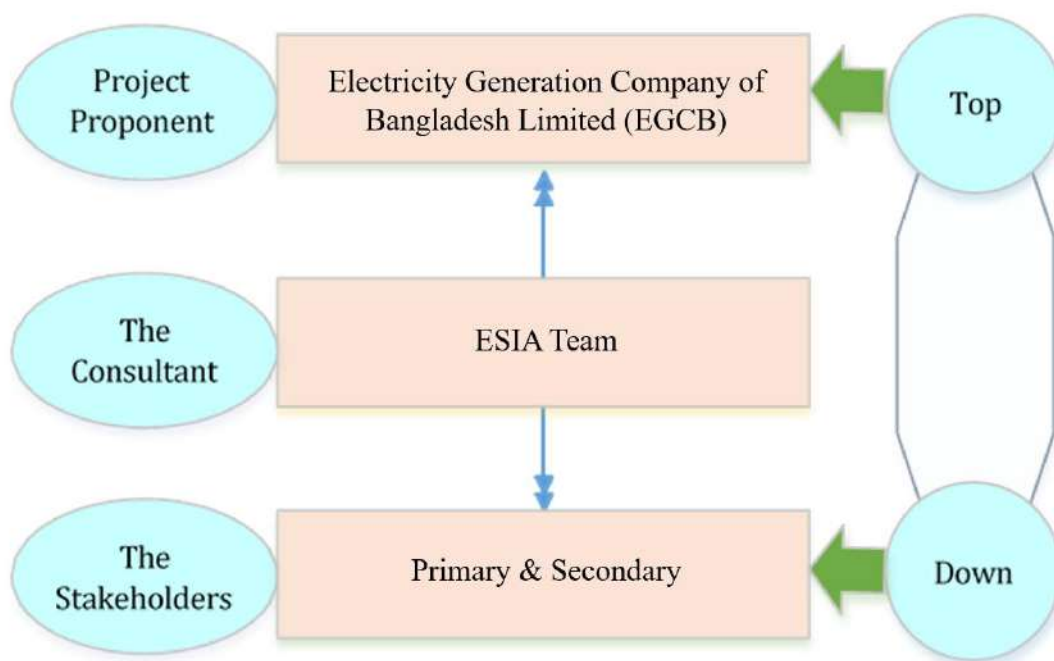


Figure 6.1: Overall Public Consultation Approach

During the consultations, an environmental & social scientist from the multidisciplinary consultant team collected opinions and comments from different groups of local people. The other members of the multi-disciplinary consultant team also attended and assisted as necessary. The consultants used maps of the project area in establishing the baseline condition to identify proper interventions for the participants of the consultation meetings. The facilitators explained all relevant points and issues to enable the participants to comprehend the proposed interventions/ activities properly and to respond accordingly. The consultants took utmost care in recording the participants' opinions and views relevant to the study. The local needs and demands were discussed by giving equal opportunity to all participants attending the meetings. During consultation, all relevant issues were discussed in detail. The overall consultation process is shown in Figure 6.1.

6.4 Identification of Stakeholders

Primarily, the stakeholders and their key groupings and sub- groupings were reviewed thoroughly. From this stakeholder analysis, a further in-depth investigation was made into the stakeholder group interests, how they will be affected and to what extent, and what influence they could have on the project. Based on the necessary adaptation of the mentioned stakeholder consultation policy of IsDB, the study team identified the project stakeholders in the following ways:

- Selection of directly and indirectly affected project stakeholders.
- Prioritization of stakeholders.
- Referring to past stakeholder information and consultation.
- Develop socio-economic fact sheets with a focus on vulnerable groups.
- Verification of stakeholder representatives.

- Engaging with stakeholders in their own communities.
- Determining government as the key stakeholder; and
- Recognizing local power structure as a good channel of communication.

Therefore, the participants of consultations belong to different occupational groups such as farmer, fisher, day laborer, school teacher etc. Moreover, to grasp the women's perception in this regard, consultation sessions were also involved a group of women to know the existing occupational status, future possibilities for employment due to the implementation of this project.

6.5 Consultation Process

Based on the stakeholder engagement guidelines of IsDB the periodic steps of consultation process are discussed below:

- **Overall Planning:** Before the consultation process, the study team prepared an overall stakeholder consultation plan including purposes, requirements, stakeholders, scoping, techniques etc.
- **Consultation Using Basic Principles of Good Practice:** The consultation was targeted, informed, meaningful, gender-inclusive, localized etc.
- **Incorporation of Public Feedback:** The consultation considered public/stakeholder opinions during the decision-making process.
- **Documentation of the Process and Results of Consultation:** The documentation of consultation process demonstrated the views of potentially affected people and civil society. These views were incorporated in the project's environmental and social mitigation strategies. Generally, public consultation is a formal participatory approach in which local people and development experts interact actively. Considering the study objectives and the socio-economic and political settings in the study area, the study team revised to some extent the stakeholder consultation guidelines mentioned in the following ways:
 - The main idea of public consultation sessions was to grasp grassroots' voice without any
 - political biasness.
 - The study team was split into two groups and facilitated public consultation sessions at the same locations.
 - The public consultation sessions were held with the Focus Group Discussion, Key Informant Interview, and Rapid Rural Appraisal techniques simultaneously.
 - To grasp the living picture of the study area the study team discussed with local people in their familiar setting instead of any formal roundtable discussion.

- To avoid any conflict of interest and to ensure voice all classes in the power structure, the study team consulted with different stakeholders separately.
- The study team used a multidisciplinary team approach centered on multidisciplinary problems/opportunities.

Respondents of public consultations were selected purposively, not at random.

6.6 Details of Consultation Meetings

The details of consultation meetings are presented below: -

- Informal Consultation:** Various occupational groups and other relevant stakeholders were consulted informally on-site during the team's visits to the project area. The aim was to raise awareness, clear any misunderstandings about the project, and gain support from local communities to conduct baseline environmental, ecological, fisheries, and socio-economic surveys. No formal questionnaire was used; instead, individual team members consulted people according to their assigned sectors (i.e., agriculture, fishery, socio-economic, etc.).
- Focus Group Discussion:** Five FGDs were conducted with farmers' communities and women's groups. These discussions aimed to gather knowledge on the potential socio-economic benefits of the proposed project, the availability of construction materials near the project site, local labor availability, site safety and security, community involvement, and sustainable environmental management. The outcomes were used to prioritize impacts and risks and to structure the Environmental and Social Management Plan (ESMP).
- Key Informant Interview:** Several KIIs were conducted with local administration, LGI representatives, different occupational groups, and women during the study period.

6.7 Responses from the Consultations

The consultation sessions included perspectives, expectations, needs, perceptions, other possibilities, perceived problems-solutions, and participant's rights and voices over the Project. They have recognized the project opportunities and challenges and have suggested solutions based on their assessments. Stakeholders had positive views on the project.

6.7.1 Outcome from Consultations, FGDs and KIIs

People of the project area were supportive, believing the project would improve employment opportunities, income generation, communication infrastructure, and utility facilities in the study area. They also expressed a desire to be involved in project activities and requested that uninterrupted electricity supply from national grid should be provided to their household level. Overall, people showed a positive attitude toward the initiative and expressed eagerness to assist.



FGD with Farmers at Purba Baradhuli, Charchandia UP



FGD with Local Farmers at Char Chandia Primary School, Bhuiar Bazar



FGD with General mixed people [Adarshogrom, Sultan Showdagor Shop, Sonagazi, Feni]



Figure 6.2: Focus Group Discussion (FGD) with Different Groups of People

6.7.2 Outcomes from Key Informant Interview (KII)

The key informants included local leaders, community representatives, government officials, and other stakeholders who possess in-depth knowledge about the local context and the potential impacts of the Solar PV Project. These interviews provided an opportunity to delve into specific issues such as land ownership patterns, socio-economic conditions, and the institutional frameworks governing resettlement. The KIIs also explored the informants' views on the challenges and opportunities associated with the resettlement process, as well as their recommendations for ensuring a smooth and equitable transition for the affected populations. Summary of KIIs conducted under this project are given below:

Table 6-2: Outcome from KII in the project area

KII No.	Name and Location	Photographs	Opinions on the Project and Its Impact
1	Mofijul Haque Assistant teacher Riyaj UddinMunshir Hatth Keremotia High School,	 12/23/24 10:22:54 AM 22.80006N 91.363775E Feni District	The project will add additional Electric power to our national grid which will be used to fulfil additional demand. Power sector will be stronger without hampering the environemntal condition.

KII No.	Name and Location	Photographs	Opinions on the Project and Its Impact
	Motiganj, Sonagazi, Feni		
2	Mawlana abu Tayyib <i>Principle</i> Adorshogrom Darul Ulum Asrafia Madrasha and Orphanage, Sonagazi, Feni		The Project will create job opportunities for locals, the surrounding socioeconomic conditions will be developed.
3	Dr. Md. Mostofa President Adorshogrom Darul Ulum Asrafia Madrasha and Orphanage, Sonagazi, Feni		Highly educated peoples will visit project area, beside IdDB will fund for this proejct. So it is expected that our village will be developed with various facility. This will improve the socioeconomic condition of our village .
4	Md. Farhad Ali <i>Inspector</i> Adorshogrom Police Station, Sonagazi, Feni		Job oppurtunity will reduce crime activity in the region. Better road condition will improve communicaiton facility allowing police to patrolling easily and reducing social crimes. Beside overall socioeconomic condition will be improved.
5	Mr. Md. Mahiuddin Executive Engineer, EGCB		The success of Sonagazi Solar Project may serve as a model for future large-scale solar initiatives in Bangladesh and beyond.

6.7.3 Outcome from Consultation with Women

Due to social and religious barriers, women in the study areas are not very willing to work outside. They are deprived of their rights and other opportunities because of traditional social structure, religious sensitivity etc. Lack of educational opportunities, early marriage with dowry is also notable. Despite the obstacles mentioned above, in the study area the rate of female literacy is not so much less than of their male counterpart. Employment opportunity for women is not significant. At present women are mostly engaged in household chores. The literates have limited employment opportunities and thus they remain unemployed.

The women participants of public consultation sessions ensured that if the government can make any employment opportunities for them through the implementation of this project, then they are very much eager to contribute their family financially. They opined that due to the implementation of this project they can find miscellaneous jobs, such as, earthwork, plantation, day laborer, petty business adjacent to the project site, etc. They opined that if available training facilities could be ensured then they also can contribute in technical jobs. Finally, if possible, they demanded some reserved employment options for them in the proposed project.



Figure 6.3: FGD with Female Group, Charchandia UP

6.7.4 Potential Positive Impacts of the Project

The participants identified several possible positive impacts of this project, such as; the national development would be accelerated with generation of power. Local people are expecting to be engaged in the project activities and that is how employment and income will be generated for them. The participants feel that because of the implementation of this project, the damaged and poor communication infrastructure will be improved and facilitated by the adjacent area residents. The development of communication infrastructures will connect the areas with the power plant more rigorously. This connection will ensure financial blessings. The participants aspire that their present unemployment, low literacy rate, low wage, less economic productivity will be changed and improved. In case of laborer recruitment, they expect that the contractor will recruit the jobless farmers in non-technical works of the Project.

6.7.5 Possible Negative Impacts of the Project

The participants said that the project's negative impact may be an increase in occupational hazards. The locals believe that the project's implementation will result in shrinkage of their cattle's grazing land.

6.7.6 Suggestions for Mitigation

The parcel of land for the proposed Project is at the acquired land of EGCB. Hence, no additional land is needed for this project and thus land related issues are remote. They also suggest improving the road communication infrastructures to reduce transportation issues once the government finalized the Project. Contractors should provide water and sanitation facilities for the laborers at the project site. Additionally, the project authority should ensure extra healthcare services for the workers and surrounding villagers in case of any accidents occurring in connection with the project activities.

6.8 Disclosure

The ESIA document will be disclosed at EGCB's website after obtaining ESIA approval and receiving site clearance certificate from DoE. The same document will be published at DoE's website after completing all requirements/necessary formalities.

7 GRIEVANCE REDRESS MECHANISM

7.1 Introduction

A grievance redress mechanism (GRM) will be established to prevent and address community concerns, complaints, grievances and reduce risks, and assist the project to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the GRM has been designed to help achieving the following objectives:

- (i) open channels for effective communication, including the identification of new environmental/social issues of concern arising from the project;
- (ii) demonstrate concerns about community members and their environmental well-being; and
- (iii) prevent and mitigate any adverse environmental/social impacts on communities caused by project implementation and operations.

The GRM is accessible to diverse members of the community, collectively called the “project affected persons” (PAPs), including more vulnerable groups such as women and the elderly. Opportunities for confidentiality and privacy for complainants are to be honored. The GRM is an integral part of the Project’s ESMP and is common for the project, across issues of environmental management and social impacts management.

7.2 Grievance Redress Mechanism

Unforeseen problems and issues may arise due to construction and operational activities. Construction work of the project could result in various inconveniences to the public, such as, civil construction works generating noise and dust which can create disturbances for the local community, restrictions to public places, heavy vehicular movement, health and safety matters, issues related to labor influx, etc. The impact of the project may raise numerous grievances and complaints on the part of the affected people. Therefore, to resolve these issues, EGCB will establish a project-level grievance redress mechanism to receive and facilitate resolution of the affected persons’ concerns, complaints, and grievances about the project’s environmental and social performance, which is easily accessible to the aggrieved parties, transparent and accountable in grievance handling and responding both effectively and efficiently to the grievances reported by the affected parties while winning the confidence of the complainants. A well-established and well-functioning GRM would be able to resolve the grievances other than disputes relating to ownership right under the court of law, the GRM will deal with complaints and grievances related to both social/and environmental issues of the project. The GRM will not prevent access to the country’s judicial or administrative remedies, which are not a part of the GRM.

EGCB will establish a procedure to deal with and resolve any queries as well as address complaints and grievances about any irregularities. In this regard, a policy and/or guideline will be prepared and adopted for assessing and mitigating potential environmental and social complaints/impacts through a GRM.

A two-tier bottom-up Grievance Redress Committees (GRCs) will be established in this project. Firstly, there will be GRC at local level (union/municipality level), thereafter, called the Local GRC (LGRC); and secondly, the PIU Level GRC (PGRC) at the central level to give room for grievances to be reviewed.

EGCB will establish upon receiving approval on the ESIA from the Government and lender for the project effectiveness. The project affected people (PAP) will be informed through public consultation that they have a right to have their grievances redressed by the LGRC as well as by the project management. The grievances will be resolved at the LGRC, but those cases that cannot be resolved at the local level will be forwarded to the PGRC. Grievances will be redressed at the latest in a month from the date of lodging the complaints, with pollution and, health and safety issues being redressed immediately. GRC decisions will be on a majority basis. Details of grievances will be disclosed in the environmental monitoring reports from the reporting period of receipt until the reporting period of closure.

7.2.1 Local Level GRC

The following composition presented in tabular form is proposed for the LGRC with representations from EGCB, the contractor, local public representatives, representatives of affected people including women in the Project area to ensure a participatory process and to allow voices of the affected communities in the grievance procedures.

1.	Executive Engineer, EGCB	Convener
2.	Representative of EPC contractor	Member-Secretary
3.	Councilor of ward of the municipality/city corporation concerned	Member
4.	Female member of ward of the municipality/city corporation concerned (especially if the complainant is female)	Member
5.	Representative of PAPs	Member

A representative of PAPs (based on the recommendation of EPC contractor and approved by the Convener) will be a member of the LGRC. The Convener will invite a community leader to represent or provide a representative of the PAPs to the LGRC. The Member-Secretary of LGRC will be available and accessible to PAPs to address concerns and grievances and schedule a weekly review and status update. The Female member/ward councilor will participate in the grievance redress sessions if the complainant is a female. The LGRC is empowered to take decisions, but it requires the approval of the Project Director for implementation of the decisions (which will be forwarded to the Project Director for approval and finalization).

The grievances will be resolved at the LGRC, but those cases cannot be resolved at the local level that will be forwarded to PIU level (PGRC). In PIU level the complaint/grievance will directly be received by website or by postal or by physical presence at PD office.

7.2.2 PIU Level GRC

The PGRC will review all unresolved cases involving social and environmental issues of the project. The Project Director will be the head of the PGRC. The composition of the PGRC will be as follows:

1	Project Director, PIU, EGCB	Chairperson
2	Senior Safeguard Specialist of EGCB, Environmental and Social Unit (ESU) or Representative of CSC Safeguard Team	Member-Secretary
3	Deputy Project Director, PIU, EGCB	Member
4	Team Leader of EPC contractor	Member
5	A representative of the aggrieved party	Member
6	A representative of the Ministry concerned or civil society	Member

The Member-Secretary in the PGRC will provide necessary knowledge and information regarding relevant standard policies and international protocols. He/she will also set examples of resolving such grievances from other development projects. The PGRC should establish fairness and transparency in the resolution of grievances of project-affected people. In case of technical or environmental issues as well as any legal matters, the Engineering or Safeguard Team Leader of the EPC contractor will advise the PGRC of the situation at the construction site of concern. In specific cases, the external legal advisors may be consulted, if required.

The GRCs will serve to resolve any grievances, but if the PAPs are not satisfied with the decision of the GRC, they have the right to take grievance to a court of law at any stage in the grievance redress process. The project grievance procedure does not impede access to the country's judicial or administrative remedies.

7.3 Processes for Filing Grievance Cases

GRC procedures and operational rules will be publicized widely through community meetings and pamphlets and information on focal contact persons, how to file grievance, etc. will be placed on the billboards of the construction sites/project site offices in the local Bangla language so that the PAPs are aware of their rights and obligations, and procedure of grievance redress. Grievances will be filed without any fear and stress and stakeholders may also raise grievances anonymously if they wish through a drop box on site. The EPC contractors will support the affected persons in drafting the grievances. All grievances must be submitted in writing to the Chair, PMU level GRC. But the grievances that need immediate action for the case like dust, noise, spills, inappropriate behavior, worker conflict, community health and safety etc. may also be raised to the respective construction site/ site office personnel even verbally or in written. The Project will set up systems to provide a written receipt of the recorded grievance to the complainant (at their address or through email/text message) with written updates every two weeks or final resolution within a month.

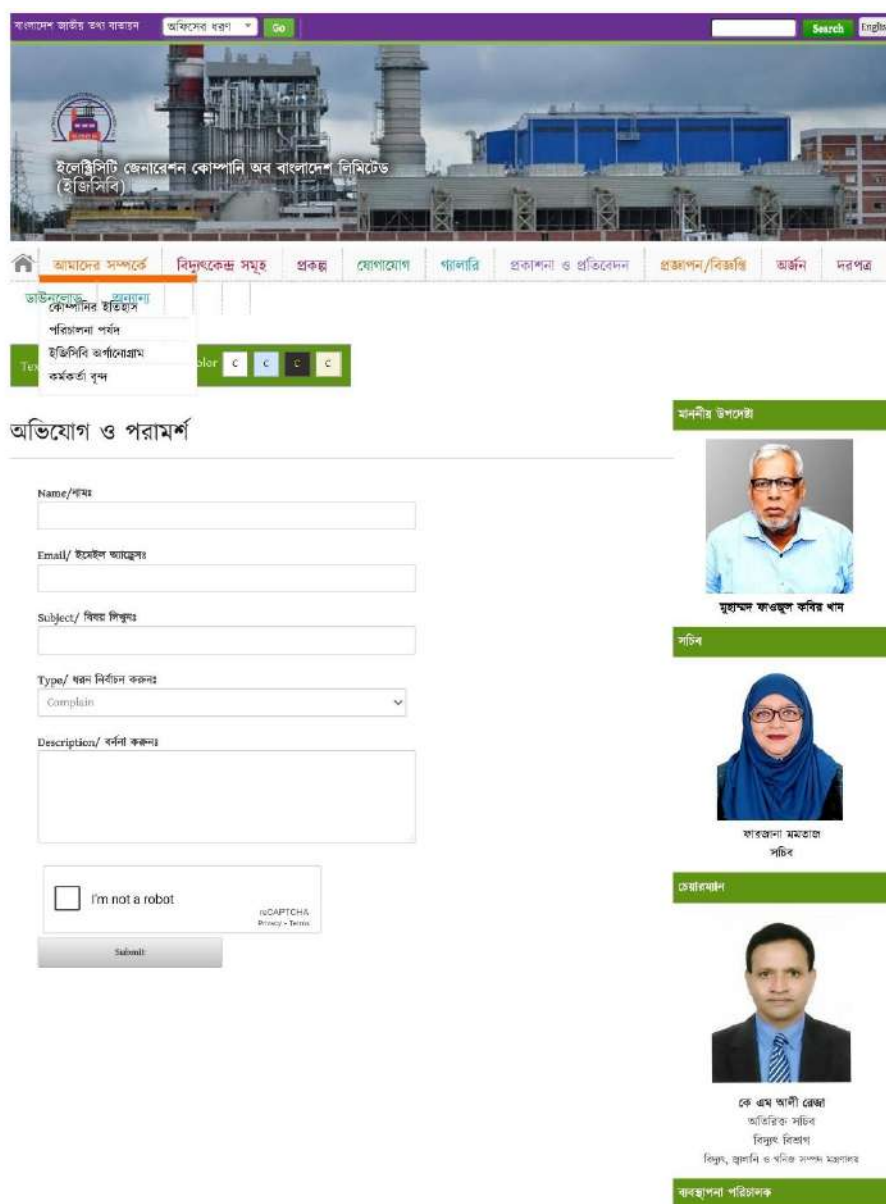
The affected person himself/herself or appointed agents such as local elected officials/legal advisors are to represent the complainants. All GRC documents will be maintained by EGCB for review and verification by IsDB or other relevant parties involved in the project. The EGCB Field Office will act as the Secretariat to the local GRCs. As a result, the records will be up-to-date and easily accessible on- site. If dissatisfied with the decision/verdict of the GRC, the affected person may request a further review of the decision of GRC. In such cases, the case will be forwarded to the Convener of the PGRC with all documentation. All grievances no matter how minor and quickly resolved must be recorded, including the

actions/resolutions taken and reported in the environmental monitoring reports submitted to IsDB.

7.4 Grievance Redress Documentation and Monitoring

EGCB will be responsible for recording the complaints, steps taken to address a grievance, a minute of the meetings, and preparation of a report for each complaint. In effect, the Project Director of PIU will keep records of all the grievances and their redress in monthly cumulative formats, which will be provided by the contractor and to be signed by the convener of the GRC. The format will contain information on the number of grievances received with nature, those resolved, and the number of unresolved grievances.

However, The EGCB already has a GRM system for the overall project or facility they provide. With the help of EGCB Website (<https://egcb.portal.gov.bd/forms/form/feedback>) any affected person can express his/her opinion to the EGCB.



অভিযোগ ও পরামর্শ

Name/শ্রম

Email/ইমেইল

Subject/বিষয়

Type/ধরন

Description/বর্ণনা

I'm not a robot

Submit

মাননীয় উপদেষ্টা

মুহাম্মদ ফারুক হোসেন খান

সচিব

মহারজা মমতাজ

সচিব

সেফারদাস

কে এম আলী রেজা

অতিরিক্ত সচিব

বিদ্যুৎ বিভাগ

বিদ্যুৎ, জ্বালান ও খনিজ সম্পদ মন্ত্রণালয়

বাংলাদেশ পরিচালক

Figure 7.1: EGCB's Existing GRM System

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 General

The Environmental and Social Management Plan (ESMP) aims to ensure the compliance of all activities undertaken during the implementation and the operation of the proposed project with the environmental and social safeguard requirements of the donor agencies and Government of Bangladesh. Furthermore, it aims at integrating the environmental and social components of the project with existing initiatives and programs in these fields. The plan consists of mitigation, monitoring, and institutional measures to be taken during implementation and operation to eliminate adverse environmental impacts, offset them, or reduce them to acceptable levels. The plan also includes the actions needed to implement these measures.

8.2 Objectives

This Environmental and Social Management Plan (ESMP) aims at ensuring the application of the mitigation and monitoring *measures* needed to reduce and control the various environmental and social impacts associated with the implementation of the proposed project.

The key objectives of the ESMP are summarized below:

- Minimizing all kinds of adverse environmental, social and health impacts resulting from the project activities.
- Conducting all project activities in accordance with relevant Bangladesh Legislation and applicable World Bank guidelines.
- Implementation of on-going environmental monitoring programs.
- Periodic review of the Environmental Management programs to allow for iterative improvement.
- Ensure that all stakeholder concerns are addressed.

Overall, this ESMP aims at ensuring the application of the mitigation and monitoring measures needed to reduce and control the various environmental and social impacts associated with the implementation of the proposed project.

8.3 Environmental And Social Management Plan (ESMP)

On the basis of identification of the environmental impacts and recommended mitigation measures linked with the project activities, an ESMP has been prepared which will be followed at the pre-construction, construction, operation, and decommissioning stages. While preparing the ESMP, medium and significant impacts are taken into consideration to recommend possible mitigation measures.

Table 8-1: Environmental and Social Management Plan (ESMP) & Mitigation Measures for Power Plant Construction Activity

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Pre-construction Phase						
Land Use	Landfilling/ Earthworks activity may lead to soil erosion & may change the existing landscape	The project area is a barren char land and without any trees. Also, it is located immediately beside a river, landfilling works will only make the land high. Besides, the land below the solar panel mount will be covered with small grass, so it is not a severe landuse change issue and has no severe impact.	Quantity of land use	Minimum change of Landuse category	Contractor.	- National Land use Policy, 2001 - National Environmental Policy, 2018 - National Environmental Management Action Plan, 1995 - Industrial Policy, 1986 - Private Sector Power Generation Policy of Bangladesh, 1996 - Policy Guideline for small Power Plants in Private Sector, 1997
Cultural Heritage Impact	Pre-Construction activities may disturb culturally significant sites or artifacts.	There are no cultural heritage sites nearby, therefore no issues regarding this.	-	-	Contractor.	-
Flood Hazards	Flood may damage the Project and its various components.	A land development of approximately 3 meters or higher will be necessary to counteract potential flood levels before establishing the solar power plant. Channels need to be developed for proper drainage of water to the river.	no. of flood	Consideration of flood hazard in project design	Contractor.	-
Land clearing and removal of vegetation and topsoil	Loss of biodiversity	Plantation of trees around the project site (Away from solar panel area), which will serve as a biodiversity component as well as protect the plant area from erosion and cyclone impact.	One Time	Availability of Birds and insects	Contractor.	Forest Act, 1927

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Construction Phase						
Visual Amenity	Visual impacts from construction activities such as materials lay down, infrastructure development, etc.	The contractor shall always ensure general cleanliness and good housekeeping practice at the project site.	Daily	Good housekeeping and tidiness of work areas within the project site.	Contractor.	National Land use Policy, 2001 National Environmental Policy, 2018 National Environmental Management Action Plan, 1995
Drainage Condition Improvement	Waterlogging	Drainage canals should be designed following elevation pattern, and the outfall should be the river or canal with proper sluice gate, culverts or bridges.	Seasonal	No waterlogging condition and good quality drainage system	Contractor.	Environment Conservation Rules, 2023 National Water Policy, 1999
Waste Generation	Improper management and handling of hazardous and non-hazardous waste during construction.	- The contractor shall segregate storage for different types of waste, such as hazardous, non-hazardous recyclable construction material, plastic, paper, etc. to facilitate proper disposal. - The contractor should provide a separate storage area for hazardous materials. The hazardous materials/products must be labeled with proper identification of its hazardous properties. - Chemical waste shall be stored in accordance with the provisions of Material Safety Data Sheets (MSDS). The contractor shall keep MSDS onsite. - The contractor shall establish regular intervals for waste collection and disposal as per the contractor's waste management procedures.	Daily	Compliance with Waste management procedures. Current and Complete records of regular waste pickup and disposal.	Contractor.	Environment Conservation Rules, 2023 The Environment (Pollution Control) Act, 1995 Environmental Conservation Rules (ECR), 2023

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		The sanitary and organic waste shall be collected in a septic tank to be installed on site and disposed of regularly.				
Groundwater	As the amount of water requirement for domestic and household purposes is too little, the impact on aquifers is not that significant. However, if groundwater is used for panel cleaning, then it will have a very negative impact on the GW table.	- Use of Groundwater is not suggested for panel cleaning, most of the month of the year rain will clean the panel, the rest of the month it is suggested to use dry cleaning method. Besides, rainwater should be harvested during rainy periods which should be used when dry cleaning won't work. - In addition, if the panels can be mounted with rainwater harvested system as shown in Figure 3.9, then the water can be reused	Daily	Compliance with DoE and National guideline for groundwater pollution	Contractor.	Environment Conservation Rules, 2023 National Water Policy, 1999
Surface Water	Surface water quality at project sites might degrade due to disposal of solid waste, sewage effluents to nearby ponds and ditches spillage of litter and noxious chemicals during different stages.	- planned disposal system, storage, handling and transportation of disposal of waste and effluents, controlled spillage of litter and other contaminated materials - any kind of Waste dumping to canal and waterbody should be avoided - The project site should be free from oil and chemical spillage - Kitchen water should be dumped in a pit	Daily	-	Contractor.	ECR 2023
Air Quality	Dust generation is due to construction activities. Exhaust Emissions due to operation of construction plant and machinery.	- Setting an appropriate site speed limit to reduce dust generation from vehicles travelling over unmade surfaces. - During construction dust generated on unpaved roadways and work areas should be controlled by the application of water on an "as needs" basis.	Daily	No visible dust plumes originating from construction sites. Regular machineries maintenance records.	Contractor.	Environment Conservation Rules, 2023 Environment Conservation Rules (ECR), 2023 Environment Court Act, 2000

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	The existing 75 MW solar power plant also may be affected due to air quality degradation and dust pollution.	- Unnecessary handling of dusty materials will be avoided such as minimizing drop heights when loaders dump soil into trucks. - Train workers to handle construction materials and debris during construction to reduce fugitive emissions. - Provide a temporary boundary besides the existing 75MW solar power project to avoid dust pollution - Ensure adequate maintenance and inspection of vehicles to minimize exhaust emissions. Not running engines for longer than is necessary.				Bangladesh Climate Change Strategy and Action Plan (2008)
Noise	Increased noise levels during construction & machinery Noise From Vehicle movements on access road	- The contractor shall use heavy equipment, machinery, and fuels in compliance with national regulations. The contractor shall perform regular maintenance on all equipment, vehicles and machinery to prevent excessive noise generation. - The contractor shall limit the idling of engines when not in use to reduce its contribution to noise emissions. - Temporary boundaries beside both sides of the road should be developed during vehicles movements - Vehicles movements should be limited by maximum 20-30 KM/h - Late night vehicles movements should be avoided - Peak hour (School & Office Time) vehicles movements should be limited	Every week and after receiving any complaints from workers or local community	Compliance with DoE and National guideline limits for Environmental noise at sensitive receptors.	Contractor.	Noise Pollution (Control) Rules, (2006) Environmental Conservation Rules (ECR), 2023. Environment Court Act, 2000. Bangladesh Climate Change Strategy and Action Plan (2008)
Soil	Soil characteristics may deteriorate at project sites due to accidental	Handling, operation and storage of noxious chemicals, and other hazardous materials, etc.	Daily	-	Contractor.	ECR 2023

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	spillage of chemicals, and ill planned disposal of solid wastes and effluents at project site.	- cautiously and carefully avoiding accidental spillage. - Waste and effluence from project sites should be disposed of cautiously in pits dug for the purpose at service areas or elsewhere properly				
Terrestrial Ecology	Potential disturbance to birds	- Minimize human and vehicular contact with fauna, including their burrows / nests and feeding grounds. - Waste shall be stored on site within closed containers, especially food remnants to avoid attracting birds on site.	Daily	N/A	Contractor.	Bangladesh Wildlife Preservation Order 1973 and Revision 2008 (Draft) National Forest Policy and Forest Sector Review (1994, 2005) The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry) National Biodiversity Strategy and Action Plan (2004)
Income and Employment	The project proponent will be responsible for creating these employment opportunities. Priority will need to be given to the local community for unskilled labor. This may result in an increase on household income.	Contractors as far as practicable will recruit construction workers from amongst the locals where possible and shall maintain gender equity while employing the locals	-	-	-	-
SEA/SA	Demand for sex by migrant workers will increase SEASH	Hire Local labor from local community	Regularly	No harassment record by the project	Contractor & EGCB	Bangladesh Labor Law 2006 & amendments

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
(Labor Influx)	- Sexual harassment within the labour camp and nearby community - Force and early marriage by construction workers - Child labor or forced labor - Community school or college girls may be harassed or sexually abused by the project workers - Presence of outsiders in the community and interaction with them may create stigmatization for women which may result in early marriage for adolescent girls and intimate partner violence/divorce/abandonment for married women. - Project workers may tempt the community women and girls to achieve a job in exchange of sexual activity	- Strict HR policy should be developed for employees so that they do not engage in such activity - Awareness creating among workers as well as local community - Introduction of GRM system and access to project authority - Monitoring and taking strict measures for such activity etc. - Ensuring safe working environment for women labors (If women workers are engaged)		No discrimination between men & women in terms of salary or facility		

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	Salary discrimination of the female workers					
Occupational & Community Health & Safety	Potential exposure to safety events such as tripping, working at height activities, fire from hot works, smoking, failure in electrical installation, mobile plant and vehicles, and electrical shocks. Exposure to health events during construction activities such as manual handling and musculoskeletal disorders, hand-arm vibration, temporary or permanent hearing loss, heat stress, and dermatitis.	- All construction equipment used for the execution of the project works shall be fit for purpose and carry valid inspection certificates and insurance requirements. - Risk assessment shall be prepared and communicated prior to commencement of work for all types of work activities on site. - Maintain applicable Work Permit (PTW) during all work. - Provide walkways that are clearly designated as walkways; all walkways shall be provided with good conditions underfoot; signposted and with adequate light.	Continuously	Total Recordable Incidence Rate (TRIR) Lost Time Incidence Frequency Fatal Accident Rate Number of safety Training performed Number of nonconformance events Reports. Medical Treatment Case (MTC) HSE Training Hours	Contractor.	Bangladesh Labor act, 2006 Bangladesh Labor Rules, 2015 & Amendment, 2022 Bangladesh Labor Law, 2006 and Ammendment, 2023
Archaeology and Cultural Resources	No anticipated impact from construction on these receptors; therefore, the impact assessment process for this receptor has yielded the low significance.	- Timely completion of the construction work and provision of alternative routes during the construction. - Establishment of construction site camp and labor camp must maintain proper distance from the cultural sites.	Regularly	N/A	Contractor.	
Operation Phase						

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Visual Amenity	Reflection from the solar panel will create visual intrusion.	The technology used has Anti- Reflective coating (ARC) that significantly reduces the reflectance of the Panels (from 2.5% to 2.6% only).	N/A	N/A	Contractor will look after this issue Upto to defect liability period and afterward it will be PMU's responsibility	National Land use Policy, 2001 National Environmental Policy, 1992 National Environmental Management Action Plan, 1995
Noise	Significant sound pollution from backup generator	- Establish the generator inside an insulated room and use noise reduction canopy to keep the environment free from sound pollution. - A noise barrier should also be provided around the generator room. - The workers inside the project area should use earmuffs during the operation of diesel generator.	Every week and after receiving any complaints from workers or third parties.	Compliance with DoE and National guideline limits for Environmental noise at sensitive receptors.		Environment Conservation Rules, 2023 Noise Pollution Control Rules, 2006
Air Quality	Very low air emissions of air pollutants such as sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, and the greenhouse gas carbon dioxide.	- Check regularly to identify potential sources of air pollutants. - Replace the damaged and expired tools, equipment, PV panels and batteries as soon as it is noticed.	Daily	No visible dust plumes originating from the project site. Regular machineries maintenance records.	Contractor will look after this issue Upto to defect liability period and afterward it will be PMU's responsibility	Environment Conservation Rules, 2023 Environmental Conservation Rules (ECR), 2023 Environment Court Act, 2000 Bangladesh Climate Change Strategy and Action Plan (2008)
Water Resources	Surface and ground water quality in the adjacent rivers, channels, ponds and plant sites might insignificantly degrade during operation stage	- The contractor should dispose of the debris material to a designated disposal site. - All reasonable measures should be taken to prevent the wastewater produced in construction from entering the canals	Monthly	- Number of spills or incidents to be recorded during onsite audits. - Training records of Personnel trained in spill response	Contractor will look after this issue Upto to defect liability period and afterward it will be	- The Environment (Pollution Control) Act, 1995 - Environmental Conservation Rules (ECR), 2023

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	due to disposal of solid waste. Besides, overextraction of GW source for cleaning the solar panels will have a negative impact on the groundwater table.	- The contractor's camp will be provided with sanitary latrines that do not pollute surface waters & Groundwaters. - Generators should be kept in a designated place with a concrete base so that oil spill may not interact directly with soil - Vehicles repair and refueling stations should be a designated place and having concrete basements to stop interacting with soil and oil - Check regularly (monthly) the surface, ground and drinking water quality to assess the impact. - Dry cleaning techniques should be introduced for cleaning the solar panels. Where not possible, alternative sources like surface water & rainwater should be used (Details are in chapter 4)		procedures must be filed - Minimum use of water for cleaning system - Installing monitoring well and checking the water level regularly.	PMU's responsibility	
Soil	Potential spillage of stored oil and chemicals	- Specific procedures shall be developed for the removal of waste or spilled fuel, oil and contaminated soil at approved disposal facilities. - Proper storage for chemicals and fuel within confined areas on site and adopting proper safety measures when handling those chemicals to prevent their leakage and infiltration into the soil.	Post event rainfall Weekly	Maintain readily available records of all workers training on spill response procedures.	Contractor will look after this issue Upto to defect liability period and afterward it will be PMU's responsibility	The Environment (Pollution Control) Act, 1995
Terrestrial Ecology	Potential disturbance and harm to birds	- Minimize human and vehicular contact with resident birds including their burrows / nests and feeding grounds. - Ground nests found on site shall be translocated outside the project boundary.	Weekly	No reported harm to birds.	Contractor will look after this issue Upto to defect liability period and afterward it will be PMU's responsibility	Bangladesh Wildlife Preservation Order 1973 and Revision 2008 (Draft); National Forest Policy and Forest Sector Review (1994, 2005)

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		Waste shall be stored on site within closed containers, especially food remnants to avoid attracting birds on site.				The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry) National Biodiversity Strategy and Action Plan, 2004
Waste Generation	Solid waste from PV modules contains toxic metals. Wasted PV modules a few other solid wastes generated during the operational stage. These include end-of-life solar PV modules, electrical waste, metallic waste and stationary wastes of office works etc.	- A proper temporary storage facility is needed for the wasted batteries to avoid potential lithium contamination. - For broken solar panels, A contract should be signed with the supplier that they will take the broken panel and recycle/dispose it with their own accords. - For other electric waste, it should be sold to a third party who will then recycle it. - Collect the domestic waste in septic tanks to be treated according to the approved procedure.	Continuously	Compliance with Waste management procedures. Current and Complete records of regular waste pickup and disposal.	Contractor will look after this issue Upto to defect liability period and afterward it will be PMU's responsibility	Solid Waste Management Rules, 2021 E-waste Management Rules, 2022 The Environment (Pollution Control) Act, 1995
PV panels	The most significant source of soil pollution is the damage of PV panels in case of major accidents. These contain chemicals and may be harmful for soil quality. Wasted PV modules few other solid wastes generated during the operational stage. These include end-of-life solar PV modules,	- The supplier will collect PV panels for maintenance and destroy and they will be responsible for management of PV panels. - The project proponent should check these devices regularly and have to replace the damaged and expired or bad devices. However, if possible, the damaged and expired devices should be maintained properly and recycled or sold to third party.	Continuously	Compliance with DoE Regular machineries maintenance records.	Contractor will look after this issue Upto to defect liability period and afterward it will be PMU's responsibility	Environmental Conservation Rules (ECR), 2023 Environment Court Act, 2000

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	electrical waste, metallic wastes and stationary wastes of office works etc.					
Batteries (for UPS) and diesel generators	Lithium-ion batteries contain a few chemicals, including lithium. If the battery is damaged or exposed to high temperatures, these chemicals can be released into the air as toxic fumes. These fumes can be harmful if inhaled and can cause respiratory problems and other health issues. Diesel generators may emit greenhouse gases while in operation.	- All the Battery will be frequently monitored and managed to mitigate such type of impacts as ESMP. Faulty batteries will be replaced immediately and will be recycled by battery suppliers - Diesel generators will only be used in emergency situations. Proper maintenance and regular emission monitoring will be performed regularly.	Continuously	Compliance with DoE Regular machineries maintenance records.	Contractor will look after this issue Upto to defect liability period and afterward it will be PMU's responsibility	Environmental Conservation Rules (ECR), 2023 Environment Court Act, 2000, E-waste Management Rules, 2021
Health and Safety	Leaching of materials from broken or fire damaged PV modules Emergency Fire Hazard Electrocution of workers Electromagnetic radiation from PV modules Slipping and tripping, working at height activities	- Provide walkways that are clearly designated as a walkway; all walkways shall be provided with good conditions underfoot; signposted and with adequate lighting. - Ensure all works and storage areas are tidy, all material deliveries shall be planned to minimize accumulated materials at project site. - Signpost any slippery areas, provide proper footwear during work within slippery areas. - Carry out fire risk assessment during operation to identify sources of fuel and	Continuously	Total Recordable Incidence Rate (TRIR) Lost Time Incidence Frequency Number of safeties Training performed Number of nonconformance events.	Contractor will look after this issue Upto to defect liability period and afterward it will be PMU's responsibility	Bangladesh Labour Law, 2006

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	Lead can enter body in two ways: by breathing or by swallowing it. Lead Sulfide dust enters the body through breathing. Very fine lead particles may penetrate into the lungs result in absorption in the bloodstream. As a power plant, the plant has always some risks of fire hazards. Electrical equipment is the main source of a potential fire hazard. Risk of electrocution of workers during performing duties in a power plant is always present.	ignition and establish general fire precautions including, means of escape, warning and fighting fire. - Set up a system to alert workers on site. This may be temporary or permanent mains operated fire alarm. - Fire extinguishers should be located at identified fire points around the site. The extinguishers shall be appropriate to the nature of the potential fire. - Establish and communicate emergency response plan with all parties, the ERP to consider such things as specific foreseeable emergency situations, organizational roles and authorities, responsibilities and expertise, emergency response and evacuation procedures, in addition to training for personnel. - Adequate first aiders shall be on site in accordance with Bangladesh Labour Law requirements. - First aid kit with adhesive bandages, antibiotic ointment, antiseptic wipes, aspirin, non-latex gloves, scissors, thermometer, etc. shall be made available by the contractor on site.				
Decommissioning Phase						
As can be noted from the impact assessment chapter 5, no impacts with high significance are anticipated to take place during decommissioning of the project since all facilities will be removed, solar power plant decommissioned, and PV panels, batteries and generators will be dismantled and sent for recycling or disposal. The main mitigation and monitoring measures to minimize or reduce the environmental and social impacts during decommissioning are anticipated to be similar to those identified for the construction phase. The solar PV panels that will be used in the project will have a life span of 25 years. Disposal of wasted solar PV modules is very important because if not properly decommissioned, the greatest health risk from end-of-life crystalline solar modules arises from lead containing solders. Under the right conditions it is possible for the lead to leach into landfill soils and eventually into water bodies. While the solar cell is the heart of a photovoltaic system, on a mass basis it accounts for only a small fraction of the total materials required to produce a solar panel. The outer glass cover constitutes						

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	the largest share of the total mass of a finished crystalline photovoltaic module (approximately 65%), followed by the aluminum frame (~20%), the ethylene vinyl acetate encapsulant (~7.5%), the polyvinyl fluoride substrate (~2.5%), and the junction box (1%). The solar cells themselves only represent about four percent (4%) of the mass of a finished module. Lifecycle of Li-ion batteries are 12 years and after that all the batteries and associated generated waste will be recycled by suppliers as per appendix x and xi. Proper decommissioning and recycling of solar panels, batteries, and generators should be done both for ensuring that potentially harmful materials are not released into the environment and reduces the need for virgin raw materials. In recognition of these facts, the photovoltaic and energy storage system (Batteries) industries are acting voluntarily to implement product take-back and recycling programs at the manufacturing level.					

Table 8-2: Environmental and Social Management Plan (ESMP) & Mitigation Measures for Access Road

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Construction Phase						
Construction Work of Access Road	Drainage condition & Waterlogging	Drainage system should be developed properly to avoid any kind of waterlogging during road construction activity	When required	No waterlogging condition and good quality drainage system	Contractor.	Environmental Conservation Rules, 2023 National Water Policy, 1999
Tree Cutting and vegetation Removal	Loss of biodiversity	Plantation of trees around the project site (At least three tree per one Tree cut) to restore biodiversity like birds and insect's habitat.	Regularly	Availability of Birds and insects	Contractor.	Forest Act, 1927
Waste Generation	Improper management and handling of hazardous and non-hazardous waste during construction.	- The contractor shall segregate storage for different types of waste, such as hazardous, non-hazardous recyclable construction material, plastic, paper, etc. to facilitate proper disposal. - The contractor should provide a separate storage area for hazardous materials. The hazardous materials/products must be labeled with proper identification of its hazardous properties. - Chemical waste shall be stored in accordance with the provisions of Material Safety Data Sheets (MSDS). The contractor shall keep MSDS onsite. - The contractor shall establish regular intervals for waste collection and disposal as per the contractor's waste management procedures. - The sanitary and organic waste shall be collected in a septic tank to be installed on site and disposed of regularly.	Daily	Compliance with Waste management procedures. Current and Complete records of regular waste pickup and disposal.	Contractor.	Environmental Conservation Rules, 2023 The Environment (Pollution Control) Act, 1995 Environmental Conservation Rules (ECR), 2023

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Groundwater	Extraction of GW can have negative impact on GW Table	Use of Groundwater is not suggested for construction of road. Rather Surface water (harvested Rainwater should be used for construction	Daily	Compliance with DoE and National guideline for groundwater pollution	Contractor.	Environment Conservation Rules, 2023 National Water Policy, 1999
Surface Water	Surface water quality at project sites might degrade due to disposal of solid waste, sewage effluents to nearby ponds and ditches spillage of litter and noxious chemicals during different stages.	- planned disposal system, storage, handling and transportation of disposal of waste and effluents, controlled spillage of litter and other contaminated materials - any kind of Waste dumping to canal and waterbody should be avoided - The project site should be free from oil and chemical spillage	Daily	-	Contractor.	ECR, 2023
Air Quality	Dust generation due to construction activities. Exhaust Emissions due to machinery operation	- Setting an appropriate site speed limit to reduce dust generation from vehicles travelling over unpaved surfaces. - During construction dust generated on unpaved roadways and work areas should be controlled by the application of water on an “as needs” basis. - Ensure adequate maintenance and inspection of vehicles to minimize exhaust emissions. Not running engines for longer than is necessary. - Provide a boundary along the road side to minimize impacts of air quality to surrounding community	Daily	No visible dust plumes originating from construction sites. Regular machineries maintenance records.	Contractor.	Environment Conservation Rules, 2023 Environment Conservation Rules (ECR), 2023 Environment Court Act, 2000 Bangladesh Climate Change Strategy and Action Plan (2008)
Noise	Noise From Vehicle movements on access road impacting local community	- The contractor shall limit the idling of engines when not in use to reduce its contribution to noise emissions. - Temporary boundaries beside both sides of the road should be developed during vehicles movements	Every week and after receiving any complaints from workers or local community	Compliance with DoE and National guideline limits for Environmental noise at sensitive receptors.	Contractor.	Noise Pollution (Control) Rules, (2006) Environmental Conservation Rules (ECR), 2023. Environment Court Act, 2000.

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		- Vehicles movements should be limited by maximum 20-30 KM/h - Late night vehicles movements should be avoided - Peak hour (School & Office Time) vehicles movements should be limited				Bangladesh Climate Change Strategy and Action Plan (2008)
Soil	Soil characteristics may deteriorate at project sites due to accidental spillage of chemicals, and ill planned disposal of solid wastes and effluents at project site.	- Handling, operation and storage of noxious chemicals, and other hazardous materials, etc. - cautiously and carefully avoiding accidental spillage. - Waste and effluent from project sites should be disposed of cautiously in pits dug for the purpose at service areas or elsewhere properly	Daily	-	Contractor.	ECR 2023
Terrestrial Ecology	Potential disturbance to birds	- Minimize human and vehicular contact with fauna, including their burrows / nests and feeding grounds. - Waste shall be stored on site within closed containers, especially food remnants to avoid attracting birds on site.	Daily	N/A	Contractor.	Bangladesh Wildlife Preservation Order 1973 and Revision 2008 (Draft) National Forest Policy and Forest Sector Review (1994, 2005) The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry) National Biodiversity Strategy and Action Plan (2004)
Occupational & Community Health & Safety	Potential exposure to safety events such as tripping, working at height activities, fire from hot works, smoking, Exposure to	- All construction equipment used for the execution of the project works shall be fit for purpose and carry valid inspection certificates and insurance requirements. - Risk assessment shall be prepared and communicated prior to commencement	Continuously	Total Recordable Incidence Rate (TRIR) Lost Time Incidence Frequency Fatal Accident Rate	Contractor.	Bangladesh Labor act, 2006 Bangladesh Labor Rules, 2015 & Amendment, 2022

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	health events during construction activities such as manual handling and musculoskeletal disorders, hand-arm vibration, temporary or permanent hearing loss, heat stress, and dermatitis. Road accidents to local community	- of work for all types of work activities on site. ▪ Maintain applicable Work Permit (PTW) during all work. ▪ Provide walkways that are clearly designated as walkways; all walkways shall be provided with good conditions underfoot; signposted and with adequate light.		- Number of safety Training performed - Number of nonconformance events Reports. - Medical Treatment Case (MTC) - HSE Training Hours		Bangladesh Labor Law, 2006 and Amendment, 2023
Operation Phase						
Community Health & Safety	Road accidents to local community and domestic animals by project vehicles	▪ Adequate number of safety signboards installation, ▪ Providing temporary boundary during road operation and project construction phase ▪ Limiting driving speed by identifying sensitive location like schools, mosques, temples etc.	Continuously	Number of Incidents	Contractor.	- Bangladesh Labor act, 2006 - Bangladesh Labor Rules, 2015 & Amendment, 2022 - Bangladesh Labor Law, 2006 and Amendment, 2023
Occupational Health and Safety	Accidents of vehicle drivers	▪ Ensure proper licensing and training ▪ No vehicles driving by children (At least should be 18) ▪ Making shift system and avoiding overtime workers ▪ Ensure drivers are getting proper rest and sleep	Continuously	Number of Incidents	Contractor.	- Bangladesh Labor act, 2006 - Bangladesh Labor Rules, 2015 & Amendment, 2022 - Bangladesh Labor Law, 2006 and Amendment, 2023

A transmission line for the existing 75 Mw project is already completed, the new project will be connected to the existing TL route so no impact during construction phase is expected. The TL impact during operation phase area as follows:

Table 8-3: Environmental and Social Management Plan (ESMP) & Mitigation Measures for Transmission Line

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Operation Phase Only						
Occupational Health & Safety during repair works	Potential exposure to safety events such as tripping, working at height activities, fire from hot works, smoking, failure in electrical installation, electrical shocks.	- All construction equipment used for the execution of the project works shall be fit for purpose and carry valid inspection certificates and insurance requirements. - Maintain applicable Work Permit (PTW) during all work. - Wear of PPE during Tower repair works	Continuously	- Total Recordable Incidence Rate (TRIR) - Lost Time Incidence Frequency - Fatal Accident Rate - Number of safety Training performed - Number of nonconformance events Reports. - Medical Treatment Case (MTC) - HSE Training Hours	Contractor will look after this issue Upto to defect liability period and afterward it will be PMU's responsibility	Bangladesh Labor act, 2006 Bangladesh Labor Rules, 2015 & Amendment, 2022 Bangladesh Labor Law, 2006 and Amendment, 2023
Community Health & Safety	Community may be affected during tower failure by disaster, exposed wire due to tree falling by wind action etc.	- The Tower boundary should be inaccessible by the local community, - Adequate number of safety signboards should be installed near the tower base to aware local community about the risk - Creating social awareness	Continuously	No Recordable Incidents	Contractor will look after this issue Upto to defect liability period and afterward it will be PMU's responsibility	Bangladesh Labor act, 2006 Bangladesh Labor Rules, 2015 & Amendment, 2022 Bangladesh Labor Law, 2006 and Amendment, 2023

8.4 Environmental and Social Management Budget

The following budget table is provided to mitigate the Environmental and Social Impact of the project.

Table 8-4: Environmental and Social Management Budget

Srl	Item/Type of Cost	Estimated Cost (BDT)	Remarks
1.	Waste Management and Proper dumping	10,00,000	For dustbins and disposal cost
2.	Environmental Training/Capacity Building	5,00,000	Labour training for capacity building and Environmental Awareness
3.	Pollution prevention	15,00,000	Air, Noise, Water, Soil pollution Prevention
4.	Sanitation and hygienic practice in basecamps	25,00,000	Building up toilets, washing facilities
5.	Community Health and Safety	7,00,000	Provide safety signboards, warning boundaries, traffic management, awareness building.
6.	Dust pollutions control	15,00,000	Water sprays stop dust movements along the project area.
7.	Settling ponds for construction water to settle down and then reuse	200,000	During construction phase of the project, any kind of construction water should not directly dump into open water body, rather it should first go to a settling pond and then when the pollutant gets settled down then the water above should be reused or dumped to waterbody
8.	Environmental Monitoring Plan	35,00,000	including DoE Certification
9.	Greenhouse Gas Emission Reduction	8,00,000	Vehicles and generator's engine maintenance, system optimization, use of natural gas instead of fossil fuels, fitness checking etc. Use renewable energy (like solar energy in base camps) where possible.
10.	Rainwater harvesting System for Solar Pannels (Figure 3.9)	25,80,00,000 (Average 500 Taka Per Panel)	- PVC pipes + joints: BDT 150/- - Gutter brackets & channel: BDT 100 - Installation/labor: BDT 100–350 - Storage tanks (5,000 to 50,000 liters): BDT 20,000–200,000 each - Contingency 10%
11.	Tree Plantation	200,000	-
12.	Drainage Management	50,00,000	Excavation of existing canals
Estimated Total Budget		27,54,00,000	Subject to change as per field condition.

The budget can be changed as per site condition and as and when required. The other type of management cost will be included in the engineering cost of the project.

8.5 Environmental And Social Monitoring Plan (ESMP)

8.5.1 General

An Environmental and Social Monitoring Plan will be prepared to provide guidelines for environmental and social management plans during the construction and operation phases of the project. The environmental components that will be monitored are those that will be positively or negatively affected, or expected to be affected, by construction activity. Environmental management is a sustainable way of planning, arranging, supervising, organizing, and developing the environment for the maintenance of the preservation of natural resources and the prevention or reduction of damage to the environment. The major environmental impact, monitoring method, responsible organization, and expense for each environmental item in the construction and operation phases for the proposed development are listed in Table 8.2.

8.5.2 Objectives

The objective of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and the protection of the ambient environment based on national standards. The main objectives of the pre-construction, construction and operation phase monitoring plans will be to:

- Monitor the actual impact of the works on physical, biological and socioeconomic receptors within the project area for indicating the adequacy of the ESIA;
- Recommend mitigation measures for any unexpected impact or where the impact level exceeds that anticipated in the ESIA;
- Ensure compliance with legal and community obligations including safety on construction sites;
- Ensure the safe disposal of excess construction materials.
- Appraise the adequacy of the ESIA with respect to the project's predicted long-term impacts on the physical, biological and socio-economic environment.
- Evaluate the effectiveness of the mitigation measures proposed in the ESMP and recommend improvements, if and when necessary

Table 8-5: Environmental and Social Monitoring Plan

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility
Pre-Construction Stage				
Air Quality	SO ₂ , NO _x , CO, O ₃ , PM _{2.5} , PM ₁₀ , SPM	Air Pollution Control Rules, 2022	Quarterly	Contractor
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	Quarterly	Contractor
Surface Water Quality	Surface water: As per Baseline Groundwater: As per Baseline	Surface water quality standard by DoE, Bangladesh	Quarterly	Contractor
Soil Quality	Parameters given in Table 4.11	-	Quarterly	Contractor
Flora and Fauna	Ensure that the existing flora and fauna along the project AOI are unharmed as far as possible. Information regarding the species along the project AOI needs to be collected and informed to the respective local authorities and take measures to compensate where necessary (e.g., if trees need to be cut).	-	Yearly	Contractor
Construction Stage				
Air Quality	SO ₂ , NO _x , CO, CO ₂ , PM _{2.5} , PM ₁₀	Air Pollution Control Rules 2022	Quarterly	Contractor

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility
Dust	Dust control	Air Pollution Control Rules 2022	Quarterly	Contractor
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	Quarterly	Contractor
Water Quality	Surface water: pH, Temperature, Total Dissolved Solids (TDS), Electric Conductivity (EC), Oxidation-Reduction Potential (ORP), Salinity, Dissolved Oxygen (DO), Ammonia, Phosphate, Total Suspended Solid (TSS), and Arsenic (As) Ground water: pH, Electric Conductivity (EC), Total Dissolved Solids (TDS), Salinity, Oxidation-reduction potential (ORP), Temperature, Dissolved Oxygen (DO), Total Suspended Solid (TSS), Total Arsenic (As), Total Coliform (TC) and Fecal Coliform (FC)	Water quality standard by MoEFCC, Bangladesh	Quarterly	Contractor
Waste	- Check storage, transportation, disposal, handling of hazardous waste - Waste and effluent to be collected and disposed safely from camp. - Wastes and garbage from construction sites to be disposed safely	Monitoring	Weekly	Contractor
Occupational Health and Safety	- Check quality of food and accommodation at construction camp; - Check safe water supply, hygienic toilet at camp, construction of drain at camp site; - Check toilets are close to construction site;	Monitoring	Regularly	Contractor

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility
	- First Aid Box with required tools and medicines; - The heavy construction material to be handled and stored safely putting due care on public safety; - Heavy construction materials at construction site to be stored and handled safely; and - Check of personal protective equipment (PPE) for worker at the sites			
Operation Stage (Per Year)				
Air Quality	SO ₂ , NO _x , CO, CO ₂ , PM _{2.5} , PM ₁₀	Air Pollution Control Rules 2022	Quarterly	The contractor will be responsible until the warranty period and PMU for the rest of the years.
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	Quarterly	The contractor will be responsible until the warranty period and PMU for the rest of the years.
Water Quality	Surface water: pH, Temperature, Total Dissolved Solids (TDS), Electric Conductivity (EC), Oxidation-Reduction Potential (ORP), Salinity, Dissolved Oxygen (DO), Ammonia, Phosphate, Total Suspended Solid (TSS), and Arsenic (As) Ground water: pH, Electric Conductivity (EC), Total Dissolved Solids (TDS), Salinity, Oxidation-reduction potential (ORP), Temperature, Dissolved Oxygen (DO), Total Suspended Solid	Water quality standard by DOE, Bangladesh	Quarterly	Contractor



Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility
	(TSS), Total Arsenic (As), Total Coliform (TC) and Fecal Coliform (FC)			
Accident and Public Safety	Record of accidents, different levels of disabilities/fatalities.	Non-Specific	-	Contractor

8.6 Environmental And Social Monitoring Budget

The estimated budget for implementation of the mitigation and monitoring measures proposed in the ESMP is presented in Table 9.3. The overall costs of the ESMP will comprise:

- Environmental and social monitoring through sample collection and analysis.
- Any remedial measures necessary to reduce or avoid environmental and social damage.
- Designing and implementing all mitigating and enhancement measures.

The total budget is estimated as BDT. 18,66,000 (Grand Total= 35,00,000). This budget does not include the decommissioning stage since the minimum operation period is 20 years and the rate will vary largely from the present cost.

Table 8-6: Environmental Monitoring Budget

Component	Item	Unit	Quantity	Rate	Amount
				(In BDT)	(BDT)
PRE-CONSTRUCTION STAGE					
Air Quality	Measuring air quality	No.	4	20,000	80,000
Noise Level	Measuring ambient noise level	No.	16	5,000	80,000
Water Quality	Surface water quality	No.	2	22,000	44,000
	Groundwater quality	No.	2	22,000	44,000
Soil Quality	Measuring soil quality	No.	2	25,000	50,000
Flora-Fauna Survey	Quadrat, transect walk, Transect Line	Lump-sum			1,00,000
Sensitive Location Survey	Throughout the Project AOI	Lump-sum			1,00,000
Sub Total					498,000
CONSTRUCTION STAGE (per year)					
Air Quality	Measuring air quality	No.	3	20,000	60,000
Noise Level	Measuring ambient noise level	No.	12	8,000	96,000
Water Quality	Surface water quality	No.	2	22,000	44,000
	Groundwater quality	No.	2	22,000	44,000
Soil Quality	Measuring soil quality	No.	2	25,000	50,000
Tree Plantation and Management	Along the Project AOI	Lump-sum			100,000
Water Spraying for	Along the Project AOI	Lump-sum			50,000

Component	Item	Unit	Quantity	Rate	Amount
				(In BDT)	(BDT)
Dust Suppression					
Waste Disposal and Management	Disposal and management of construction waste		Lump-sum		30,000
Training & Workshop	Health and Safety, Environmental and social issues, Traffic Management, GBV issues etc.	No.	4	10,000	40,000
Health & Safety	Health check-up camps for construction workers		Lumpsum		60,000
Total					574,000
OPERATION STAGE (per year)					
Air Quality	Monitoring air quality	No.	3	20,000	60,000
Noise Level	Monitoring ambient noise level	No.	12	8,000	96,000
Water Quality	Monitoring of surface water quality	No.	2	22,000	44,000
	Monitoring of groundwater quality	No.	2	22,000	44,000
Soil Quality	Measuring soil quality	No.	2	25,000	50,000
Environmental and Social Survey					
Flora-Fauna Survey	Monitoring Plants and Animals in and around project site		Lump-Sum		50,000
Ecological Survey	Monitoring Ecological diversity around the project area.		Lump-Sum		50,000
Environmental Hotspot Survey	Monitoring environmental hotspots around the project area		Lump-Sum		50,000
Biodiversity Assessment	Monitoring biological diversity around the project area		Lump-Sum		50,000
Environmental and Social Management					
Safety Signboards	For community awareness and accident prevention		Lump-Sum		60,000
Awareness Building/Capacity Enhancement	Awareness building, training activity		Lump-Sum		50,000

Component	Item	Unit	Quantity	Rate	Amount
				(In BDT)	(BDT)
Water Spray	For dust suppression in the access road and project area		Lump-Sum		50,000
Emergency Aid/ Repair works	Repair works for nearest community schools, bridge-culverts repair		Lump-Sum		140,000
Sub Total					794,000
DECOMMISSIONING STAGE (1 Year)					
Air Quality	Measuring air quality	No.	2	20,000	40,000
Noise Level	Measuring ambient noise level	No.	6	8,000	48,000
Water Quality	Surface water quality	No.	1	22,000	22,000
	Groundwater quality	No.	1	22,000	22,000
Total					132,000
Additional					15,02,000
Grand Total (BDT)					35,00,000

9 ENVIRONMENTAL AND SOCIAL BENEFIT

9.1 Introduction

Renewable energy is recognized internationally as a major contributor in protecting our climate, nature, and the environment as well as providing a wide range of environmental, economic, and social benefits that will contribute towards long-term global sustainability.

Increasing the supply of renewable energy would allow replacing carbon-intensive energy sources and significantly reducing global warming emissions. Generating electricity from renewable energy offers significant public health benefits. The air and water pollution emitted by coal and natural gas plants is linked to breathing problems, neurological damage, heart attacks, and cancer.

Solar systems generate electricity with no associated air pollution emissions. While solar energy systems emit some air pollutants, total air emissions are generally much lower than those of coal and natural gas-fired power plants. In addition, solar energy essentially requires no water to operate and thus does not pollute water resources or strain supply by competing with agriculture, drinking water systems, or other important water needs.

9.2 Energy and Climate Concern

The negative environmental impacts from generating electricity through conventional fossil fuel burning at thermal power plants are very well known. This most importantly includes air pollutant emissions such as ozone, sulfur dioxide (SO₂), Nitrogen Dioxide (NO₂), particulate matter, and other gases, which are the cause of some serious environmental concerns such as smog, acid rain, health effects, and many others.

In addition, the burning of fossil fuels results in carbon dioxide emissions; a primary greenhouse gas emitted through human activities, which contributes to global warming. The main human activity that emits CO₂ is the combustion of fossil fuels for electricity production and transportation. Concurrently, global climate change has become an issue of concern and so reducing greenhouse gas emissions have also emerged as primary issues to be addressed as the world searches for a sustainable energy future.

Electricity produced using solar energy emits no greenhouse gases (GHGs) or other pollutants. As with any electricity-generating resource, the production of the PV systems themselves requires energy that may come from sources that emit GHGs and other pollutants. Since solar PV systems have no emissions once in operation, an average traditional PV system will need to operate for an average of four years to recover the energy and emissions associated with its manufacturing. A thin-film system currently requires three years. Technological improvements are anticipated to bring these timeframes down to one or two years. Thus, a residential PV system that can meet half of average household electricity needs is estimated to avoid 100 tons of carbon dioxide (CO₂) over a 30-year lifetime.

9.3 Energy and Livelihood Concern

The belief that the provision of electricity through renewable resources can bring about desired socio-economic changes (increased economic opportunities, improved health, and education facilities. With the availability of energy livelihood strategy changes connecting the industrial production, output, cost and other variability. The changes come from using renewable resource technology is positive and sustainable for the livelihood strategy and running business.

The development of micro-enterprises in rural areas is linked with the increase in access and use of grid electricity services, leading to changes in micro-enterprises, and changes in livelihood characteristics of entrepreneurs, employees, and community members in areas where these enterprises are located. Micro-enterprises are important in their role as contributors to the economy of the rural poor especially women, technological development of rural people and in their potential for employment creation.

9.4 Energy and Economy Concern

Bangladesh has major problems with energy shortage, persisting poverty and environmental degradation. Per capita energy use is only 180 kW-h (Energypedia-2014). With only 59.60% of Bangladesh's having access to electricity connection whereas the national grid could so far cover only 42 percent of 161 million of the total population.

Energy is a foundation stone of the modern industrial economy. Energy provides an essential ingredient for almost all human activities: it provides services for cooking and space/water heating, health, food production and storage, education, mineral extraction, industrial production, and transportation. Modern energy services are a powerful engine of economic and social development, and no country has managed to develop much beyond a subsistence economy without ensuring at least minimum access to energy services for a broad section of its population. Throughout the world, the energy resources available to them and their ability to pay largely determine the way in which people live their lives. Nevertheless, it is critical to recognize that what people want are the services that energy provides, not fuel or electricity per se. Many factors play a role in influencing energy supply, not least of which is its availability, price, and accessibility. The regional endowment of energy sources and the pace at which they are developed and distributed are not uniform around the world.

The last two centuries have seen massive growth in the exploitation and development of energy sources, and the world has gained many benefits from these activities. The magnitude of energy consumed per capita has become one of the indicators of development progress of a country, and as a result, energy issues and policies have been mainly concerned with increasing the supply of energy. This approach is now seen as a vision that needs challenge.

In the last two years, countries around the world have added almost as much new solar photovoltaic (PV) capacity as had been added since the invention of the solar cell. Nearly 38,000 megawatts of PV came online in 2013, a new annual record. In all, the world's

installed PV generating capacity is now close to 140,000 megawatts. Falling costs and effective policies continue to drive tremendous growth in solar power.

Solar PV generation increased by a record 270 TWh (up 26%) in 2022, reaching almost 1 300 TWh. It demonstrated the largest absolute generation growth of all renewable technologies in 2022, surpassing wind for the first time in history.

10 CONCLUSION

According to the above analysis, it can be concluded that the project will be environmentally sound and sustainable if the recommended mitigation measures and environmental management processes are effectively implemented. The project is expected to primarily benefit the national economy, with notable advantages for the local area, aside from temporary employment and business opportunities during the construction phase. The establishment of the solar photovoltaic power plant will enhance the livelihood of the local population, which, in turn, will contribute to regional economic growth.

Although there may be some negative impacts during construction, these are predictable, manageable, and unlikely to result in significant residual effects if appropriate mitigation measures are applied. No major cumulative adverse impacts have been identified for the operational phase. Additional human and financial resources will be necessary to enhance environmental management, ensure statutory compliance, and obtain the required environmental clearance and permits as mandated by Bangladesh's environmental laws.

The project is anticipated to have a minimal environmental footprint. While some endangered and protected species of flora and fauna have been reported at the project site, the proposed activities are not expected to cause significant harm, provided that a time-bound execution plan and advanced construction technologies are utilized. The mitigation measures align with established codes and practices for the construction and operation of the project.

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12 APPENDICES

Appendix I: Occupational Health and Safety Framework

12.1 Occupational Health and Safety Framework

12.1.1 Introduction

This Chapter will guide the Project level Contractors to prepare a site and contract's specific occupational health, and safety (OHS) plan based on the information on design, construction program, and work forces for project activities. The OHS plan will be implemented by the Contractor(s) that will be monitored by the Project Implementation Unit (PIU) comprising of relevant experts from the EGCB and Contractors.

12.1.2 High Risk Activities

OHS framework is applicable to all construction activities specially related to the establishment of Solar panel, land development, laborer camp construction, trench excavation for underground transmission line laying and backfilling, civil works for sub-station and office building construction etc.

Some of the key activities that are associated with health risk and safety issues may involve the following:

- Laborer influx and site preparation.
- Vehicle mobilization and operation.
- Ground control and support structures.
- Construction of a coffer dam (e.g., any kind of work near water).
- Trenching/excavation work for cable line laying.
- Pile driving (Mounting structures and other building construction).
- Operation of mobile equipment on site and on community roads including passenger vehicles, truck dumpers, excavators, graders, loaders etc.
- Work at height and falling objects.
- Work over or near water.
- Work in Confined Space
- Material haulage.
- Manual handling.
- Lifting and cranning.
- Welding work.
- Construction of Sub-station and office building.
- Concrete batching.
- Works under extremely hot and cold weather.
- Natural disaster (Flood, cyclone, thunderstorm, earthquake etc.);
- Electrical work.
- Construction of laborer camp.
- SEA-SH/GBV issues.

12.1.3 Objectives and Targets

The following are the objective of developing the OHS framework:

- Full and effective deployment of Company's HSE Management System.
- A healthy and secure workplace, free incident operations and a clean environment, all with ZERO Harm.
- Industry-leading equipment reliability and facility environmental performance.
- Compliance with all applicable 'OHS' requirements and standards.

The Contractor will establish project specific measurable targets to achieve above mentioned objectives. The determination of these targets is based upon Contractor's continual improvement philosophy, external peer group benchmarking and stakeholders' inputs. The Contractor will establish targets for every fiscal year and can make targets as the following:

- The number of people and hours worked by that entity at each Work Area.
- Total Recordable Injury Rate (TRIR)¹³ of 1.5 or less (or based on the Contractor previous yearly trend)
- Lost Time Injury Frequency Rate (LTIFR)¹⁴ of 0.5 or less (or based on the Contractor previous yearly trend)
- Recordable Fires – the number of fires where there was a loss of structures, equipment, raw materials or products, and/or where an injury or fatality occurred.
- Spills/Releases – the number of accidental or unauthorized releases or discharges of hydrocarbons and chemicals.
- Spill/Release Volumes – the total volume of petroleum or chemical spills or releases.

The Project management unit should be fully committed to achieving the above-mentioned targets. Leading and lagging indicators should be established by the Contractor to drive performance to meet these targets. The following are some leading indicators showing senior management commitment. Complete details of all Key Performance Indicators (KPIs) should be presented in "Measurement Process" of Contractor's project specific OHS framework.

- All Project Manager complete 1 Walk-through Inspection per month through all over the project site.
- All Construction Managers complete 2 Walk-through Inspections per month with their assigned Health and Safety Officer.
- All OHS supervisors complete 1 site inspection weekly.
- Warmup meeting with workers before commencing the work.
- Preparation of critical operations.
- Hygiene and Environment Inspection.

¹³ Total recordable incident rate (TRIR) is a measure of occupational health and safety based on the number of safety incidents reported against the number of workers present and the number of hours worked.

¹⁴ LTIFR = Number of lost time injuries in a reporting period x 200,000 / total number of employee hours worked in a reporting period

- Emergency drills.
- Internal Audit.
- Audit performed.
- Tools, PPE and Equipment inspections.
- Security systems.

Those inspections should cover all the project location where the construction activities will be conducted.

12.1.4 Working Together for Success

The responsibility for safety cannot be “delegated” to “OHS Officers or HSE Managers”. The OHS staff of the Contractor support line management by assisting in jobsite training, serving as trained and knowledgeable observers, providing administrative assistance, monitoring and evaluating the success of the safety program and acting to continuously improve this plan where and as required. While this role is important, commitment and active participation by everyone, every day, on every task, is necessary if the Contractor is to achieve the level of safety excellence that the Borrower expects.

Skill-based training based on the skill gaps and need assessment should be provided to the workforce depending on supervision and rank. Provision of fire safety training and response as part of workforce health and safety induction / training, including training in the use of fire suppression equipment and evacuation, with advanced fire safety training provided to a designated firefighting team.

EGCB can also undertake skill-based training for enhancing skills of the interested community members (specifically youth) that are required in maintaining ancillary services.

Finally, the Contractor will follow a hierarchy of OHS implementation. Mandatory requirements are established by the HSE policy, followed by the agreed OHS Management system standard, linked to other OHS system controls such as standards, codes of practices, safe job procedures, safe work practices and facility / site specific safety instructions and any other safe systems of work that fosters a safe environment at the work execution level (ref. to diagram in Figure 1).

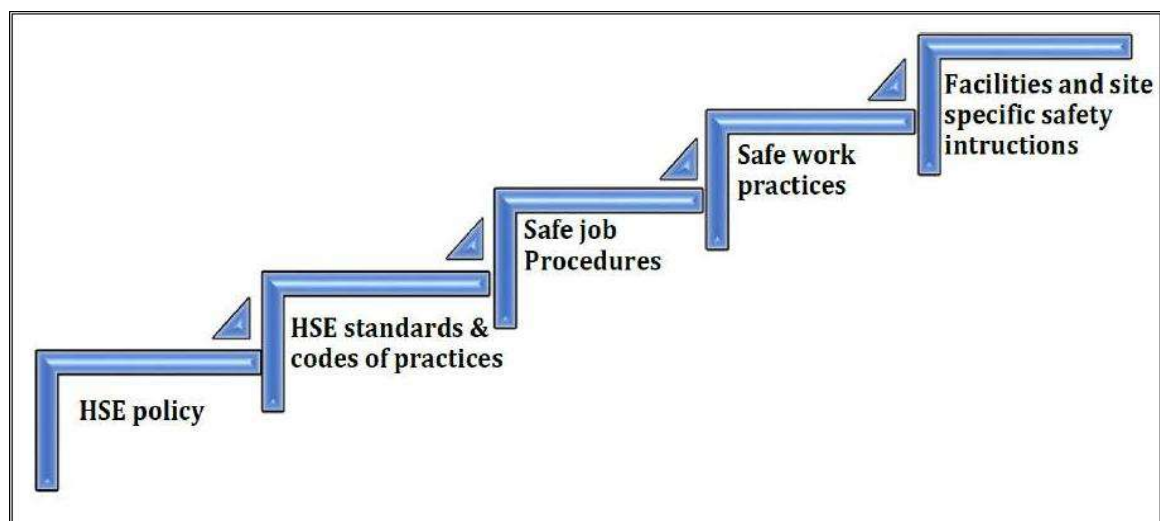


Figure 1: Management System

Requirements at any level must meet and support the requirements at higher levels. The HSE policy and OHS management system standard apply to all activities covered in the scope of this OHS framework. All relevant OHS documents and tools are available and held by the OHS Officer of the project.

Proponent shall establish, implement and maintain a procedure called Behavior Based Safety (BBS) guide for the participation of workers by their appropriate involvement in hazard identification, risk assessments and determination of controls. BBS checklist should be comprised of the following issues:

- PPE
- Housekeeping
- Using tools
- Body positioning
- Material handling
- Communication
- Following procedures
- Visual focusing
- Using a mobile at work

12.1.5 OHS Framework Review and Revision

This document provides a comprehensive framework to meet the contractual obligations to achieve safe work. The OHS Plan will be a set of living documents that will undergo routine review and updates when any of the following happens:

- There is a change in the scope of the project, or
- A yearly periodic review, or
- There is a change in construction methodology/technique based on site condition, or
- Following a significant OHS hazard or a major accident, and instructed by the Engineer, or
- At the end of the Project (to allow for improvements in subsequent projects).

The Contractor's OHS Officers are responsible for the review and update.

In addition, the Contractor can also prepare, submit and implement OHS sub-plans and Standard Operating Procedures (SOPs) to address specific construction hazards either as a separate document or as part of the Method Statement.

12.1.6 OHS Management System Expectations

The Contractor management should believe in ZERO harm to workers and all individuals while carrying out operational activities. To ensure that the Contractor has prepared the OHS Plan in accordance with the following minimum expectations in line with the policies stated above:

- Safety requirements mentioned in the contract document.
- National regulations and district level by laws (if any).

- IsDB's Environmental and Social Standards
- WB's ESS2 – Labor and Working Conditions and associated Guidance Note.
- World Bank Group Environmental, Health and Safety, General Guidelines-2007.
- ESF/Safeguards Interim Note: COVID 19 Considerations in Construction/Civil Works Projects, April 7, 2020.
- International Labour Organization Code of Practice in Health and Safety in Construction, 1992; and
- Good International Industry Practices (e.g., OSHA, ANSI).

Given above, all resources of standards and guidelines have been described. The following principles further elaborate on this.

- Wherever there is a conflict in guidance of the above, the more stringent safety requirement shall be applied. The Contractor will make sure that all applicable local regulations are always complied with.
- In this document 'Shall' and 'Must' signifies a mandatory requirement whereas 'Should' will be used to mention a recommended practice that the Contractor management will strive to accomplish.

12.1.7 Hazard Risk Assessment

Hazard risk assessment is a critical examination of health and safety hazards at a construction site and operation and maintenance (O/M) work. Performing regular hazard risks assessments can help construction and O/M stakeholders comply with OHS regulations. Hazard risks assessments can help OHS and technical teams implement corrective measures to protect workers from health and safety threats during construction and operation stages. When referring to risk in relation to safety the common definition is "risk is the likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard."

$$\text{Risk} = \text{Impact/Consequence} \times \text{Likelihood}$$

12.1.8 Hazard Risks Assessment Codes

The principle behind the Hazard Risks Assessment System and the assignment of Hazard Risks Assessment Codes (HRACs) is to identify and control workplace hazards. HRACs are based on the hazard severity, probability of occurrence, and number of people exposed or potentially adversely affected in the event of an accident. While all hazards should be resolved as soon as possible, the Hazard Risks Assessment System is a safety risk ranking method to assist in making informed decisions concerning hazard control while providing decision makers with a consistent and defensible approach for prioritizing safety hazard abatement efforts based on available resources and with consideration towards competing demands and priorities.

12.1.9 Likelihood and Consequence of Hazards

The Likelihood or probability Code is considered numerical (1 through 5). These are presented in Table 1.

Table 1: Likelihood Ratings

Likelihood	Definition
Almost certain (5)	It will happen again and soon – recurring event (e.g., daily or weekly).
Likely (4)	It will reoccur, but not as an everyday event.
Moderate (3)	It may occur from time to time in the project.
Unlikely (2)	It is not expected to happen again in the foreseeable future.
Rare (1)	Unlikely that it is not expected to happen again in the project.

Next is the Consequence or severity Code, varies from 1 to 5 and is presented in Table 2.

Table 2: Consequence ratings

Consequence	Definition
Insignificant (1)	Injury or illness that resulted in first aid treatment or minimal effects that required no medical treatment, and the worker continued to work.
Minor (2)	Injury or ill health where the worker/person affected is absent or unfit to perform work (i.e., loss work time).
Moderate (3)	Injury or ill health related including bone fractures, a burn or penetrating injury to the eye, any injury or acute illness resulting in unconsciousness, requiring resuscitation or requiring admittance to hospital.
Major (4)	Single fatality or disability (e.g., amputations, loss of sight) resulted from work-related or community-related caused by the impact of the project
Catastrophic (5)	Multiple fatalities resulted from work-related or community-related caused by the impact of the project.

12.1.10 Risks Assessment Matrix

The hazard risks level is presented in **Table 3**. This matrix helps OHS team to prioritize workplace hazards by identifying them as low, Moderate, High and Extreme.

Table 3: Risk Level Table

Risk Level	Definition	Legend
Low	Will involve the relevant supervisor to review the circumstances of the event and try to learn any lessons which will prevent future occurrences.	Low (1)
Moderate	Will involve an investigation by the relevant supervisor or line manager into the circumstances and determine the immediate, underlying and root causes of the adverse event, to try to prevent a recurrence and to learn any general lessons.	Moderate (2)
High	Will involve a more detailed investigation by site manager/supervisor/safety officer and look for the immediate causes, the underlying causes and the root causes by using available incident analysis methodologies	High (3)

Extreme	Will involve a team-based investigation, comprising site manager, supervisors, safety officer, worker representatives and external consultants/ specialists (if required). It will look at the immediate causes, the underlying causes and the root causes by using available incident analysis methodologies	Extreme (4)

Those hazards identified as extreme will require the most stringent controls available as well as immediate attention. They may even demand that such activities be cancelled from the Project. Specific workplace controls can be applied so that the associated hazards are more effectively controlled and therefore, result in a revised assessment category to a more acceptable level. Using the World Bank EHS Guidelines Risk Ranking Table (**Table 4**) provided below, the Site Manager/Supervisor/Safety Officer will assess the incident and risk rank to one of the four risk categories below:

Table 4: Risk ranking

Consequences Likelihood	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost Certain (5)	Low	Moderate	Extreme	Extreme	Extreme
Likely (4)	Low	Moderate	High	Extreme	Extreme
Moderate (3)	Low	Moderate	High	Extreme	Extreme
Unlikely (2)	Low	Low	Moderate	High	Extreme
Rare (1)	Low	Low	Moderate	High	High

Source: "Incident Reporting and Investigation Guidelines" of South Asia Region published on 22nd June, 2022
by World Bank

12.1.11 Summary of Assessed Hazard Risks

The project's potential risks and their significance have been assessed using the methodology described in Section 1.8.2 and Section 1.8.3. A summary of these risks and their significance along with the control measures are presented in Table 5.

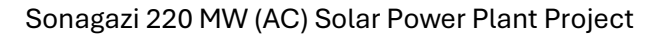
Table 5: Summary of Risks, their Significance and Control Measures

Risk Assessment												
Index	Activity	Hazards	Reasons	Risk Ranking			Protective Measures	Evaluation after choice of measures			Residual justification	Responsibility
				Likelihood	Consequence	Risk		Likelihood	Consequences	Risk		
Workforce Mobilization and construction material/equipment deployment												
1.	Workforce mobilization/ Construction	Bumping among workers due to Labor Influx	Lack of space among workers	3	2	Moderate	• Project Worker Welfare Facilities	2	2	Low	Though enough precaution measures and training will be provided to the workers, still there might have some chaos among the workers	Site Supervisors
		Physical injuries	• Social conflict • Different political and religious views	3	3	High	• Camp Management	2	2	Low		
		SEA/SH and other GBV		3	4	Extreme	• Contractor Security Management	2	3	Moderate		
		• Child laborer • Force laborer	• Lack of awareness • Unavailability of the workers • Low wages	3	3	High	• Induction Process	2	2	Low		

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3.	Traffic movement	Knocked over or struck by or run over	Vehicle operations in the area and unauthorized entry	3	5	Extreme	• Induction Process • Personnel Competency and Training • Check in Check out procedures • Explosives – Storage, Transport and Use • Mobile Equipment • Safe Driving. • Traffic Interface Planning. • Barricading and Signage. • Barricading and Signage. • Equipment Inspection & Maintenance.	2	4	Moderate	Largely administration controls. Likelihood reduced due to lower potential of multiple fatalities	Site Supervisor/ OHS expert
4.	Material/ equipment unloading	Accident/Incident Physical Injuries	• Lack of adequate skill • Reluctance to use the proper PPE	3	2	Moderate	• Mobile Equipment. • Barricading and Signage. • Material Haulage (Loading and Unloading). • Personal Protective Equipment (PPE) • Personal Risk Assessment	1	2	Low	No change to severity but lower likelihood.	Security / Site supervisor



Environmental and Social Impact Assessment (ESIA)



6.	Extreme weather exposure	• Extreme Heat Exposure • Extreme cold weather	• Working under direct sunlight for a long time • Work under extreme cold	4	2	Moderate	• Severe Weather • First Aid • Worker Welfare Facilities • Emergency Response Plan • Follow the command and instruction of the respective site supervisor,	2	2	Low	Control measures can reduce the likelihood but not reduce the consequences	OHS expert/ Supervisors/ Workers
7.	Electrical work	Electrocution, electrical shock, fire accident	Short circuit Rapture Electrical fault Arcing	3	3	High	• Barricading and signs • Fire • Electrical Systems • Contractor Security Management • Personal Protective Equipment (PPE) • Personal Risk Assessment	2	2	Low		OHS expert/ Supervisors/ Workers
8.	Construction	Air quality (Dust)	Piling for mounting structure, land development for solar panel field	4	3	High	• Ventilation • Plant Construction and Operation • Hazardous	2	2	Low	Correct application of wetting and ventilation should lower the	Contractor project manager/



			preparation,				Materials				likelihood of this	OHS expert/ Site supervisor
		Noise level	Piling nod running other machineries and equipment	3	3	High	• Camp Management • Personal Protective Equipment (PPE) • Equipment Inspection & Maintenance. • Plant Construction and Operation • Personal Protective Equipment (PPE)	2	2	Low	Unlikely to drop the likelihood to “Possible” due to the typically poor implementation of noise controls	
Underground Cable Laying												
9.	Trench excavation for underground cable	• Accident/ incident • Physical injuries • Land sliding	• Hit by excavator or tipping truck while shifting temporary trench soil. • Excavator and tipping truck hit by a public vehicle while working at the roadside. • Slip, trip and fall • Pipe swinging and falls while lifting • Collapse of the	4	3	High	• Excavation • Lifting and Rigging • Barricading and signs • Ground Support • Electrical Systems • Equipment Inspection and Maintenance • Contractor Security Management • Safe access/egress to be provided	2	2	Low	Proper implementation of the SOPs and careful attitude will reduce the likelihood and consequences	Contractor project manager/ OHS expert/ Site supervisor

			trial hole trench wall				(Ladder/Stair) • PPE to be used (safety goggles, dust mask, ear plug) • Sprinkling water regularly					
10.	Underground cable laying or Cable Installation	• Electrocutation, fire. • Electric shock. Fire • Electric shock from live circuit, shorting sparks, wrong connections, wrong item • Electric shock. Property damage. Damage to test equipment	• Due to leakage in power line, machine and improper connections, scattered cables, inadequate maintenance (including cable wearing) • Lack of proper training and skilled worker • Indifferent attitude	3	4	Extreme	• Barricading and signs • Fire • Electrical Systems • Contractor Security Management • Personal Protective Equipment (PPE) • Personal Risk Assessment	2	2	Low	Proper implementation of the SOPs and careful attitude will reduce the likelihood and consequences	OHS expert/ Site supervisor

11.	Backfilling Using Hand tools	- Physical injuries - Slip and trip - Property and life loss - Heat stroke	- Fugitive dust due to backfilling work - Struck by hand tool and other refilling tools - Exposure of heat in a sunny day for a long time	4	3	High	- First Aid - Worker Welfare Facilities - Camp Management - Plant Construction and Operation - Personal Protective Equipment (PPE) - Use the right tools for the right job - Hand tools should check and provide proper sticker to ensure the safety of the workers - Foreman to check if back fill procedure is being complied	2	2	Low	Proper use of PPE can reduce the likelihood and consequences	Contractor project manager/ OHS expert/ Site supervisor
12.	- Construction of trench - Backfilling of the	Air quality (Dust)	- Excavation of trench - Fugitive dust - SPM	4	3	High	- Ventilation - Plant Construction and Operation - Hazardous Materials - Camp Management	2	2	Low	Correct application of wetting and ventilation should lower the likelihood of this	Contractor project manager/ OHS expert/

	excavated trench						Personal Protective Equipment (PPE)					Site supervisor
13.		Noise level	- Operation of rotatory machineries - Continuous noise exposure	3	3	High	- Equipment Inspection & Maintenance. - Plant Construction and Operation - Personal Protective Equipment (PPE)	2	2	Low	Unlikely to drop the likelihood to “Possible” due to the typically poor implementation of noise controls	
Biological Agent												
14.	Site preparation / construction	Soil Fungus	- Breathing the fungus - Lack of protective measures	3	2	Moderate	- First Aid - Worker Welfare Facilities - Camp Management - Plant Construction and Operation - Personnel Competency and Training - Personal Protective Equipment (PPE) - Incident Investigation	2	2	Low	Proper use of PPE can reduce the likelihood and consequences	OHS manager/ Site Supervisor/ workers

15.		Pandemic (Viruses including COVID-19 Corona virus)	• Highly infectious • Laborer influx • Lack of PPE • Lack of emergency medical facilities • Lack of spacious and adequate accommodation • Indifferent attitude about the severity of COVID-19	4	5	Extreme	• First Aid • Worker Welfare Facilities • Camp Management • Plant Construction and Operation • COVID-19 Guidance • First Aid • Camp Management • Pandemic Action Plan (COVID-19) • Medical screening and proof of vaccination are needed prior to the employment • The Contractor may conduct induction training or workshop for all workforce to introduce the basics of these diseases, how they transmit and about the preventive	2	3	Moderate	Protective measures might reduce the likelihood but still the chance of fatalities or even death will be same	



							measures. • Contractor can organize vaccination program in the camp for the non-vaccinated workforce prior to the engagement on-site. • Use masks properly to inhibit the inhalation of virus or bacteria or other dust materials • Maintain a safe distance (6 feet) among workers to prevent the infectious from other carriers including human body • Contractor will develop a Grievance procedure in place that will be adopted for					



							COVID-19 where both workers and community members have an establish mechanism to contact the Project authority (e.g., point of contact, phone numbers) regarding COVID-19 issues. - As this project is associated with construction works, guidance given in the ESF/Safeguards Interim - Note on COVID 19 (Issued on April 7, 2020) should be followed strictly.					
16.		Bacteria and its group	Airborne, dirty environment, stagnant water, warm-water systems	3	2	Moderate	- Worker Welfare Facilities - Camp Management - Plant Construction and Operation	2	2	Low	Proper use of PPE can reduce the risk	



							- Personnel Competency and Training - Personal Protective Equipment (PPE)										
17.		Attack by wild animals like snake, hornets etc.	- Lack of awareness - Lack of safety measures	2	4	High	- First Aid - Worker Welfare Facilities - Camp Management - Personal Protective Equipment (PPE)	1	3	Moderate	Protective measures and proper awareness will reduce this hazard mostly						
18.	Transport of material on access and public roads	Being struck or run over by moving machines, 3rd party accident from loose material	- Driving at unsafe speed and not to conditions - Fatigue - Equipment failure - Distraction	3	4	Extreme	- Mobile Equipment - Barricading and signs - Safe Driving - Material Haulage (Loading and Unloading) - Traffic Interface Planning - Equipment Inspection & Maintenance	2	3	Moderate	If an accident occurs, it may still result in multiple fatalities. None of these controls restricts a truck to only killing one person					OHS Manager, Foreman	
19.		Unsecured loads	During transportation of mucking material filled to the point where it falls out of the truck	2	4	High	- Mobile Equipment - Barricading and signs - Safe Driving	1	2	Low	Assuming that the trucks are not overfilled, large material is unlikely to					Site supervisor, Foreman	



							• Material Haulage (Loading and Unloading) • Traffic Interface Planning • Equipment Inspection & Maintenance.				fall out of the truck.	
20.		Machine failure	Due to poor maintenance and repair	3	4	Extreme	• Safe Driving • Equipment Inspection & Maintenance.	2	3	Moderate		Site engineer / OHS manager
21.		Lack of edge protection	• Land sliding • Equipment failure • Wet roads • Fatigue	3	3	High	• Mobile Equipment • Barricading and signs • Camp Management • Traffic Interface Planning	2	2	Low	If an accident occurs, it may still result in the death of the driver. None of these controls will prevent a driver from driving off the edge but it will reduce the likelihood.	Site manager / Foreman

22.	Civil works of Substations and other infrastructures	• working in the vicinity of electrical power lines. • Electric Shock/ Electrocutation	Due to leakage in power line, machine and improper connections, scattered cables, inadequate maintenance (including cable wearing)	3	4	High	• Electrical Systems • Equipment Inspection & Maintenance. • First Aid • Camp Management • Plant Construction and Operation • Personnel Competency and Training • Critical Risk Protocols • De-energizing the electric line, • Isolating and earthing the line for the duration of the work, or • Re-routing the electric line away from the work area.	2	3	Moderate	Electric shock could still result in a fatality unless the mitigation measures will be implemented.	Site engineer / OHS manager / Site supervisor



23.		Slip, trip and fall	• Due to scattered cables • Unprotected and uncovered excavated trench • Muddy land at the work site • Lack of proper drainage system • Tools and equipment left on the walkway	5	2	Moderate	• Worker Welfare Facilities • Camp management • Contractor Security Management • Establish drainage to move water away from walkways and avoid pooling. • Regular cleaning of the walkways from slush, mud. • Regular and routine cleanup of the work area removed trip hazards.	3	2	Moderate	Unlikely to significantly reduce the likelihood. Slips, trips and falls are common in the construction industry.	Site supervisor / OHS manager

24.	Scaffolding	- Working at height - Open edges - Incomplete scaffolding or railings - Unguarded openings - Poorly stored or secured equipment	- During scaffold erection, dismantling and working on scaffold - Collapse of scaffold due to inadequate design, erection, overloading, adverse weather, vehicle collision, inadequate inspection	3	4	Extreme	- Working at Height - Barricading and Signage - Scaffold Erection - Illumination - Equipment Inspections and Maintenance	2	2	Low	Due to the complexity of controls for working at heights Lapses still possible with the implementation of working at height controls. Could still result in fatality.	Site supervisor / OHS manager
25.		Falling material/object	Improper working platform, gaps in working platform, missing toe boards, missing safety nets or barricading of below working area, and throwing/dropping material during dismantling	3	4	Extreme	- Working at Height - Barricading and Signage - Scaffold Erection - Illumination - Equipment Inspections and Maintenance	2	2	Low	Due to the complexity of controls for working at heights Lapses still possible with the implementation of working at height controls. Could still result in fatality.	Site supervisor / OHS manager
26.	General working area	Slips, trips and falls,	Improper placement of material, poor housekeeping	5	2	Moderate	- Worker Welfare Facilities - Camp management - Contractor Security	3	2	Moderate	Unlikely to significantly reduce the likelihood. Slips, trips and falls are common in the construction industry	Site Supervisor / OHS manager



							Management					
Batching Plant Operations												
27.	Aggregate batching system / Feeding	Pedestrian Loader interaction	• Hit by or struck by machine or bucket or material while feeding aggregate and sand with loader • Distraction • Fatigue • Poor visibility	3	4	Extreme	• Barricading and Signage • Mobile Equipment • Safe Driving • Material Haulage (Loading and Unloading) • Traffic Interface Planning • Illumination • Operation of Crushing and Batching Plants • Plant Construction and Operation	2	2	Low	Largely administration controls. Likelihood reduced due to lower potential of multiple fatalities	Site engineer
28.	Loaded mixer vehicle operation	Dust	• Dust due to Dry material and vehicle movements • Inhaling the fine particles and other fugitive dust	4	3	High	• Hazardous Materials • Camp Management • Plant Construction and Operation • Critical Risk Protocols • Personal Protective	2	2	Low	Correct application of wetting and ventilation should lower the likelihood of this	OHS manager/ Site supervisor



							Equipment (PPE)					
							Personal Risk Assessment					
29.	Steel fiber reinforced concrete	Wound and chemical hazards	Injury due to storage of steel fibers haphazardly and chemical (cement dust) contacts during physical contact and inhaling respectively.	3	3	High	- Hazardous Material Management - Plant Construction and Operation	2	2	Low	Potential still exists for terminal lung disease from inhaling silica or fibrous materials. In addition, the controls are focused on PPE.	Site engineer/OHS manager/supervisor
30.	Using conveyor belt for transferring mixer from batching plant to the mixer vehicle	Spillage of concrete-mix may cause head or body injury to the workers; Entangle loose clothes may cause wound/casualty.	Working near conveyor belts with loose clothing and missing barricades	4	4	Extreme	- Barricading and Signage - Electrical Systems - Equipment Inspection and Maintenance - Plant Construction and Operation	2	4	High	These controls reduce the likelihood but won't reduce the consequence	Site supervisor
31.	Traffic movement	Knocked over or struck by or run over	Vehicle operations in the area and unauthorized entry	3	5	Extreme	- Mobile Equipment - Safe Driving - Traffic Interface Planning - Illumination - Contractor	2	3	Moderate	Largely administration controls. Likelihood	Site Supervisor/ Security personnel



							Security Management				reduced due to lower potential of multiple fatalities	
							Plant Construction and Operation					
32.	Electrical Installations	Electric shock and electrocution	Short circuit, contact with live parts, wet weather conditions etc.	3	4	Extreme	- Electrical Systems - Equipment Inspection & Maintenance. - First Aid	2	2	Low	Controls rely on behavior. Potential controls are not effectively put in place.	Site engineer / OHS manager

12.1.12 Incident Reporting and Investigation Process

All incidents and illnesses must be reported to site supervisor after which investigation shall be commenced and recorded so that appropriate corrective actions shall be implemented to prevent any re-occurrence and report findings shall be forwarded to management for review. Reporting requirements shall include notification of incident, investigation report, and monthly report. Notification of Incident form shall be developed which shall be filled and submitted to OHS officer or site supervisor for investigation. The PIU is ultimately responsible for all incidents that occur in the project and is required to ensure that all contractors and sub-contractors will comply with the incident reporting and investigation process.

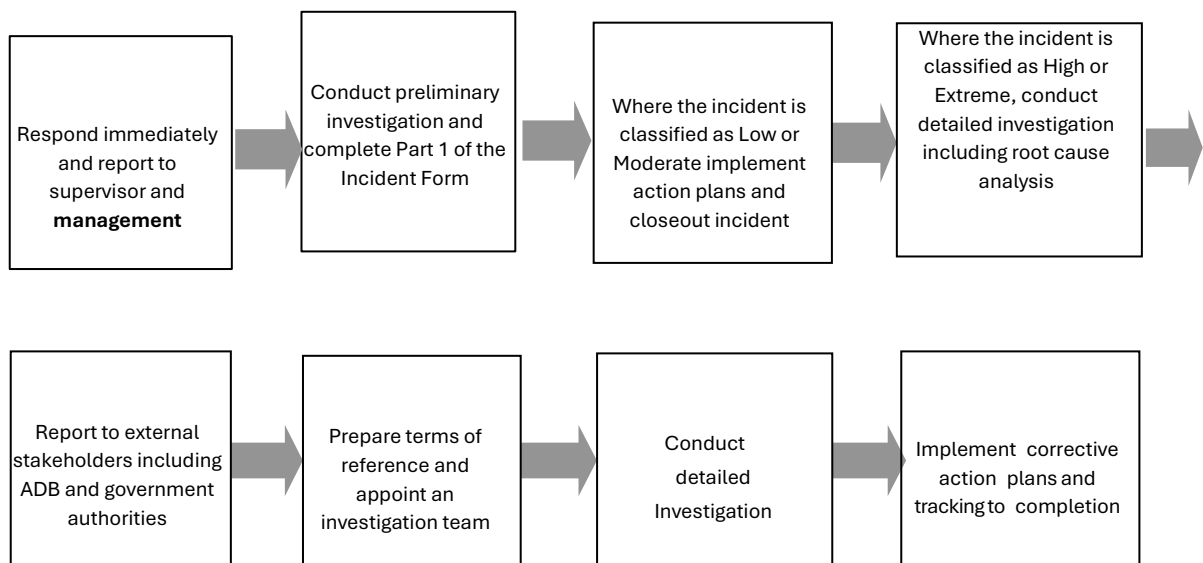


Figure 2: Simplified Incident Reporting and Investigation Process

12.1.12.1 Incident Reporting

- All incidents must be reported.
- All incidents must be immediately notified to the supervisor.
- The supervisor should notify their area manager or site manager.
- All incidents should be reported using the Project Incident Form.
- Incident Notification section to be completed by the Supervisor/ Safety Officer by the end of the shift when the incident occurred in.
- Incident Notification to be sent to the Resident Engineer/ Project Director within 24 hours after the incident.

12.1.12.2 Investigation process

The following process should be considered as a guide for conducting investigations:

- Inspect the location;
- Gather and record physical evidence including detailed description of the incident;

- Interview witnesses;
- Identify any health and safety breaches that may have contributed to the incident;
- Review relevant documents such as procedures and records;
- Attempt to resolve any conflicts in the evidence;
- Identify missing information;
- Perform data and root cause analysis;
- Identify remedial actions; and
- Prepare an Investigation Report.

12.1.12.3 Investigation Report Preparation

Concentrate on the facts and find out “who, what, where, when, why and how”. After obtaining necessary information, the incident investigation report should be completed (Final Incident Report) a copy of which shall be sent to client representative Project Manager or resident engineer.

12.1.12.4 OHS Plan Documents Structure

Figure 3 presents the document hierarchy of the OHS Plan.

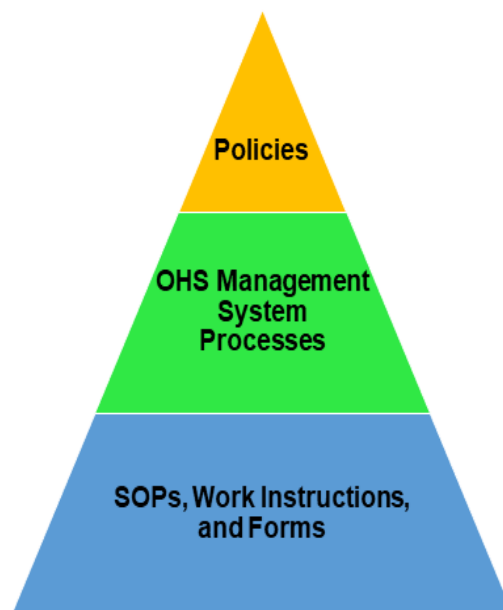


Figure 3: Document hierarchy of the OHS Plan

12.1.12.5 Policies

Contractor’s operating policies are the highest-level document. They provide with direction when the Contractor operates in different geographies of the world. These are based on the Contractor’s senior management commitments, and they guide in a day-to-day operation.

12.1.12.5.1 Human Rights Policy

Contractor’s human rights policy should focus on the responsibility to respect human rights and play a positive role among the workers and staff who will be directly and indirectly

involved in this project interventions and also in the communities where the project will be implemented. To this end, Contractor should commit to respecting human rights as set out in the United Nations Universal Declaration of Human Rights and the International Labour Organization (ILO) Declaration on Fundamental Principles and Rights at Work, as well as adhere to the United Nations Guiding Principles on Business and Human Rights, the Voluntary Principles on Security and Human Rights, and IsDB's Environmental and Social Standards.

The Contractor must continually assess the human rights context of their activities, including impacts that they may cause and those to which they may contribute or be directly linked. This determines the prevention, mitigation and control measures required, including using leverage from their business relationships.

The Contractor should recognize, respect and abide by all project workers, community worker, and employment laws and expect their subcontractors and other third-party companies to meet the same standards. No child or forced laborer is allowed under the project/program – by the contractors or sub-contractors or primary suppliers. These include prohibitions on child laborer, forced laborer and discriminatory behavior.

The Contractor should value and respect the traditions and the culture of the many different communities in the project area where they do business.

The Contractor should believe their business activities contribute to the economic well-being and quality of life. The Contractor should recognize the effect that their activities may have on local communities, and they value and strive to engage in a meaningful way with the communities where they do business to help ensure that they positively contribute to the welfare of the local communities.

The Contractor should endeavor to conduct business with communities who share their values and business principles.

12.1.12.5.2 Contractor's Health and Safety Policy

Safety and Environmental Sustainability is not a choice, it's a lifestyle. The Contractor should support a safe work environment and ensuring the safety of all employees and the clients. They should recognize Safety as a Core Value of their business. The Contractor will be responsible for the compliance of OHS/CHS including the compliance for their respective sub-contractors.

Everyone has a role to play. The Contractor's Occupational Health and Safety Plan should be built on best practices and industry leading safety management systems. To be successful, such a plan must start with proper attitudes toward injury and illness prevention on the part of all employees. It also requires cooperation on all Health and Safety matters, not only between management and employees, but also between each employee and his or her co-workers.

Recognize the responsibilities of Health, Safety and Environment

- The Contractor accepts responsibility in leading the Health and Safety program and for its effectiveness and improvement.

- Supervisors, Officers, and Managers should be responsible for developing the positive attitudes towards Health and Safety in themselves and those they supervise. And for ensuring that all activities are performed with the utmost regard for the Safety and Health of those involved.
- Employees are responsible for wholehearted, genuine cooperation with all aspects of the health and safety program.
- Provide education to participating personnel, thus enabling them to understand and share in the responsibility for monitoring and protecting the environment.
- Maintain an effective reporting and communication system, and develop a project action plan commensurate with company standards and regulatory/client requirements.
- The Contractor should make responsible decisions and should believe in environmental sustainability by applying the core values and upholding the code of conduct. They should protect their employees, the public and the environment.

12.1.12.5.3 Alcohol and Drug Policy

The use of alcohol and illegal drugs shall be strictly forbidden on all project sites. All project workers on the project shall comply with the following:

- No project worker shall distribute, possess, consume, or use alcohol or illegal drugs on the work site or in any vehicle or any other equipment.
- No project worker shall report to work or be at work under the influence of any drug, or substance that may cause impairment and/or will affect their ability to work safely.
- No project worker shall misuse prescribed or non-prescribed drugs while at work. If a project worker is taking a prescribed or non-prescribed drug for which there is a potential unsafe side effect, he has an obligation to report such potential to the supervisor.
- Management reserves the right to conduct searches of premises and worksites where there are reasonable grounds to conclude there is or has been use or possession of substances prohibited under this Policy.
- Any person taking medication that can affect or restrict their ability to do their job safely must advise and discuss with his/her direct supervisor.
- Smoking at workplaces should be banned except in designated smoking areas which are equipped with the smoking signs and trash cans, and possession of lighters and matches should be prohibited before entering at work areas
- Management at their discretion may conduct 'Reasonable Cause Suspicion Testing' if there are evident reasons to believe that the person in question is impaired.
- Management may also conduct Post Incident Alcohol & Drug testing to rule out if this may be a contributory factor in the incident.

12.1.12.6 Business Conduct and Ethics Code

The Contractor's Business Conduct and Ethics Code should be built on the core values and highlights the principles that guide their business conduct. Use it for guidance about their ethical standards and where to take worker's questions or concerns.

12.1.12.6.1 Ethical decision making

Ethical decision making is essential to the success of the Contractor. Some decisions are obvious and easy to make; others are not. By asking questions below can help to make the right ethical decisions.

Four yes answers are required to qualify an action as ethical.

1. Is it legal?
2. Is it consistent with company policies? If the proposed action does not comply with company policy, you should not do it.
3. Is it in the best interests of my co-workers, the company, and the community?
4. If it were made public, would I be comfortable?
 - a. If the answer to any of these questions is "No": STOP. If you're not sure: speak to the Project
 - b. Manager.

12.1.12.7 Project Organization

12.1.12.7.1 Contractor Organogram

A typical Contractor's organogram is presented in **Figure 4**.

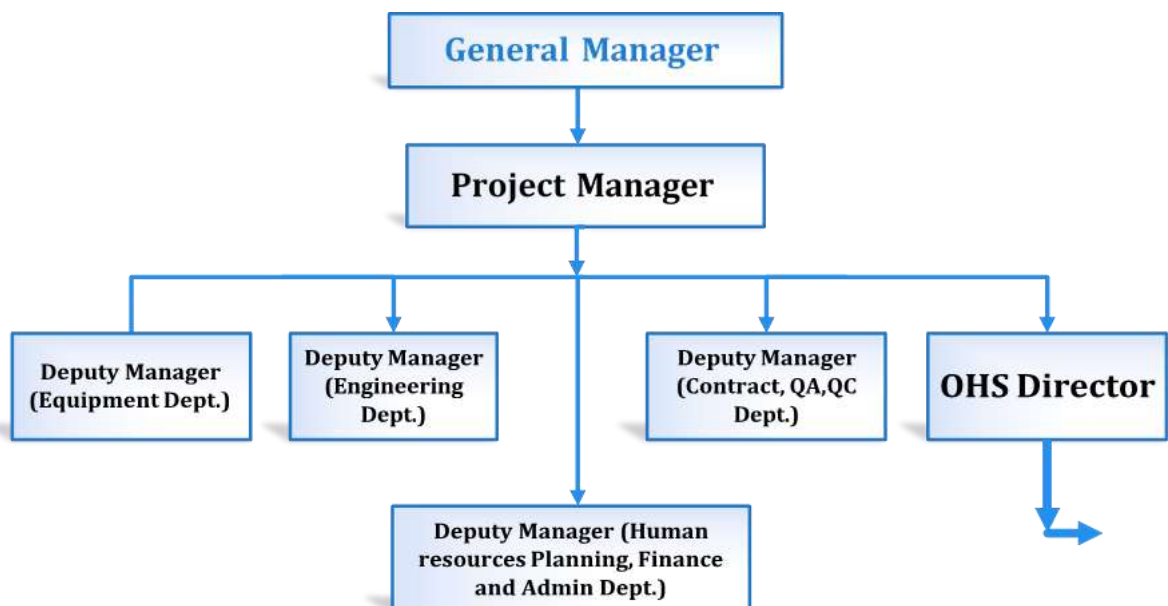


Figure 4: Contractor Organogram

12.1.12.7.2 OHS Organogram

A Contractor's typical OHS organization should resemble that shown in **Figure 5**.



Figure 5: Contractor's OHS Organization

12.1.13 Roles and Responsibilities

These roles and responsibilities give a holistic understanding pertaining for the implementation of the OHS Plan.

12.1.13.1 Contractor Project Manager

- Overall accountability for the development, implementation, and maintenance of the OHS Plan.
- Accountable for allocation of sufficient resources for the execution of the plan.
- Ensure that empowered and competent personnel are available for the execution of this plan.
- Make sure that Sr. Leadership (all directors, Construction Managers and other line management personnel) are fully aware of their responsibilities as per the Processes and SOPs of the OHS Plan.
- Demonstrate visible leadership, walk to talk behavior to reinforce the implementation of the OHS Plan.
- Attend the monthly OHS Committee/Progress Review Meeting and monitor the performance through leading and lagging indicators.
- Discourage achievement of operational results at the cost of safety violations.
- Develop a conducive culture where Personnel are authorized to STOP¹⁵ unsafe work without fear of retribution.

¹⁵ ILO COP 2.2.12. Where there is an imminent danger to the safety of workers, the employer should take immediate steps to stop the operation.

- Develop a culture where it is safe to speak up and provide the time, people and resources to respond to OHS concerns identified by their workers.
- Ensure that the Work Observation program is utilized, and all incidents are fully investigated.
- Review Executive Summary of incidents, ensure that Root Causes are being identified, and resources are provided for the closure of Preventive and Corrective Actions.
- Encourage reward and recognition where personnel demonstrate safe behavior or identify hazards and fairly apply disciplinary process when personnel cut short.

12.1.13.2 Contractor OHS Experts

The assigned EPC should have an OHS expert who will look after the workers' health risks and wellbeing at the project site. The major roles and responsibilities are as follows:

- Be a Subject Matter Expert of the OHS Plan. Provide training and awareness regarding the implementation of the OHS Plan that includes multiple Processes
- To be familiar with all local, national, and international laws that are applicable to Operations.
- Convene and raise concern in the monthly OHS Committee/Progress Review meeting regarding implementation of controls stipulated in the OHS Plan.
- Provide training to staff on the OHS Plan. Conduct regular sessions for all project team members to inculcate the requirements of the OHS Plan.
- To report to the Contractor's Management Team on implementation progress, monthly
- KPIs.
- To ensure that sufficient training and induction of all personnel is being provided and maintained.
- To ensure that visit induction is given to all visitors before they are allowed to visit the site.
- To develop the OHS awareness of all personnel employed on the project and ensures their participation in all aspects of the health and OHS program.
- Provide guidance for the purchase of personal protective equipment.
- Regular inspection of construction safety and security as per PR09: Work Observation Process.
- Provide guidance to employees regarding their emergency response responsibilities.
- Decide whether a potential rescue service or team is adequately trained and equipped to perform permit space rescues of the kind needed at the facility and whether such rescuers can respond in a timely manner, and organize drills.

- Establish and maintain a professional relationship with subcontractor representatives.
- Establish an audit system that measures the effectiveness of the OHS Plan.
- Review of OHS management plan annually.

12.1.13.3 Contractor Supervisors

Site supervisor will walk around the entire project location to identify the pros and cons in terms of health and safety issues whose main responsibilities will be as follows:

- They allocate tasks and check that the project workers are implementing OHS requirements to standard. They provide feedback and guidance on OHS implementation.
- Ensure that the controls stipulated in PTW (Permit to Work) are implemented and STOP the work when critical controls are missing or compromised.
- Discuss Job Hazard Analysis (JHA) and conduct effective Tool box Talk with all project workers. Ask questions to ensure that they have a good understanding.
- Ensure that all new employees receive training as per Induction Process and Short Service Worker Process.
- Conduct worksite observations, discuss safety concerns with project workers.
- Develop a culture where it is safe to speak up and provide the time, people and resources to respond to OHS concerns identified by their workers. They are also responsible for escalating issues that can't be resolved by the project workers or at the supervision level to OHS Team or senior management.
- Responsible for making an incident scene safe and secure and for ensuring that hazards, near misses and incidents are entered into the reporting system.
- Ensure all project workers use appropriate PPEs and train them how to use PPEs.

12.1.13.4 Workers

To ensure a healthy workplace, the workers may play a vital role along with other OHS experts. A sensible worker makes the workplace safe by deciding when and how to stop or continuing the work. The workers' responsibilities are as follows.

- Conduct Personal Risk Assessment Take 5 (Stop, Look, Assess, Control, and Monitor) and do not proceed to work if unsafe to do.
- Use authority to STOP work if observe an unsafe work by fellow worker.
- Report hazards and at-risk behavior as and help the Contractor management to develop a conducive safety culture.
- Use PPE as provided.
- Conduct a visual inspection of equipment in the beginning of the operation and ensure that equipment is de-energized before working on a piece of equipment.

- Ensuring that they wear appropriate PPE for the activity that they undertake.
- Be aware and mindful of hazards related to any work activity; do not undertake a job or task if physically or mentally not fit.
- Seek clarification for uncertainty relating to a task with the Supervisor.
- Do not undertake a job if not competent to do so.
- Raise improvement opportunities.
- Report near misses and actual incidents immediately to the supervisor.

Appendix II: Community Health and Safety Plan

12.2 Community Health and Safety Plan

12.2.1 Introduction

This Community Health and Safety Plan (CHSP) has been developed to be followed and undertaken by the assigned EPC Contractor, which will be monitored by Electricity Generation Company of Bangladesh (EGCB) during the whole tenure of project implementation up to the operation phase. The risks and impacts that may pose to the community relating to:

- Community health
- Community safety
- Community security

The proposed location of the solar plant and the ROW of the transmission line is about half a kilometer away from the nearest community settlement and thus the impact on nearby community due to the project interventions is anticipated as trivial to minimal. However, the preparation of this Community Health and Safety Plan (CHSP) is a requirement from the Asian Development Bank (ADB) that has been structured in accordance with World Bank's Environmental and Social Standards 4 (ESS4: Community Health and Safety), integrated with national laws and policy and other international guidelines. This community health and safety plan addresses the health, safety, and security risks and impacts on project-affected communities and the corresponding responsibility of Borrowers to avoid or minimize such risks and impacts, with particular attention to people who, because of their particular circumstances, may be vulnerable.

12.2.1.1 Objectives

The objectives of the Community Health and Safety Plan are to:

- Avoid or limit risks to, and impacts on the health, safety and security of the community during the implementation phase from both routine and non-routine works/circumstances. This is achieved through implementing targeted prevention programs to reduce risks, along with the implementation of an effective monitoring and evaluation program.
- Describe actions required to implement the construction-related management and preventive measures outlined in the Environment Assessment document and World Bank's Environmental and Social Standard 4 (ESS4): Community Health and Safety, Guidance Note 4 (Community Health and Safety), and IFC Performance Standard-4: Community Health, Safety, and Security (2012).
- Describe additional measures required to implement Good International Industry Practice (GIIP).

- Facilitate the addition and/or modification of control measures as new data become available via monitoring activities, health centers and community-based sources.
- Outline the roles and responsibilities of the positions in charge of implementing the CHS Plan, including monitoring and evaluation.
- Devise a training plan for all work-forces and community members who are directly exposed to the health and safety hazards of the Project.
- Describe the processes for recording and reporting non-conformances, as well as measurement and reporting of key performance indicators (KPI).

12.2.1.2 Scope

The scope of the Community Health and Safety Plan addresses the commitment to:

- Mitigate potential impacts and hazard risks of Project related activities that may affect the health and safety of communities within the project influences area.
- Maintain a healthy workforce and labor pool in the community; and
- Contribute to the improved health, safety and wellbeing of the local community in the areas of influence.

The plan will be implemented at the beginning of the construction phase and continued to the end of the Project life. The central element of the Plan is a set of control measures designed to avoid or mitigate the adverse effects of project activities on the health, safety, and security of the community, while at the same time, enhancing the beneficial effects and capitalizing on opportunities that may contribute to improving overall community well-being.

This Community Health and Safety Plan is currently preliminary draft and dynamic in nature and will continue to be developed and modified in consultation with all relevant stakeholders including but not limited to EGCB and community, throughout the lifecycle of the Project.

12.2.1.3 General Strategy for Mitigation/Control

In terms of community health and safety, the Contractor's strategy will be to implement programs that contribute to the maintenance of a healthy workforce and local community and protect against potential negative health effects of the Project within the Project Areas of Influence. As such the following programs have been identified for possible implementation:

- Health Services Program;
- Disease Prevention Program;
- Subcontractor Integrity Program;
- External Emergency Response and Preparedness;
- Security with Integrity Program;
- Community Health and Safety Awareness Program;
- Safety of Services Program by maintaining quality Management Systems;

- Potential Risks and Impacts on Ecosystem Services Program; and
- Positive Lifestyles Program.

12.2.1.4 Components of CHASP

- Identify potential hazards to community during project implementation phase;
- Control of potential hazards (how to prevent/minimize hazards);
- Prevention and protection of drinking water supplies for the nearby communities;
- Emergency response plans for electrical hazards/fire/accidents/natural disasters;
- Community notification process;
- Complaint resolution process; and
- Identification of project safety personnel/emergency contacts.

12.2.1.4.1 Sectors most likely to present community health, safety and security issues

Sectors most likely to present community health, safety and security issues are:

- Establishment of construction camps for the workers;
- Air, water and noise pollution due to Solar panel installation on mounting structures.
- Excavation of trench for cable laying and backfilling;
- Infrastructure establishment including substation construction;
- Ingress and egress road construction for project vehicle to deploy goods and equipment to site;
- Road traffic due to project interventions;
- Healthcare issue;
- Operations located in conflict or post-conflict areas; and
- Activities involving the use of security forces.

12.2.1.5 Risk Assessment

12.2.1.5.1 Likelihood and Consequence

Hazards and Risk Assessment Codes (HRACs) require assigning values for likelihood or probability of an outcome occurring and the consequence or severity of a potential outcome. Based on these assigned values, a matrix is used to place the specific hazard within a specific location of the matrix. This location can then be used to determine an HRAC number for that hazard activity.

The Likelihood or probability Code is considered numerical (1 through 5). These are presented in Table 1.1.

Table 1: Likelihood ratings

Likelihood	Definition
Almost certain (5)	It will happen again and soon –recurring event (e.g., daily or weekly).
Likely (4)	It will reoccur, but not as an everyday event.
Moderate (3)	It may occur from time to time in the project.
Unlikely (2)	It is not expected to happen again in the foreseeable future.
Rare (1)	Unlikely that it is not expected to happen again in the project.

Next is the Consequence or severity Code, varies from 1 to 5 and is presented in Table 1.2.

Table 2: Consequence ratings

Consequence	Definition
Insignificant (1)	Injury or illness that resulted in first aid treatment or minimal effects that required no medical treatment, and the worker continued to work.
Minor (2)	Injury or ill health where the worker/person affected is absent or unfit to perform work (i.e., loss work time).
Moderate (3)	Injury or ill health related including bone fractures, a burn or penetrating injury to the eye, any injury or acute illness resulting in unconsciousness, requiring resuscitation or requiring admittance to hospital.
Major (4)	Single fatality or disability (e.g., amputations, loss of sight) resulted from work-related or community-related caused by the impact of the project
Catastrophic (5)	Multiple fatalities resulted from work-related or community-related caused by the impact of the project.

12.2.1.5.2 Risk Level

The hazard risks level is presented in Table 1.3. This matrix helps OHS team to prioritize workplace hazards by identifying them as low, Moderate, High and Extreme.

Table 3: Risk Level

Risk Level	Definition	Legend
Low	Will involve the relevant supervisor to review the circumstances of the event and try to learn any lessons which will prevent future occurrences.	Low
Moderate	Will involve an investigation by the relevant supervisor or line manager into the circumstances and determine the immediate, underlying and root causes of the adverse event, to try to prevent a recurrence and to learn any general lessons.	Moderate
High	Will involve a more detailed investigation by site manager/ supervisor/safety officer and look for the immediate causes, the underlying causes and the root causes by using available incident analysis methodologies	High
Extreme	Will involve a team-based investigation, comprising site manager, supervisors, safety officer, worker representatives and external consultants/ specialists (if required). It will look at the immediate causes, the underlying causes and the root causes by using available incident analysis methodologies	Extreme

12.2.1.6 Risk Ranking

Those hazards identified as extreme will require the most stringent controls available as well as immediate attention. They may even demand that such activities be cancelled from the Project. Specific workplace controls can be applied so that the associated hazards are more effectively controlled and therefore, result in a revised assessment category to a more acceptable level. Using the World Bank EHS Guidelines Risk Ranking Table (Table 1.4) provided below, the Site Manager/Supervisor/Safety Officer will assess the incident and risk rank to one of the four risk categories below:

Table 4: Risk Ranking Table

Consequences \ Likelihood	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost Certain (5)	Low	Moderate	Extreme	Extreme	Extreme



Likely (4)	Low	Moderate	High	Extreme	Extreme
Moderate (3)	Low	Moderate	High	Extreme	Extreme
Unlikely (2)	Low	Low	Moderate	High	Extreme
Rare (1)	Low	Low	Moderate	High	High

12.2.1.7 *Community Health and Safety Management Framework*

12.2.1.7.1 *Traffic Management Including Accident*

Traffic, particularly the movement of heavy vehicles and other equipment carrier during peak hours in the construction phase of a project may cause huge road traffic in the highly populated area from Shonagazi Olama bazar to Char-Chandia, which may face the deterioration of standard living conditions of that particular community people. School, college and Madrasha going students may face an unfavorable environment for their study and attending into their classes. As the road is very narrow and damaged, fatal injuries even death may be happened due to traffic congestion and unsafe driving of the project vehicles and other public transportations. Project authorities should plan to reduce such type of risks (e.g., by re-routing traffic, adjusting the timing of traffic movements and training staff and/or contractors) and work collaboratively with the Project Affected Communities to develop an appropriate Traffic Management Plan.

12.2.1.7.2 *Health Services Program*

The health services program will enhance and monitor effective change in access to health, and any linkage to health status in general and in terms of the area of influence and specific communities and sub-populations (e.g., women, girls, children, in-migrants, visible minorities) within the project area. The health services program will use environmental, social, economic and health data to continually track and evaluate the changing vulnerability of communities within the area of influence so that action can be focused on the most vulnerable communities at any given time.

The Contractor will work with local government to identify any necessary follow-up actions if health status is negatively affected by the Project in areas of influence. Possible actions may include supporting the provision of affordable health services, including mobile health outreach clinics within the areas of influence.

At closure of the construction, the Contractor will work to maximize likelihood of continued improvement to general health and wellbeing. Under the Social Management Framework, the Contractor will work with local government to identify options to protect and enhance the health of communities in the areas of influence post-closure. During the closure phase, the Contractor will transfer knowledge of general health status, trends in health status over the life of the Project, and predictions for changes in health status for different post-closure scenarios to the government.

12.2.1.7.3 *Disease Prevention Program*

The Disease Prevention Program will focus on methods to reduce of community exposure of water related disease. The program will be delivered through the active mitigation measures (e.g., limiting bodies of stagnant water), development support in nearby communities, and community awareness. The program will be informed by health monitoring.

12.2.1.7.4 *Pandemic Action Plan Program*

To protect the health and safety of workers, as well as surrounding communities from pandemic, it is strongly recommended to conduct a workplace review and risk assessment for exposure to any kind of pandemic disease (e.g., COVID-19 or other virus infectious

diseases) where the nature of works, stage of implementation, project activities, and status of the project must be taken into consideration. In addition, vulnerable groups such as migrant workers as well as women, older workers, at-risk workers including those with underlying health conditions, or those with combined vulnerability factors who will also be disproportionately impacted, should also be taken into account. Moreover, proper testing to new workers, existing workers returning to site, and visitors to site should be strictly maintained.

Project contractor/Management must need to engage local Governments, community leader, businesses, and healthcare providers contributing to an overall community mitigation strategy to minimize illness and death.

Implementation of community mitigation measures of pandemic is based on:

- Pandemic Response Plan will be developed which will be monitored and progress is reported regularly to Senior Management (and the Board) for review and improvement.
- The project will dedicate community outreach / community relations staffs who will establish channels of communication with local communities. These channels will be used to communicate the Project's response and prevention information to communities about the pandemic situation in a culturally appropriate way
- Contractor should establish proper channels of communication and collaboration with local/regional health institutions in their jurisdiction.
 - These channels will be used to communicate and coordinate on the emergency response, for reporting cases and contact tracing.
 - The project will be following health protocols from local health authorities regarding the management of cases and fatalities
- The project authority will develop a Grievance procedure in place that will be adapted for pandemic Grievances.
- Both workers and community members have an immediate way to contact the Project (e.g., by phone) regarding any potential grievance linked to pandemic.
- Frequent meeting with community authority either seminar or FGD should be conducted to make the community aware about the severity and fatality of pandemic and also inspire them to follow the appropriate precautions. In addition, awareness campaign should be taken place among the community by putting up poster or leaflet distribution in Bengali language.

12.2.1.7.5 Chikungunya and Dengue

Chikungunya, dengue and other vector borne disease reduction campaigns will be applied consistently throughout the Project period and will include awareness of linkages between stagnant water and dengue, including through poor sanitation conditions. Open water sources are created and/or enlarged, as a result of construction activities and storage of plant, materials and equipment, with the potential for increased mosquito breeding sites. Increased burden of disease in workforce, results in increased demand on Project health services and reduce productivity.

Perform a baseline entomological study to define the most predominant vector species in the Project area, as well as determining the susceptibility of mosquitoes to the different classes of insecticides. The Contractor will encourage good sanitation practices, and the use of mosquito nets throughout the area of influence. The Contractor will support development of local knowledge and on the exposure pathways and determinants of exposure in vulnerable communities. The Health Services Program will inform the Disease Prevention Program of the most vulnerable communities (with highest dengue incidence) for prioritized action. Provide information for training of workers in Chikungunya and Dengue awareness so they can take knowledge back to communities. Actions and lessons learned in the areas of influence will regularly inform Occupational Health and Safety training.

12.2.1.7.6 Sanitation and Water Supply

The Contractor will support the development of improved sanitation and improved water facilities. Existing drinking water supply must be monitored by the contractor so that the over-use of water by the project workers and project interventions will not make scarcity of the drinking water for the local community. Extraction of the ground water for project purposes must be prohibited. Through stakeholder engagement, the Contractor will encourage people to construct, adopt and properly use improved sanitation and water facilities. Focus group Discussions (FGDs) with local government, existing communities and in-migrants may be implemented to help knowledge exchange and establish common expectations for sanitary conditions in the areas of influence.

The facilitation and dissemination of information on the linkages between improved water sources, sanitation conditions and human health, and on good hygiene practices, will promote use of the improved facilities and minimize the increased incidence of water related disease and food-borne illness in the areas of influence.

On-going monitoring of health and health impact pathways (e.g., number of bodies of stagnant water, number of people with access to improved sanitation facilities) will be implemented by the Contractor with regular feedback to those affected.

12.2.1.7.7 Sexually Transmitted Diseases

Stakeholder engagement activities will include culturally specific and gender specific awareness education about incidence of sexually transmitted diseases in the areas of influence, information on pathways of exposure, and any local evidence to aid acceptance of this information and dispel current myths about causes of HIV/AIDS. EGCB will assist communities in developing education materials such as those using anecdotal epidemiology that would aid increasing acceptance of evidence-based research and facts regarding HIV/AIDS.

12.2.1.7.8 Subcontractor Integrity Program

The Contractor will be clear about its expectations of subcontractors during all phases. The Contractor will continually monitor and evaluate companies' performance, including performing spot checks on-site, to ensure that the expected level of safety culture is being adhered to. The subcontractor integrity program will be far reaching and include, but not be limited to the performance regarding the following:

- General traffic safety;
- Hazardous materials management;
- Community health and safety;
- Occupational health and safety; and
- Adherence to construction standards stated in the general and specific conditions of the main contract.

12.2.1.7.9 Emergency Preparedness and Response Planning

The Contractor will develop an emergency preparedness and response plan (EPRP) to combat emergencies. The Contractor will work with local authorities to strengthen the national emergency response network in the areas of influence and to ensure implementation of the project specific emergencies and make arrangements with external emergency services (e.g., Fire-fighting, ambulance, etc.), if the resources available with the Contractor is not sufficient to contain the emergency.

If an external emergency arises not due to the Project but something where collaboration from the Contractor is needed for both manpower and emergency equipment, contractor can extend collaboration to work with local authorities and communities. The Contractor will develop procedures in the EPRP on actions that need to be taken, when an external emergency event is triggered. The Emergency Response Plan prepared by the contractor will cover both project-specific and emergencies in the communities. The Contractor will conduct capacity building and train local communities as needed to make sure the communities know what to do during an emergency. The Contractor will work with local authorities to make sure they are aware of it and if needed strengthen the emergency response network to be able to coordinate with the Project.

The following aspects of the Emergency Preparedness and Response Plan will be jointly addressed by the Contractor, the community and government representatives:

- Definition of information and notification chain(s) within government/regulatory agencies (who needs to be informed, who has which responsibility and access to/control over resources), following notification of the authorities by the Contractor that an emergency situation has occurred;
- Evacuation procedures for the local affected population;
- Awareness of operations and their risks and preparedness to respond (e.g., sufficient capacity of beds in local hospital);
- Preparedness of state/community emergency response teams (fire brigade) and awareness of risks and potential emergency scenarios, availability of PPE adequate for specific risks such as respirators, full-body harness etc.;
- Knowledge of site plan by ambulance teams (fastest access to critical points such as embankment, explosive storage);
- Training requirements of key people (police, hospitals and local health centers) and alignment of their training plans with the Contractor training plans;
- Commitment to coordinated emergency drills between the Contractor and police, fire fighters, national disaster management authority, etc., and aligned

plans for drills; and

- Nomination of community representatives in the preparation of the external plan, and in the planning of and participation in, drills.
- Designated coordinator for EPRP implementation and
- Measures for restoration and clean-up of the environment following any major accident.

12.2.1.7.10 Awareness on Community Health and Disease Prevention

Where an assessment identifies risks, for example communicable diseases, which may arise from the interaction of project workers with local communities, the EIA for the project will describe such risks and measures to address them. Such measures can include, more generally, the use of skilled trainers to raise awareness among project workers of the risks, expected behaviours, and consequences of violations, communicated through training, and publicized codes of conduct. It is also important to raise awareness of the risks among community members and local health authorities and inform them about available grievance mechanisms. In addition, the Contractor will create awareness of linkages between stagnant water and dengue, including through poor sanitation conditions in the communities' close proximity to the Project. Provide information for training of community representatives in Chikungunya and Dengue awareness so they can take the knowledge back to their respective communities.

Community health and disease prevention awareness campaigns will be applied consistently throughout the Project duration and will include awareness of:

- Linkages between improved water sources, sanitation conditions and human health;
- Common water related disease and food borne illness rates in the areas of influence;
- Good hygiene practices;
- Benefits to properly using the improved facilities; and
- Evidence of improvement in target communities to encourage adoption in other communities.

12.2.1.7.11 Traffic and Road Safety Awareness

Stakeholder engagement activities, a good communication strategy, as well as monitoring and management plans will help the Contractor prevent potential negative impacts resulting from a poor in-country safety culture. These actions include the following:

- Clear expectations regarding road safety culture, road safety behavior and road safety training, provided to workers and contractors;
- On-going monitoring of traffic and Pedestrian Interface in the project area (e.g., near misses, reports from communities, reports from project traffic) with regular feedback to those affected; and
- Knowledge transfer to workers and affected communities regarding road user awareness with advice on strategies for interacting with project traffic.

In addition, the Contractor will promote traffic safety awareness in communities in the Direct Area of Influence and along the transportation route.

12.2.1.7.12 Use of Security Personnel

The Contractor will engage with communities about the project's impacts on community safety and security, create awareness concerning the Code of Conduct commitment and project grievance mechanism and disclosure of the project possible outcome including the impacts through the public consultation meeting.

The Contractor will avoid internal operational silos by ensuring that their Security staff coordinate regularly with other departments, such as Community Relations and Human Resources. Through its Community Relations function, the Contractor will share information with communities about security arrangements, the Contractor's security policies, and the expected conduct of security personnel. Dialogue with communities about security issues can also help the Contractor to identify potential risks and local concerns, and can serve as an early warning system.

Community members will be informed through the awareness program, where to go with complaints about the conduct of security personnel. Can they lodge such complaints through the company's general community grievance mechanism or is there one specifically for security concerns- or even an alternative complaint mechanism (for example, as part of the local justice system)? The Contractor will maintain a clear process and communicate it. The awareness will also provide information on the community members' ability to make complaints without fear of intimidation or reprisal.

Gender considerations are also important, as women often have different experiences and interactions with security personnel. For example, the potential for sexual harassment or sexual violence against women can increase from an expanded presence of private or public security forces in a project area. The Contractor should consider to consult and create awareness separately for the women group, which may offer important perspectives and may help the Contractor to identify a fuller range of potential risks and community concerns. At the same time, security personnel's awareness of and respect for culturally specific gender issues may help the local population accept their presence. The Contractor might consider to recruit female security guards to improve cultural acceptance and reducing tensions, particularly in situations where there are frequent interactions between guards and women from the community.

12.2.1.7.13 Positive Lifestyles Program

Through the Community Development Plan, the Contractor will encourage culturally appropriate positive lifestyle choices in an effort to:

- Establish good financial management choices;
- Deter an increase in alcohol use, substance abuse and tobacco use;
- Avoid violence against women, including sexual violence;
- Avoid ethnic- or religious- based violence;
- Adopt good hygiene practices and sanitation; and
- Reduce the potential for STDs.

Awareness campaigns may be conducted within the workplace and at religious institutions, local governments, schools, and health clinics.

12.2.1.7.14 SEA/SH awareness program

Apart from the reasons of this hazard indicated in the Risk matrix (**Table 1.5**), other examples of Sexual Exploitation & Abuse (SEA)/Sexual Harassment (SH) need to be considered but are not limited to:

- A project worker tells women in the community that he can get them jobs related to the work site (cooking and cleaning) in exchange for sex
- A worker that is connecting electricity input to households says that he can connect women headed households to the grid in exchange for sex.
- A project worker gets drunk after being paid and rapes a local woman.
- A project worker denies passage of a woman through the site that he is working on unless she performs a sexual favor.
- A manager tells a woman applying for a job that he will only hire her if she has sex with him.
- Male staff comment on female staffs' appearances (both positive and negative) and sexual desirability.
- When a female staff member complains about comments male staff are making about her appearance, they say she is "asking for it" because of how she dresses.
- A male staff may touch female staff members' buttocks whether in project or in community when she passes her destination.
- School or college girls might get seduced or tempted by the project staff by offering gifts or other financial benefits

To protect and prevent community SEA/SH Strengthen community engagement and awareness- raising is essential. Critical awareness activities need to be conducted which will include training and awareness-raising sessions with women, girls, boys and men in communities of concern as well as with other stakeholders (including implementing and operational partners, government officials, civil society organizations, and companies in the private sector). To prevent SEA effectively, all staff and project workers must make sure that project Persons of Concern (PoC) are aware of their rights and entitlements. On the other hand, PoC from contractor and project management side should know that they are entitled to assistance that they should never be expected to provide any form of sexual favour, and that demands for such favors are strictly prohibited. Community and project victims should also know how and where to report SEA incidents safely and confidentially when they occur. As part of prevention, training and information campaigns should be put in place for all project personnel and PoC. Training and information campaigns may include the distribution of information sheets, posters and videos, or community meetings, focus group discussions, etc.

Besides that the project will include a general Code of Conduct (CoC) as well as a Labor Code of Conduct, covering the Gender-Based Violence (GBV)/SEA/SH related risks for the contractors, sub-contractors, and laborers who will be employed under the project.

12.2.1.7.15 Other Measures to Manage CHS Risks

Safety of Services by maintaining quality Management Systems

The Contractor will establish and implement appropriate quality management systems to anticipate and minimize risks and impacts. Projects may provide many kinds of services to communities, such as those relating to education and health, social security and social protection, transport, and utilities, such as electricity and gas, water and sanitation, and waste disposal. Management systems that address the safety of such services are important because without adequate protection measures the provision of such services can present dangers for communities. Such systems address the community health and safety risks posed by project services, for example, risks associated with:

- Infrastructure construction and heavy equipment movement, such as, struck by moving vehicle;
- Slip, trip and fall injuries due to wet road and uncovered excavated trench.
- Waste disposal, such as toxicity, waste dump collapse, or air pollution;
- Quarries or excavation works, such as rock falls or hazardous equipment;
- Water and sanitation services, such as contaminated water or spread of disease;
- Electricity supply, which may result in electric shock from electrical cabinets or cables;
- Service providers, which may use their service for the purpose of financial, sexual, or other exploitation, particularly of vulnerable groups such as women, children, and the elderly.

In such circumstances, the Contractor will apply hierarchy of controls, such as, eliminate/substitute, and engineering control of hazards and if hazards are low risk, then introduce administrative controls and as a final resort provide appropriate personal protective equipment.

12.2.1.7.16 Potential Risks and Impacts on Ecosystem Services

The project's direct impacts on ecosystem services may result in adverse health and safety risks to and impacts on affected communities. Where appropriate and feasible, the Contractor will identify the project's potential risks and impacts on ecosystem services that may be exacerbated by the project interventions. Adverse impacts will be avoided, and if they are unavoidable, the Contractor will implement appropriate mitigation measures.

Ecosystem services are the benefits that people derive from ecosystems. The provisioning services that ecosystems provide include the products people obtain from the ecosystems, such as food,

freshwater, timbers, fibers, and medicinal plants. Regulating services of ecosystems are the benefits people obtain from the regulation of ecosystem processes, such as surface water purification, carbon storage and sequestration, climate regulation, and protection from natural hazards. Ecosystems and ecosystem services affected by the project need to be part of the environmental and social assessment. ESS1 of the World Bank's ESF guidelines has clearly described the importance of the ecosystem services while running a project within a community-driven area.

12.2.1.8 Organization, Roles, and Responsibilities

The requirements of this CHS Plan will be stewarded and implemented by the Project. The Environment, Health and Safety (EHS) Officer will own this Plan.

The following roles and responsibilities are examples of the type of roles that will apply during the construction phase. As the needs of the Project change over time, some roles may be replaced and/or combined with others that are more appropriate to the Project's needs at the time.

12.2.1.8.1 Environment, Health and Safety (EHS) Officer

- Responsible for overall implementation including coordination with government and community representatives
- Responsible for ensuring safe behaviors by Project personnel such that community safety is protected
- Investigates and analyses community safety events when/if they occur and escalates findings and required remedial actions to Management as required
- Responsible for notification of community safety incidents, as described in the Environmental and Social Management Plan.

12.2.1.8.2 Medical Doctor/Coordinator

- Responsible for health support coordination, delivery and implementation of health services to the workforce
- Ensure health specifications and programs/procedures meet Country health regulatory requirements
- Develops and coordinates the implementation of health inspection and audit programs to monitor compliance with health requirements
- Provides review of disease prevalence data and recommends changes to address disease prevalence and severity.

12.2.1.8.3 Security and Community Health Representative

- In consultation with Medical Doctor/Coordinator, identifies and evaluates community health risks
- Identifies mitigation steps to address community health issues affected by project activities

- Conducts inspections and audits for effective implementation of community health programs
- Management and coordination of security guards employed by the Project
- Management of security incidents which occur both on the Project site and outside the site
- Collects, analyses data, reports on and provides recommendations on initiatives for continuous improvement in the community health program performance and compliance.

12.2.1.9 Training and Competency

The Contractor will ensure that personnel responsible for the execution of tasks and requirements in this Plan are competent on the basis of education, training, and experience.

This Plan requires workforce awareness program/training be provided as part of camp initiation as well as incorporated into ongoing and regular training commitments, particularly with regard to the management of communicable diseases. This training is applicable to all Government, Contractor, sub- contractor, and the Engineer personnel and will be developed and implemented by the Contractor in association with the Engineer following the Government review and approval. Training will include, but not be limited to:

- Voluntary Principles for Security and Human Rights training for all Project security guards and security management, including the appropriate use of force and protection of human rights;
- STI and HIV/AIDS prevention and awareness training for all workforces;
- Driver training to improve driver and vehicle safety, as well as systems for monitoring and enforcement;
- Road and traffic safety awareness for school children and the community leaders;
- Sanitation and nutrition awareness and education for all workforces, with a focus on messages which can be taken home to families to encourage good sanitation and nutrition practices in rural settings;
- Respiratory illness and infectious disease management, including TB;
- Vector-borne disease awareness including Chikungunya and Dengue;
- Speed restrictions in populated areas, safe driving in rural areas, safe driving in dusty environments, defensive driving and basic first aid;
- Benefits of vaccinations and disease prevention; and
- Adverse impacts of Drug and Alcohol usage.

12.2.1.10 Performance Indicators

The Borrower will review and endorse indicators which will be monitored to determine the effectiveness of Community Health, Safety, and Security impact and risk mitigation measures.

Examples of indicators may include, but should not be limited to:

- Rates of communicable disease in the Project workforce;
- Rates of communicable disease in the community;
- Project related safety and security incidents in the community; and
- Number of grievances or claims of Project related impacts on the community.

The development of risk and impact management strategies will include specific performance indicators. Indicators will be included in the monthly report of the Contractor and the Engineer, with the aim that regular reviews for effectiveness and achievement of desired outcomes are part of the report development process. This will ensure that improvements and additional preventions can be implemented as and when required.

Project environmental assessment report should include provisions for specific community health monitoring which may be undertaken in partnership with government, NGOs, or third parties with the intent to share the data with Government or appropriate health planning and consideration by the Government. Community health indicators may include, but not be limited to:

- Rates of Chikungunya and Dengue, and other vector-borne diseases;
- Community health aspects, i.e., rate of STI's, TB, HIV/AIDS; and
- Number of active cases of any kind of pandemic diseases (e.g., COVID-19) after the project intervention starts.
- Number of community accident/ incident and its type

The Borrower may, at its discretion, audit any contractors, subcontractors, or suppliers to assess compliance with this Plan. The Borrower may also, at its discretion, undertake audits of other third- party facilities and providers associated with the Project, as relevant to the Environmental and Social Management Plans.

[*12.2.1.11 Monitoring and Maintenance*](#)

[*12.2.1.11.1 Confidentiality Requirements*](#)

The Contractor will ensure health data are handled to an international standard of medical ethics. Health data is confidential to the individual and health professionals only. the Contractor will assure that data is stripped of all personal identifiers before dissemination to other (non-medical) company employees or external bodies, reducing the potential for any internal or external discrimination of employees or community members. Sample size and relative risk of personal identification will need to be taken into account before combined health data is published internally and externally. The Contractor understands that confidentiality of health data overrides any need to demonstrate vulnerability in a population, sub-population or individual.

12.2.1.11.2 Community Health Monitoring

Community health monitoring will include monitoring of exposure pathways as well as disease. Regular feedback to local communities will be important to provide evidence and encouragement for long-term adoption of positive health related behaviours.

The Contractor will identify opportunities for collaboration with local governments and communities to develop or share in health data collection and reporting for the communities within the areas of influence. Data would preferably be collected and analysed by community and gender, age and socio- economic or other health-associated status if data size allowed and is protective against confidentiality breaches.

Audit

The Contractor will conduct an annual internal community health and safety audit to evaluate the ethical compliance, comprehensiveness and effectiveness of the Community Health and Safety Plan. Periodically the plan may be audited by qualified external auditors to verify the internal auditing.

12.2.1.11.3 Review and Update

The Plan shall be regularly updated, taking into account the following aspects, as applicable:

- Updated Project design;
- Change in project phase;
- Operational experience;
- Ongoing stakeholder consultation;
- New regulatory requirements and changed legislative framework; and
- Emerging social change and community health issues such as new communicable or non- communicable diseases.

There is no authoritative guidance on the frequency of the updates, however, in line with the best international practice, yearly update would be advisable, and more often if major changes have occurred.

Responsibility for the update lies with the Environment, Health and Safety Officer, in cooperation with other departments such as the Security and Community Health Representative.

Appendix III: Labor Management Plan (LMP)

12.3 Labor Management Plan (LMP)

12.3.1 Specific objectives of the LMP

This LMP has been developed to achieve the following specific objectives:

- To highlight and promote workplace safety and health.
- To promote fair treatment, non-discrimination, and equal opportunity for project workers irrespective of sex, race, or ethnic identity.
- To protect project workers, including vulnerable workers such as women, persons with disabilities, children and, contracted workers and primary supply workers, as applicable.
- To prevent the use of all forms of forced labor and child labor.
- To support the principles of freedom of association and collective bargaining of project workers consistent with national law.
- To provide project workers with accessible means to raise workplace grievances.
- To mitigate the risks of sexual exploitation and abuse and sexual harassment (sea/sh) in the workplace

Implementation of the Project will require direct workers, contracted workers, and primary supply workers for civil and construction works. The LMP covers protocol related to the direct workers, contracted workers, and primary supply workers to be involved with the Project. The respective PIUs will ensure that all the engaged contractors prepare Labor Management Plans for contracted works as part of their Contractor ESMPs (C-ESMPs) and in line with these LMPs. The approach will be assessed as part of the initial screening of E&S risks and subsequent site-specific environmental and social impact assessments (ESIAs). The potential sexual exploitation and abuse (SEA) and sexual harassment (SH) related risks are assessed to be moderate, but this will be revisited during implementation based on site specific ESIAs.

12.3.2 Timing of labor requirements and their gender

The direct workers will be recruited when the project is approved, especially those forming part of PIUs. The employment of field-level staff and consultants will be done after Project effectiveness. Considering the nature of the project workforce (unskilled, semiskilled, and skilled construction labor and specialist consultants) and Bangladesh's labor force market characteristics, it is not expected that the number of female workers will be high. It is estimated that women would represent about 5-10 percent of the workforce, and those would likely be technical/managerial and/or staff working in the operation offices and camps (maids, cooks, cleaners etc.).

12.3.3 Information on all Categories of Workers

The PIUs will gather and retain information on the engagement of contracted workers. The contractors and any consulting firms engaged for the PIUs will be contractually obligated to maintain updated information on all categories of contracted workers, including those employed by the sub-contractors, especially the non-local workers, and periodically share

the same with the PIUs, which in turn will be made available by the PIU accessible to the parties interested including the IsDB.

The format for the submittal of workers' information will be finalized at the mobilization of the contractors. The information database on contracted works to be maintained by the contractors will include but not be limited to the following:

- Name and age (supported by NID/ Birth Certificate/ Certificate from the Union Parishad)
- Mother's and Father's name and permanent address
- Marital status and name of the spouse (if married)
- Number of dependents with relations and gender (as applicable)
- Place of stay of spouse and children during work engagement under the Project
- Address and contact number (in case of an emergency) with at least one alternative contact number and person(s) of contact
- Key skills and years of experience
- Work activities, schedule, and duration of engagement as per the contract with the contractors/PIUs
- Duration of contract and rotation arrangements
- Facilities arranged by contractor/firm including health check-ups before engagement, accommodation (to be specified by contractor)
- Pre-employment check-ups, fitness tests, and health awareness campaigns for workers.

12.3.4 Policies and procedures

Decisions relating to the employment or treatment of project workers will not be made based on personal characteristics unrelated to inherent job requirements. The employment of project workers will be based on the principle of equal opportunity and fair treatment, and there will be no discrimination concerning any aspects of the employment relationship, such as recruitment and hiring, compensation (including wages and benefits), working conditions, and terms of employment, access to training, job assignment, and promotion, termination of employment or retirement, or disciplinary practices. Most environmental and social impacts of sub-projects resulting from activities directly under the control of contractors will be mitigated directly by the same contractors. Consequently, ensuring that contractors effectively mitigate project activity-related impacts is the core of the project's approach.

Under no circumstances will IAs, Contractors, suppliers, or sub-contractors engage forced labor. Forced labor includes bonded labor (working against an impossible debt), excessive limitations of freedom of movement, excessive notice periods, retaining the worker's identity or other government-issued documents or personal belonging, the imposition of recruitment or employment fees payable at the commencement of employment, loss or delay of wages that impede the workers' right to end employment within their legal rights, inappropriate fines, physical punishment, use of security or other personnel to force or extract work from project workers, use of SEA/SH to extract work from project workers, or

other restrictions that compel a project worker to work in a non-voluntary basis can be referenced or annexed to the LMP, together with any other supporting documentation.

12.3.4.1 Equal Opportunity for All

Decisions relating to the employment or treatment of project workers will not be made based on personal characteristics unrelated to inherent job requirements. The employment of project workers will be based on the principle of equal opportunity and fair treatment, and there will be no discrimination with respect to any aspects of the employment relationship, such as recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, or disciplinary practices.

12.3.4.2 Occupational, Health, and Safety (OHS)

The health and safety procedure illustrated in the Bangladesh Labor Act 2006, IsDB Environmental and Social standards, WB Environmental and Health Safety Guidelines (EHSG), ESS 2, Communicable Diseases (Prevention, Control, and Eradication) Act 2018, and guidelines to address COVID-19 issues will be referenced in all activities under the Project.

The PIUs will ensure that the Contractors are:

- Complying with legislation and other applicable requirements which relate to the OHS hazards.
- Enabling active participation in OHS risks elimination by promoting appropriate skills, knowledge, and attitudes towards hazards.
- Continually improving the OHS management system and performance.
- Communicating this policy statement to all persons working under the control of IA emphasizes individual OHS responsibilities.
- Availing this policy statement to all interested parties at all IA facilities and sites.
- The Contractor will have a designated Safety, Health, and Environmental Representative for the workplace or a workplace section for an agreed period. At a minimum, the Representative must:
 - Identify potential hazards;
 - In collaboration with the Contractor, investigate the cause of accidents at the workplace;
 - Inspect the workplace to ascertain the safety and health of workers, provided that the employer is informed about the purpose of the inspection;
 - Accompany an inspector while that inspector is carrying out the inspector's duties in the workplace;
 - Attend meetings of the safety and health committee to which that safety and health representative is a member;
 - Make recommendations to the Contractor in respect of safety and health matters affecting workers through a safety and health committee; and

Where there is no safety and health committee, the safety and health representatives shall make recommendations directly to the Contractor regarding any safety and health matters affecting the workers.

Further, to avoid work-related accidents and injuries, the contractor will:

- Provide OHS training to all workers involved in project works.
- Provide PPEs (protective masks, hard hat, overall and safety shoes, safety goggles).
- Ensure availability of first aid box.
- Provide workers with access to toilets and potable drinking water.
- Ensure the voluntary reporting of any COVID-19 or other symptoms and arrange for health emergency services.

Further to enforcing environmental management compliance, contractors are responsible and liable for the safety of site equipment, laborers and daily workers attending to the construction site, and safety of citizens for each subproject site, as mandatory measures.

12.3.4.3 SEA/SH

Contractors will need to manage labor relations with local communities through worker Codes of Conduct (CoC). The CoC commits all persons engaged by the contractor, including sub-contractors and suppliers, to acceptable standards of behavior. The CoC must include sanctions for non-compliance, including non-compliance with specific policies related to SEA/SH (e.g., termination and recourse to legal system). The CoC should be written in plain local language and signed by each worker to indicate that they have:

- Received a copy of the CoC as part of their contract;
- Had the CoC explained to them as part of the induction process;
- Acknowledged that adherence to this CoC is a mandatory condition of employment;
- Understood that violations of the CoC can result in severe consequences, including dismissal or referral to legal authorities.

A copy of the CoC shall be displayed in a location easily accessible to the community and project-affected people. It shall be provided in Bangla. Contractors must address the risk of SEA/SH through:

- Mandatory training and awareness-raising for the workforce about refraining from unacceptable conduct toward local community members, specifically women. Training may be repeated.
- Informing workers about national laws that make SEA/SH a punishable offense that is prosecuted.
- Adopting a policy to cooperate with law enforcement agencies in investigating complaints about SEA/SH;
- Developing a system to capture gender-based violence, sexual exploitation, and workplace sexual harassment-related complaints/issues.

12.3.4.4 Terms and Conditions

The terms and conditions of employment for the Project workers are governed by the provisions of the Bangladesh Labor Act 2006 (amended in 2013 and 2018) (BLA 2006), National Child Labor Elimination Policy 2010 (NCLEP 2010).

Conditions of employment and service. The employers must provide workers with an Appointment Letter, Identity Card, and a Service Book (Sections 5 and 6 of BLA 2006). A register of workers, including details of all workers engaged, is also mandatory to be

maintained by the employer (Section 9). Leave Procedures are illustrated in Section 10. Termination of employment is described in Section 26 for both permanent and temporary workers. No children below the age of 14 can be employed, and working children between the ages of 14 and 18 should not be engaged in any work hazardous to their health and well-being (Section 10 (a) of NCLEP 2010).

Working hours. Working hours (maximum 8 hours a day ordinarily, except exceptional cases and 48 hours a week), rest hour (1 hour for more than 6 hours of work), overtime work (more than 8 hours a day with twice the rate of the normal working hour), working hour for women (no work between 10 PM to 6 AM without her consent) and leave entitlement [Chapter IX].

Wages and calculation of wages. Section 123 describes the time for wage payment (the wages of a worker shall be paid before the expiry of the seventh working day following the last day of the wage period in respect of which the wages are payable). Section 125 defines the cases where deductions may be made from wages.

Condition of the minimum wage rate. Section 148 makes it binding on the contractors (employers) to abide by the minimum wages rate. Contractors will also be required to comply with the most current decision of the Wages Board assigned by the government. The Wage Board Order and the Labor Act specify the minimum wages, hours of work, overtime pay, leave entitlements, traveling and subsistence allowances, and the issue of protective clothing.

Trade Unions and Industrial Relations. The workers shall, without distinction whatsoever, have the right to form a trade union primarily to regulate the relations between workers and employers or between workers and workers and, subject to the constitution of the union concerned, to join the trade union of their own choice.

Upon receiving the Project contract, the Contractor shall certify in writing that the wages, hours, and conditions of work or persons to be employed by him on the contract are not less favorable than those contained in the most current wages regulation issued by the government recommended by the Wages Board Chairman. The Contractor shall maintain the worker's register, which will be available for inspection during working hours for the Inspector appointed by PIUs, other interested parties, and the AIIB

In ensuring full compliance with the law, the Contractor will be required to furnish PIU with copies of the Service Book or copies of the contract of all its workforce. Contractors will not be allowed to deploy any employee to work in the project if such a copy of that employee's employment has not been handed to PIU. The Contractor is also obliged by the law to allow workers to form trade unions subject to BLA 2006.

As a monitoring mechanism, a contractor shall not be entitled to any payment unless he has filed, together with his claim for payment, a certificate: - a) stating whether any wages due to employees are in arrears; b) stating that all employment conditions of the contract are being complied with. The contract will be a material term to allow PIU to withhold payment from the contractor should the contractor not fulfill their payment obligation to their workers.

12.3.4.5 *Grievance redress mechanism*

Workers who believe that they are adversely affected by the project may submit complaints/concerns to the existing labor grievance redress mechanism outlined in this LMP.

The Labor Act 2006 Section 33 provides the formal grievance procedure if a laid-off worker retires, is discharged, dismissed, removed, or otherwise terminated from employment. Section 202 (Subsection 24) describes the responsibilities of a Collective Bargaining Agent (CBA), especially bargaining with the employer in matters of the workers' conditions of work or environment and conducting cases on behalf of any individual worker or a group of workers under this Act. Workers' grievance redress mechanisms (GRM) under the project will support all project workers, direct contracted and, if applicable primary supply workers.

Direct Workers: The Project Director of this project will be responsible for providing guidance and advice on all grievances of the direct workers and their management, in line with the national legal and regulatory framework related to labor and the provisions of this LMP.

Contracted Workers: The Consulting Firm(s) and Contractors under all PIUs will be obligated to set up a workers GRM, specially to redress complaints relating to workers deployed for construction works under the project. The Workers GRM will have due representation of respective PIUs, Contractors' workers, and women (either from PIUs/contractor/workers) and function under PIUs. The mandate for GRM, institutional arrangements, procedure for receiving complaints, time limits for redressal of complaints, escalation level for unresolved cases, and resolution thereof will be finalized during the approval of C-ESMP by the PIUs with assistance from the national PIU. The GRM will be set up at mobilization of the contractors and engagement of the PMC. The contractor and the consulting firm(s) will also be responsible for tracking and resolving workers grievances and maintain records about grievances/complaints received, minutes of discussions, recommendations and resolutions made thereof and intimation of resolution of grievance to the complainant.

In the COVID-19 context, the nature of complaints will be particularly time-sensitive and sensitive in terms of confidentiality. Hence, the Contractor should consider streamlined procedures to address specific worker grievances, allowing workers to quickly report labor issues, such as a lack of PPE, lack of proper procedures, or unreasonable overtime, and allow the workers to report and respond and take necessary action freely.

The responsible person (preferably a Labour Specialist) at the PIU will provide implementation and capacity-building support to all sub-PIUs on managing workers' related grievances. The Specialist will also include workers' grievance status in the progress reports. The Workers GRM will be well circulated and written in a language understood by all categories of workers engaged in the project activities. All workers' related grievances will be received through established communication channels and registered with the Workers GRM at the PIUs. Workers will also be able to submit their grievances through the regional and divisional labor offices of the Department of Labor, whose addresses and contact telephone numbers will be prominently displayed by contractors for the visibility of all workers at all worksites.

12.3.4.5.1 The Workers GRM will include:

- A channel to receive grievances such as comment/complaint form, suggestion boxes, email, a telephone hotline that might also be anonymous.
- Stipulated timeframes to respond to grievances.
- A register to record and track the timely resolution of grievances.
- A responsible section/wing/committee to receive, record, and track the resolution of grievances.

The Workers' GRM will be described in workers' induction training, which will be provided to all project workers. The detailed induction training plan and content have been provided in the ESMF. The mechanism will be based on the following principles:

- The process will be transparent and allow all project workers to express their concerns and file grievances.
- There will be no discrimination against those who express grievances, and any grievances will be treated confidentially.
- Anonymous grievances will be treated equally as other grievances, whose origin is known.
- Management will treat grievances seriously and take timely and appropriate action in response. Information about the existence of the grievance mechanism will be readily available to all project workers through notice boards, the presence of "suggestion/complaint boxes," and other means as needed.
- The Project workers' grievance mechanism will not prevent workers from using the conciliation procedure provided in the BLA 2006 or recourse to legal means.

The PIU will outline workers' GRM in a handout, explaining institutional setup and representation in local language, timing and procedure for receiving complaints, mechanism of handling complaints, maximum time limits for redressal of complaints, and escalation level unresolved cases and resolution thereof. The PIUs will monitor the Contractors' recording and resolution of grievances and report these in their monthly progress reports to share with the PMU.

Management of Gender and SEA/SH Related Complaints. Gender-based discrimination is strictly prohibited and monitored by the PIU of the Project. With support from Gender and SEA/SH specialists/consultants, the PIU will identify issues of SEA/SH associated with the investments by the PIUs by ensuring GRM is responsive to SEA/SH cases. In case the PIUs and the contractor are not equipped to handle complaints or provide relevant services to survivors of SEA/SH, they will refer them to SEA/SH service providers (could be local NGOs having such program and services) who will in turn use health facilities, law enforcement's gender unit or others, and other services for management of the issue. Grievances related to SEA/SH should also be channeled through the related service provider, if employed, else keeping the complainants' confidentiality.

The PIU will keep records of all resolved and unresolved complaints and grievances (one file for each case record) and make them available for review as and when asked for by Bank. The PIUs will also prepare periodic reports on the grievance resolution process and publish these on their respective official websites.

12.3.4.5.2 Disciplinary Procedure

The starting point for all disciplinary action rules may be implied or explicit and will vary from workplace to workplace. Some rules are implied in the employment contract (e.g., rule against stealing from the employer). However, even implied rules should be included in the disciplinary code or schedule of offenses. In an organized workplace, these rules ideally are negotiated with the trade union and are often included in the Recognition Agreements signed by the employer and trade union. These workplace rules must be:

- a. Valid or reasonable;
- b. Clear and unambiguous;
- c. The employee is aware, or could reasonably be aware of the rule or standard; and
- d. The procedure to be applied in the event the employee contravenes any of these rules

IAs will establish a fair and effective disciplinary procedure in the workplace, which should be fair and just. The procedure is as follows: -

- a. Investigate to determine whether there are grounds for a hearing to be held;
- b. If a hearing is to be held, the employer is to notify the employee of the allegations using a form and language that the employee can understand;
- c. The employee is to be given a reasonable time to prepare for the hearing and to be represented by a fellow employee or a union representative;
- d. The employee must be allowed to respond to the allegations, question the witnesses of the employer, and lead witnesses;
- e. If an employee fails to attend the hearing, the employer may proceed with the hearing in the absence of the employee;
- f. The hearing must be held and concluded within a reasonable time and is to be chaired by an impartial representative.

If an employee is dismissed, it must be given the reasons for dismissal and the right to refer to the dispute concerning the fairness of the dismissal. Therefore, it is incumbent upon the Contractors to ensure that they have a disciplinary procedure and Code and standards which the employees are aware of. Each contractor will be required to produce this procedure to ensure that employees are not mistreated.

12.3.4.5.3 Individual Grievance Procedure

Every employer, including contractors, must have a Formal Grievance Procedure that should be known and explained to the employee.

It is recommended that such procedure should at least:

- a. Specify to whom the employee should lodge the grievance;
- b. Refer to time frames in the Labor Management Plan to allow the grievance to be dealt with expeditiously;
- c. Allow the person to refer the grievance to a more senior level within the organization if it is not resolved at the lowest level;
- d. If a grievance is not resolved, the employee has the right to lodge a dispute with the IA.

All the contractors, as relevant, who will be engaged for the project, will be required to produce their grievance procedure as a requirement for tender, which complies with these requirements. Besides, good international practice recommends that the procedures be transparent and confidential, adhere to non-retribution practices, and include the right to representation. After they are engaged, they will be required to produce proof that each employee has been inducted and signed that they have been inducted on the procedure.

12.3.4.5.4 Collective Grievances and Disputes resulting from the negotiations of Collective agreements

Where a trade union is recognized, it is entitled to negotiate regularly with the employer over terms and conditions existing at the workplace, and the employer is obliged to negotiate with it. The procedures followed in such instances are usually contained in the agreement, which states how the issues are raised, the procedure for negotiations, the composition of the parties involved in the negotiation, and the procedure to deal with issues that are not resolved through consensus. In the type of dispute, if the dispute is not resolved at the workplace, the parties to the dispute can utilize the dispute resolutions mechanisms provided for in the labor legislation.

12.3.4.6 Engagement And Management Of Contractors And Sub-Contractors

12.3.4.6.1 Contractors Requirements

Any Contractor selected for the Project must be a legitimate and reliable entity and must have their labor management procedure and practice materially consistent with the requirement of ESS2. The requirement of ESS2 will be incorporated in the bidding documents and contractual agreement and will also include non-compliance remedies. Any subcontractors engaged will also have similar requirements in their agreement, including non-compliance remedies.

The project requires that contractors monitor, keep records and report on terms and conditions related to labor management. The contractor must provide all project workers with evidence of all payments made, including social security benefits, pension contributions, or other entitlements regardless of the worker being engaged on a fixed-term contract, full-time, part-time, or temporary. The application of this requirement will be proportionate to the activities and the size of the contract, in a manner acceptable to the IAs and the AIIB. An outline of the contractors' labor management plan in the Contractors ESMP is attached at Annex-III.

The contractual agreement will also require the inclusion of Contractors' measures in light of the COVID-19 situation. They will include:

- Provision of adequate measures for the workers working under the COVID-19 situation, including free PPEs and sanitization. Provision of workers needing to report COVID-19 symptoms and referral to health facilities and not forcing them to work.
- Provision of medical insurance covering treatment for COVID-19, sick pay for workers who either contract the virus or are required to self-isolate due to close contact with infected workers, and payment in the event of death.

- Requirement of safe working conditions and the conduct of the work (e.g., creating at least 6 feet between workers by staging/staggering work, limiting the number of workers present).
- Procedures and measures deal with specific risks, for example, for health care contractors: infection prevention and control (IPC) strategies, health workers exposure risk assessment and management, developing an emergency response plan, per [WHO Guidelines](#).

Appointing a COVID-19 focal point responsible for monitoring and reporting COVID-19 issues and liaising with other relevant parties.

12.3.4.6.2 Project Workers

The contractors and sub-contractors, who will be primarily engaging the contracted workers at field level and possibly community workers, will be overseen and managed by the respective PIUs- under the overall guidance of the PIU of this project. At the field level, every contractor will be mandated by contract to deploy at least one EHS officer (Environment, Health, and Safety) per construction package to oversee workers' supervisors managing workers daily. The sub-contractor workers will be supervised by their supervisors and report to EHS Officers of the main contractor. Table 2 provides details about the engagement and management of project workers.

Table 1: Engagement and Management of Project Workers

Category of Project Workers	Project Workers by Role	Responsible Staff for Executing and Implementing Agencies	Responsible Work Unit
Contracted Workers	Subject matter specialists and experts supporting PIU	Project Director reporting to IA	PIU
	Subject matter specialists and experts serving with the PMC firm(s)	Project Director reporting to IA	PIU
	All managerial and professionally qualified staff deployed by contractors	APDs, sub-PIUs reporting to PIU	Contractor
	All workers deployed by contractors	APDs, sub-PIU reporting to PIU	Contractor
	All workers of specialized agencies engaged by contractors	APDs, sub-PIU reporting to PIU	Contractor
Primary Supply Workers	Skilled and unskilled laborers for material production, handling, and loading operations at sales stackyards	APDs, sub-PIU reporting to PIU	Contractor

12.3.4.6.3 Primary Supply Workers

The project involves civil works for which construction materials (brick, cement, sand, iron bars, etc.) may be sourced from primary suppliers. Suppliers of electrical and sanitary equipment, IT, and communication equipment are not known to involve significant risks of child labor and forced labor.

In the case of construction material suppliers, Contractors shall be required to carry out due diligence procedures to identify if there are significant risks that the suppliers are exploiting child or forced labor or exposing the worker to serious safety issues. In instances where foreign suppliers are likely to be contracted, the Contractor will be required to inquire during the procurement process whether the supplier has been accused or sanctioned for any of these issues and their corporate requirements related to child labor, forced labor, etc. safety. If any risks related to child and forced labor and safety are identified, the Contractor will notify national PIU and address these risks and avoid such suppliers, where possible.

12.3.4.7 Outline of Contractor's LMP

Introduction	Contract Package and authorization
Workforce Management	- Profile of workforce – work activities, schedule, contract duration, workforce rotation plan, workers' place of stay, workers with underlying health issues - Measures to mitigate risks on account of COVID 19 - Measures to prevent waterborne, airborne diseases and diseases spread by insects (dengue, malaria, etc.) - Contingency plan covering – pre-health check-up, access restrictions, hygiene, waste management, accommodation arrangements, PPE provision, and usage - Reporting and handling of incidents of accidents and COVID-19 cases, training and communication with workers, training, and SOPs on communicating and contact with community
Occupation Health & Safety and Emergency Management	- List of work locations, hazards/risks with PPE requirement and numbers - Lists of tasks and work zone critical for hazard prevention - Location of warning signage for hazard prevention - Requirement of first aid boxes and fire extinguishers – task and location wise - Provision of drinking water at worksite - Key person(s) to be contacted during emergency - Protocol for deciding the level of emergency – need for hospitalization, information to authorities, etc. - Process of accident analysis, corrective and preventive measures, and need for reporting
Addressing SEA/SH Risks	- Preventive measures – provision of lighting, separate toilet areas for men and women, increased vigil and security arrangement for community sensitive SEA/SH hotspots, if identified by dam authorities. - Sensitizing and awareness of labor on SEA/SH issues, including penalties and legal action against offenders - Awareness about the sensitivity of SEA/SH related complaints management - Notification requirements and method of reporting SEA/SH incidents

Workers Code of Conduct	• Preparation of Code of Conduct • Making labor aware of conduct with all the provisions, dos, don'ts, penalties for non-compliance, etc. • Displaying CoC at prominent locations • Signing of CoC by workers
Awareness and Training	• Plan for training and awareness covering pollution prevention, OHS, Rights of labor, use of PPEs, accident reporting and emergency management, CoC, SEA/SH, GRM, etc. • Training schedule • Training records
Workers Grievance Mechanism	• Details of GRM including contacts • Linkage with centralized GRS of the GoB • Process of receiving, redressing, escalation, reporting back • Consolidated statement on Grievances (segregated by non-COVID related & COVID related) • Contacts of nearest labor offices of the Department of Labor in the Ministry of Labor and Employment
Monitoring and Reporting	• Scope, methodology, and outcomes of supervision and monitoring of LMP, attention issues

Appendix IV: Stakeholder Engagement Plan (SEP)**12.4 Stakeholder Engagement Plan (SEP)****12.4.1 Objectives of the stakeholder engagement plan**

Effective stakeholder engagement through a robust consultation and disclosure mechanism promotes the environmental and social sustainability of a project, enhances its acceptance and makes important contributions to design and aids in smooth implementation of the project. Stakeholder engagement is an inclusive process and is carried out throughout the life cycle of the project. The objectives of SEP are as follows:

- Establishment of a systematic approach to stakeholder engagement that will enable borrowers to identify and form constructive relationships with the relevant stakeholders, including Project Affected People (PAP).
- To assess the level of interest and support stakeholders have for the project and ensure that through this mechanism, the views of the stakeholders are incorporated into the project design.
- Encourage and facilitate effective, meaningful consultation and engagement with PAPs throughout the project cycle on issues that could potentially have an impact on them
- Ensure that project information related to environmental and social risks and impacts is disclosed to stakeholders in a timely, understandable, accessible and appropriate manner and format.

The process of stakeholder engagement involves the design and implementation of a Stakeholder Engagement Plan (SEP). The SEP covers the following aspects:

- (i) Stakeholder identification and analysis.
- (ii) planning how stakeholder engagement will take place.
- (iii) disclosure of information.
- (iv) consultation with stakeholders.
- (v) addressing and responding to grievances.
- (vi) reporting to stakeholders.

The coordination and monitoring mechanisms in the SEP will be overseen by IsDB as well as EGCB and their field/site level project management setup, as relevant.

12.4.2 Stakeholder engagement at project preparation stage**12.4.2.1 The consultation process**

The preparation of the SEP started during the inception stage of the project preparation and involved extensive consultations with a broad array of stakeholders. The feedback from these consultations shaped the overall approaches, methods and process of engagement with the stakeholders of this SEP. Continued consultations along with the other relevant engagement methods and tools will be utilized all through the project duration and feedback of the stakeholders will be incorporated in the project's implementation strategy.

12.4.2.2 Stakeholders Analysis

“stakeholder” is defined as individuals or groups who:

- (a) are affected or likely to be affected by the Project (project-affected parties); and
- (b) may have an interest in the Project (other interested parties).

Stakeholder identification for the ESIA study was initiated during the Environment and Social Impact Assessment (ESIA) processes initiated by the EGCB. The stakeholder mapping workshop was undertaken to:

- Confirm the stakeholders and groups who were identified in initial scoping exercises and further revise and update the stakeholder list with input from key stakeholders.
- Analyze the level of impact the Project has on each stakeholder group, their level of interest, influence and importance, to identify the level of engagement required for each group; and
- Identify engagement strategy with each stakeholder group and assign responsibility to team members.

Mapping project stakeholders marks the first step in preparing the Stakeholder Engagement Plan (SEP), given its contribution to developing the Project’s approach to consultation and communication. Doing so entails identifying relevant Project stakeholders or groups of stakeholders, their key characteristics, specific needs or demands, preferred means of communication and appropriate level of engagement needed for each. In order to ensure effective and tailored engagement, stakeholders of this proposed project have been classified into three overlapping categories:

Affected people refer to individuals, groups, local communities and other stakeholders that are directly or indirectly affected by the Project, with particular focus being accorded to those directly and/or adversely affected. It also refers to those who are more susceptible to changes associated with project activities and thus need to be closely engaged in identifying impacts and their signification, as well as in decision-making on mitigation and management measures.

Interested parties predominantly refer to those who are not directly affected by project activities, but are interested owing to its proximity, as in broader local communities where beneficiaries are located, or by virtue of their role in project preparation and implementation.

Disadvantaged and vulnerable groups, although somewhat covered under the first category, experience unique limitations and barriers to participating in consultation process and being minimally represented in stakeholder engagement. By extension, they are disproportionately impacted or further disadvantaged due to their vulnerable status, notably women, elderly, children, female-headed households, person with disabilities (PWD), ethnic and religious minority’s communities etc. Given engagement efforts required to enable their equitable representation in the consultation and decision-making process for the project, this additional category seeks to explore their constraints, means of receiving information and any additional assistance required.

12.4.2.2.1 Affected Parties

Affected Parties include individuals, groups, and communities directly affected by project interventions or who may be subject to direct impacts from the Project. In this case, the land has already been acquired by EGCB and hence no directly affected parties are present.

12.4.2.2.2 Other Interested Parties

This includes stakeholders who are not directly affected but otherwise have an interest and/or can exercise influence in the outcome of the project. This includes the Civil Society Organizations (CSOs) including media (on/offline) & contractors/suppliers.

12.4.2.2.3 Disadvantaged and Vulnerable People

It is particularly important to understand that project impacts may disproportionately fall on disadvantaged or vulnerable individuals or groups or communities who often do not have the voice to express their concerns or understand the impacts of a project or otherwise, may not be able to access the project benefits equally due to their vulnerable social, economic, occupational or cultural conditions. It is important to ensure that awareness raising of and engagement with disadvantaged or vulnerable individuals or groups be adapted to consider the needs of such community/groups or individuals, their concerns and cultural sensitivities, and to ensure a full understanding of project activities and benefits. Within the Project, the vulnerable or disadvantaged communities/groups may include are, although not limited to the following:

- Women and poor street vendors who may face dislocations due to land acquisition or civil construction.
- People with disabilities (PWD) depend on livelihood on access to the current infrastructure of the IAs.
- Poorest households whose livelihood are likely to be disrupted due to civil works or land acquisition.
- Women and female-headed households who face displacement from land acquisition.
- Slum/tenement dwellers around/nearby the sites who face displacement or disruptions of income due to civil works or land acquisition.
- Local communities may face temporary or permanent disruption of income or livelihood from civil work.

12.4.2.2.4 Engaging with disadvantaged and vulnerable groups

It is particularly important to understand whether project impacts may disproportionately fall on disadvantaged or vulnerable individuals or groups or communities who often do not have a voice to express their concerns or understand the impacts of a project and to ensure that awareness raising and stakeholder engagement with disadvantaged or vulnerable individuals or groups be adapted to take into account the needs of such community/groups or individuals, their concerns and cultural sensitivities, and to ensure a full understanding of project activities and benefits. Vulnerable groups consist of people who may not be able to access Project information and articulate their concerns and priorities about potential Project impacts owing to certain barriers that disadvantage them. The barriers could be socio-political, for example in Bangladesh, and especially rural patriarchal societies, women are expected to not speak out in public. Other factors could be related to poverty,

socio-economic conditions or physical conditions as people influenced by these factors are not expected to or do not feel that they can have a 'voice' in public.

Several measures will be used to remove obstacles to participation for vulnerable groups:

- Focus groups for women, led by a female facilitator, to introduce the Project and discuss any issues and concerns that the women may have regarding the Project development while assuring privacy and anonymity.
- Individual household visits to as many households in 'deep poverty', single female headed households, people with disability, the elderly who have mobility issues, and households of minority religious groups in the Directly and Indirectly Affected Population as possible at each Project milestone to ensure they are provided with the Project information and have opportunities to raise their questions and concerns freely without intimidation, discomfort or ridicule.
- While reaching out to different groups particularly vulnerable groups such as women, elderly and disabled, the Project team will make sure time and location of consultation are appropriate to their needs.
- Through implementation, the IA will continue to identify representatives of these groups locally and at the district level to facilitate two-way communication on Project development.
- During the construction phase and operation, EGCB may carry out an awareness raising campaign for human trafficking; a platform or body within a relevant government agency will also be established to monitor human trafficking

Engagement with all identified stakeholders may incentivize their maximum contributions to successful implementation of the project by drawing on their existing expertise, experience and networks. It also facilitates community and institutional endorsement of project activities.

12.4.3 Stakeholder engagement program

12.4.3.1 Institutional responsibility of stakeholder engagement

The PIUs will coordinate and will lead the implementation and updating of the SEP as the implementation progresses. The PIUs will identify the stakeholders of their respective component activities and will assist in communication. Social, environmental and genders experts with the PIU consultants will provide technical support in the process of engagement with their stakeholders. PIU specific stakeholder engagement program (SE Program) will be developed following the guidelines in this SEP and implemented throughout the identification, design, procurement, and implementation of the activities. The activities under the respective PIUs for implementation of the project and the stakeholders who have been identified will be updated at the implementation level as the SEP will be considered as a living document.

Objectives of each activity, implementation approach, environmental and social impacts and their management, and areas of stakeholders' engagement will be shared with the stakeholders to facilitate obtaining their feedback through consultation and other relevant engagement processes. The topics of discussion and frequency and timing of relevant consultation events, notification procedures, and method of consultation will be defined in

the PIU specific SE Program. The PIUs will identify the relevant stakeholders including their contact details (telephone, e-mail address, street/location address and contact person). These contact details will be included in the PIU specific SE Program.

12.4.3.2 Advance Public Notification

Advance public notification of an upcoming consultation meeting will be given, and it will be available via publicly accessible locations and channels. Selected participants for formal public meetings or consultation workshops will be notified individually formally through e-mail and phone notifications and sharing invitation letters to the address of the selected participant stakeholders. The primary means of notification for formal and informal meetings may include mass media and the dissemination of posters/ advertisements in public places. The project keeps proof of the notification (i.e. a copy of the newspaper announcement, and/or email correspondence) for accountability and reporting purposes. Existing notice boards in the communities may be particularly useful for distributing the announcements, such as boards adjacent to the widely visited public premises like local government office (ward counselors office, city corporation/Pourashava/union parishad offices), highway side and local markets, bus stops and terminals, and offices of the local NGOs and road safety organizations, transport owners and workers association offices and any other public places.

The notification should contain date, time and venue, consultation agenda, objectives of consultation, and commitment of potential review and consideration of stakeholders' feedback in project design and the environmental and social planning documents.

12.4.3.3 Documenting Consultations

Consultation proceedings in any format will be recorded for transparency, accuracy of capturing public comments and feeding the information obtained from the consultation process into project design and implementation approach. The consultation proceedings will be recorded in the following three ways, including:

- Taking written minutes of the meeting by a specially assigned person.
- Audio recording of the discussions with prior information to the participants (if virtual); and
- Photographing.

Photographs of notable scenes during consultation will be captured at reasonable intervals but not distracting or disturbing the audience excessively. Where feasible, the video recording may also be undertaken. Combination of these methods assures us that the course of the meeting is fully documented and that there are no significant gaps in the records, which may result in some of the important comments received from the stakeholder audience being overlooked.

12.4.3.4 mechanisms for information disclosure

The SEP and other relevant documents will remain in the public domain for the entire project life cycle, and will be updated on a regular basis as the project progresses through its various phases, in order to ensure timely identification of and engagement with any new stakeholders and interested parties to tracking changes to characteristics and subsequent

methods of engagement, if required. To that extent, the latter would also be revised periodically to maintain their effectiveness and relevance to project performance and external circumstances.

Distribution of the disclosure materials will also be made by making them available at venues and locations frequented by the community and places to which the public have unhindered access. Free printed copies of the ES documents in Bangla and English will be made accessible for the general public at the following locations, if situation permits:

- PIU
- District Administration offices
- Project offices at Local and Regional
- Other designated public locations to ensure wide dissemination of the materials
- Newspapers, posters, radio, television
- Information centers and exhibitions or other visual displays
- Brochures, leaflets, posters, nontechnical summary documents and reports etc.

Appendix V: Gender Action Plan**12.5 Gender Action Plan (GAP)****12.5.1 Women's roles in the economic sphere in Bangladesh**

Despite impressive achievements in schooling and microfinance for women, Bangladesh still has low female labor force participation reaching just 35% in 2021. While this participation figure is a slight increase from its 2011 level of 31%, it is still largely limited to low-paying unskilled jobs. Barriers that women face to their full economic participation include discrimination and sexual harassment in the workplace, and poor access to information and job networks. These barriers to women's employment are exacerbated in typically male-dominated industries such as the energy sector. Women are a small minority in decision-making roles across the Bangladeshi economy. In 2016, 13% of firms included women ownership and 5% of firms had women in top management.

12.5.2 Women in the Bangladeshi energy sector

The energy sector in Bangladesh continues to lag in gender equality provisions. The absence of gender mainstreaming is typically attributed to the technical and male-dominated nature of the energy sector. Women are significantly underrepresented in technical studies and roles in the industry which is driven in part by the low number of girls both entering technical education and choosing to pursue professional growth in nontraditional or technical fields. The expansion of the energy sector into renewable sources, such as solar power, potentially opens up new opportunities for women to become more involved in various aspects of the industry.

12.5.3 EGCB

As a government company, EGCB has taken measures to strengthen gender equality in its workplace including implementing an anti-sexual harassment policy, a gender and diversity policy, flexible work policy, and a non-discrimination policy. In addition, EGCB also provides segregated facilities for men and women such as change rooms, toilets, prayer rooms etc. The company also offers on-site day care facilities, easing the challenges faced by working parents.

12.5.4 Gender Action Plan (GAP)

The project is categorized as effective gender mainstreaming. The gender measures for the project are presented in Table below:

Result Chain Outputs	Performance indicators with Targets
1. Gender and disability inclusive local	At least 10% of the management roles during operation of the new solar power plant will be held by women.
	At least two women with disabilities are employed at the new solar plant project work

Result Chain Outputs	Performance indicators with Targets
employment generation	One gender equality policy will be adopted by the new solar power plant project
2. Gender equality in the workplace enhancement	At least five women will undertake a paid technical or management internship at the new solar power plant
	At least 80% of women in management or technical roles at the new solar power plant receive professional development training

Appendix VI: Climate Resilience and Disaster Risk Assessment

12.6 Climate Resilience and Disaster Risk Assessment

In this section, disaster and climate change implications on the proposed project and potential climate resilience aspects have been discussed along with the counter measures.

The hazard assessment has been carried out to identify the potential hazard(s) associated with or inherent in the design process and to identify possible measures to avoid the hazard(s) along with the safety plan for minimizing the risks. The assessment process involves the following steps:

- Identification of potential hazards
- Identification of causes and consequences
- Risk management

Being located in the coastal belt, the study area is highly prone to cyclone, storm surge, sea level rise, salinity, shoreline and riverbank erosion. The basic hazard related information and their causes and consequences have been collected through field investigations, reviewing feasibility study report and visiting available secondary data sources (e.g., BMD, BWDB, DDM, DRIP portal etc.). Based on the information pile, the potential impacts of climate change and natural disasters on the proposed project have identified and assessed. For mitigating such climate induced hazards, suitable risk reduction measures have been identified and prescribed as in Table 1 below.

Table 1: Assessment of Potential Disaster Impacts

Sl. No.	Natural Disaster	Potential Impact	Disaster Risk Reduction/management
1	Cyclone	As a newly formed land, the study area is highly vulnerable to cyclonic damage. The solar panels and mounting structures can be affected by cyclonic activity if properly not mounted. The unavailability of high ground land and proper structure may affect negatively for	a) Appropriately strong structures should be used for the solar panel mounts b) Tree plantation around the project area but not immediate to the solar panel structures for cyclone impact reducing c) Establishment of multipurpose cyclone shelters, Emergency medical facilities with free distribution of medicines, Proper distributions of drinking water and relief goods d) Availability of emergency medical facilities with free distribution of medicines. e) Establishment of mobile sanitation facilities f) Strengthening early warning and cyclone forecasting systems g) Capacity building among affected

Sl. No.	Natural Disaster	Potential Impact	Disaster Risk Reduction/management
			people for switching to alternate profession during post cyclone period.
2	Erosion	The study area is situated between Little Feni and Feni rivers. Both the rivers have meandering nature. But the study site and its close vicinity area do not face any erosion. Rather the island area is increasing day by day by depositing sand and clay from the nearby rivers.	a) Small sized Tree plantation can be a very sustainable practice for the land erosion protection. Saline tolerant (mangrove nature) plants are recommended to plant near the riverbank area
3	Salinity	The study area faces salinity intrusion due to sea water inflow during tidal process. As the island is located near the Meghna estuary, freshwater flow from upstream reduces salinity during monsoon substantially. During dry season, salinity is higher. Salinity in surface water made it non usable for panel cleaning as it may create corrosion in panel frame, mounting structure and cause mineral deposition and affect the panel capacity. Also, the sea level rise can potentially affect groundwater table by saline intrusion	a) Use of alternative source (Like rainwater, waterless cleaning system, dry washing by compressed air etc. to avoid using surface water for panel cleaning. b) Introduction of water treatment plants for surface water treatment to remove salinity and TDS value. c) Planting saline tolerant plants near riverbank for saline absorption. d) Building awareness among community to avoid aquaculture/shrimp culture by trapping saline water in non-saline land.
4	Sea level Rise	Sea level rise is a very severe issue for the coastal area of Bangladesh. Increasing sea level may create inundation and increase salinity in coastal lowlands. However, sea level rise may create flooding in the project area affection project progress and outcome.	a) Elevated land development for project structure development, b) Building a Dike around the project area (Above 9 Meter) to stop high rise water c) Building of elevated platforms for taking shelters during exceedance in danger level. d) Establishment of multipurpose cyclone shelters, e) Arrangement of emergency medical facilities with free distribution of medicines, f) Stocking of drinking water and relief goods before the disaster season g) Building awareness among workers and local community for disaster encountering
5	Storm Surge	Storm surge is an abnormal rise in sea level over and above the normal tide levels. It can be thought of as the change in the water level due to the presence of a storm. These powerful	a) Building a Dike around the project area (Above 9 Meter) to stop surge water during natural hazards. b) Strong mangroves plants and trees

Sl. No.	Natural Disaster	Potential Impact	Disaster Risk Reduction/management
		ocean movements are caused by strong winds piling water up against the coast as a cyclone approaches. Storm Surge can cause tidal flood and may wash away the project infrastructure including solar panel structures if appropriate mitigation measures are not taken	should be planted (away from the dyke and project area but close to the riverbank so that tree shade does not affect the solar panel), which will act as the primary preventive measures to reduce impact c) Access to necessary utility facilities such as emergency lighting facilities and fuel supply. d) Building of elevated platforms for taking shelters during exceedance in danger level. e) Establishment of multipurpose cyclone shelters, f) Arrangement of emergency medical facilities with free distribution of medicines, g) Stocking of drinking water and relief goods before the disaster season and predication results. h) Building awareness among workers and local community for disaster encountering

12.6.1 Existing Disaster Profile at the Project location

The information tabulated below was gathered from the **Disaster and Climate Risk Information Platform (DRIP)** web tool for the Feni District. In DRIP database, all data related to natural disaster vulnerability are represented at the district level aggregation. The DRIP web tool represents hazard, exposure and risk level on a scale of 1 to 5 where the levels are very low, low, medium, high, and very high.

Disaster	Hazard Level	Exposure Level	Risk Level
Cyclone	Very High	High	Very High
Erosion	Very Low	Very High	Very Low
Salinity	High	Very High	Very High
Sea Level Rise	High	Very High	Very High
Storm Surge	Very High	High	Very High

The study area is prone to cyclone and storm surge as the area is exposed to the sea due to its geographic location. Hence the hazard levels for these disasters are very high. The risk levels are very high due to the absence of adequate necessary infrastructures. Hazard levels for Salinity and Sea level rise is also very high, as the area is located near meghna estuary.

12.6.1.1 Climate Change Risk Analysis

The climate change risk analysis for the study has been carried out following several activities, which are:

12.6.1.1.1 Trend analysis of recent climate

Meteorological or microclimatic data of the study area has been collected from the nearest station of BMD. Historical records of meteorological parameters i.e. precipitation, temperature etc. has been collected from the respective agencies. Besides, water level, discharge etc. have also been analyzed based on data availability from BWDB and CEGIS archive. Based on the data, trend of recent climate has been analysed for understanding the pattern of climate in the study area.

12.6.1.1.1.1 Rainfall

The monthly maximum and average rainfall data of the last 42 years (1980-2022) was collected, analyzed, and shown in **Figure 1**. Annual average rainfall for this station is 2946.3 mm. It shows that about 77.2% of the annual rainfall occurs during the five months of June to October with July getting the maximum rainfall. On the other hand, relatively insignificant rainfall occurs during the months of November to March. **Figure 2** represents the annual rainfall increasing trend of 0.764 mm/year during this time period.

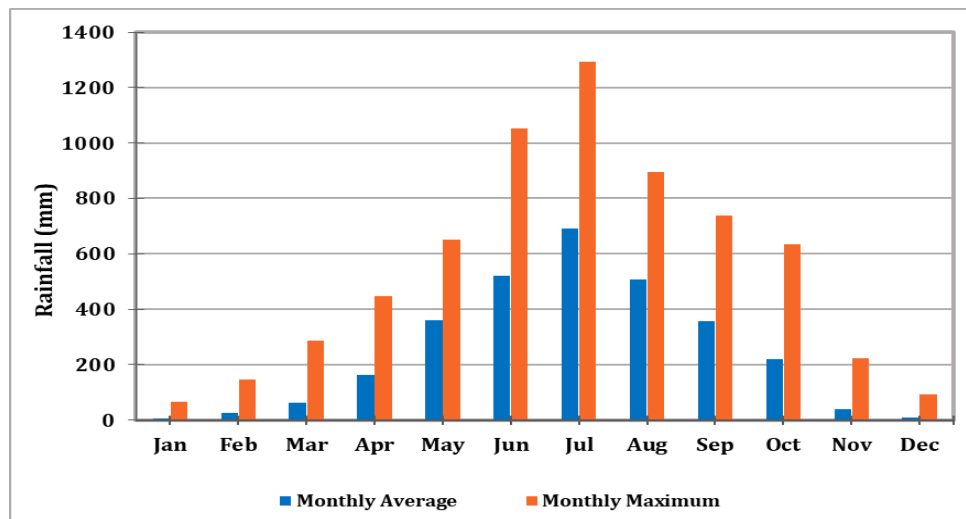


Figure 1: Monthly maximum and average rainfall at Feni BMD station

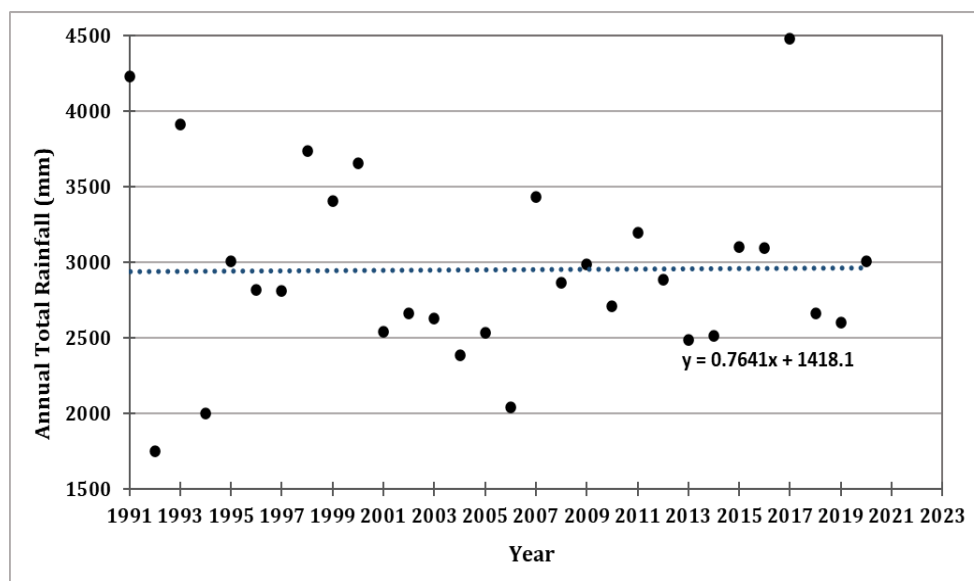


Figure 2: Annual rainfall Trend at Feni BMD station

12.6.1.1.1.2 Temperature

The monthly average temperature data of the last 42 years (1980-2022) reveals that in the pre-monsoon season, the average maximum and average minimum temperature at Feni ranges between

31.6 to 32.6°C and 20.4 to 24.5°C respectively (**Figure 3**). In the post-monsoon season, the average maximum and average minimum temperature of Feni ranges between 30 to 31.7°C and 19 to 23.7°C. During winter season the maximum and minimum temperature of Feni ranges between 25.8 to 26.9°C and 12.7 to 14.5°C respectively.

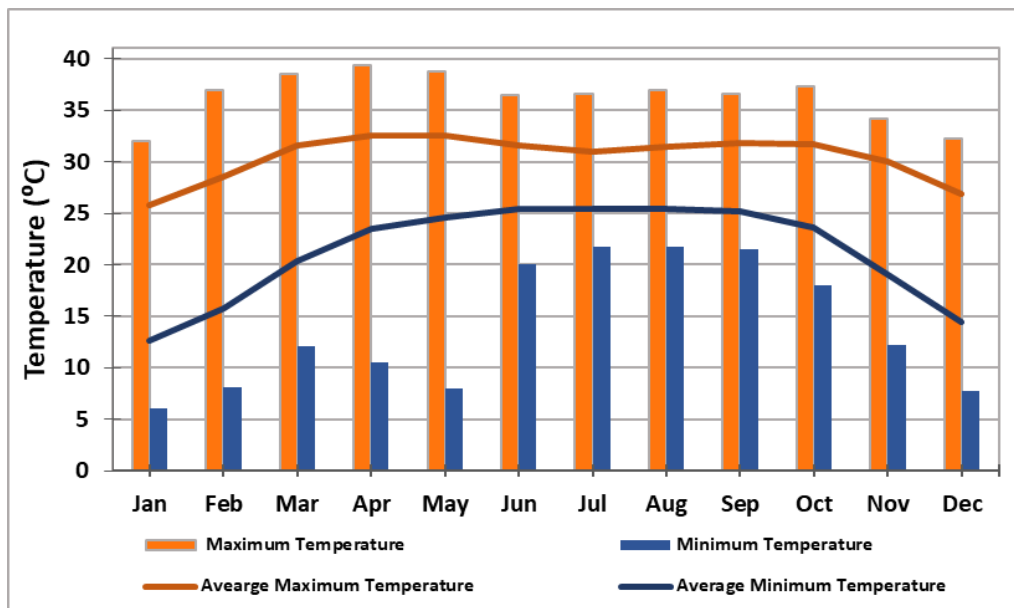


Figure 3: Monthly Temperature at Feni BMD station

Analysis of annual maximum temperature shows an increasing trend of 0.0341°C/year while the annual minimum temperature shows an increasing trend of 0.0005°C/year during 1980 to 2022. So, in general, the area is experiencing hotter climate.

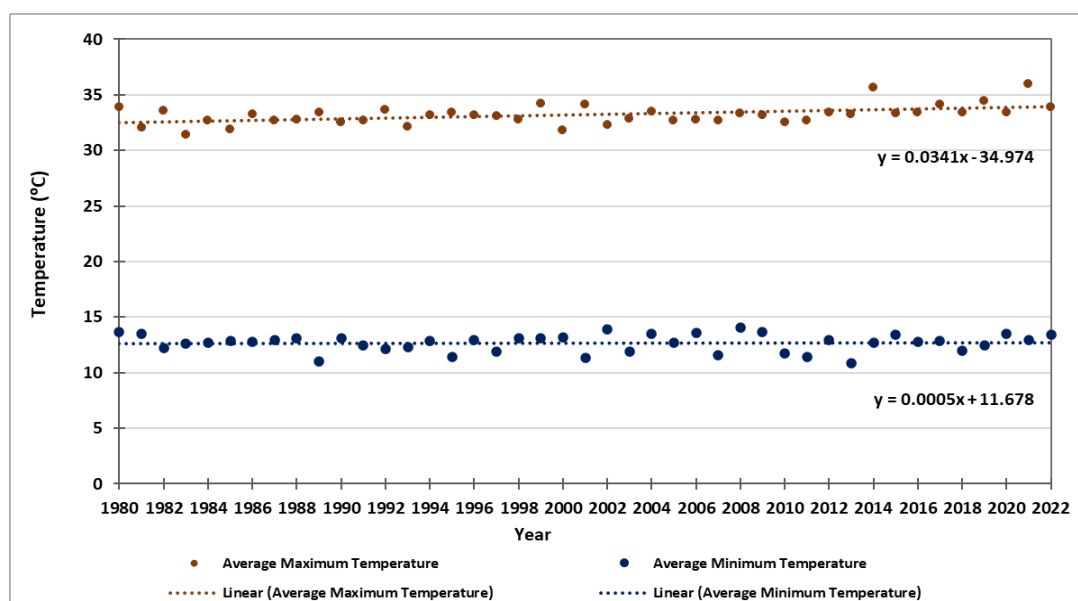


Figure 4: Annual Trend of Average Maximum and Average Minimum Temperature

12.6.1.1.1.3 Relative Humidity

Monthly average relative humidity of Feni has been analyzed for the period 1980-2022. The monthly average relative humidity in Feni varies between 72.8% to 87.4%, March is the driest month and July is the most humid month. Analysis of annual relative humidity trend indicates an increasing pattern of 0.0034% increase per year reaching annual average value of 78.3% in 2022.

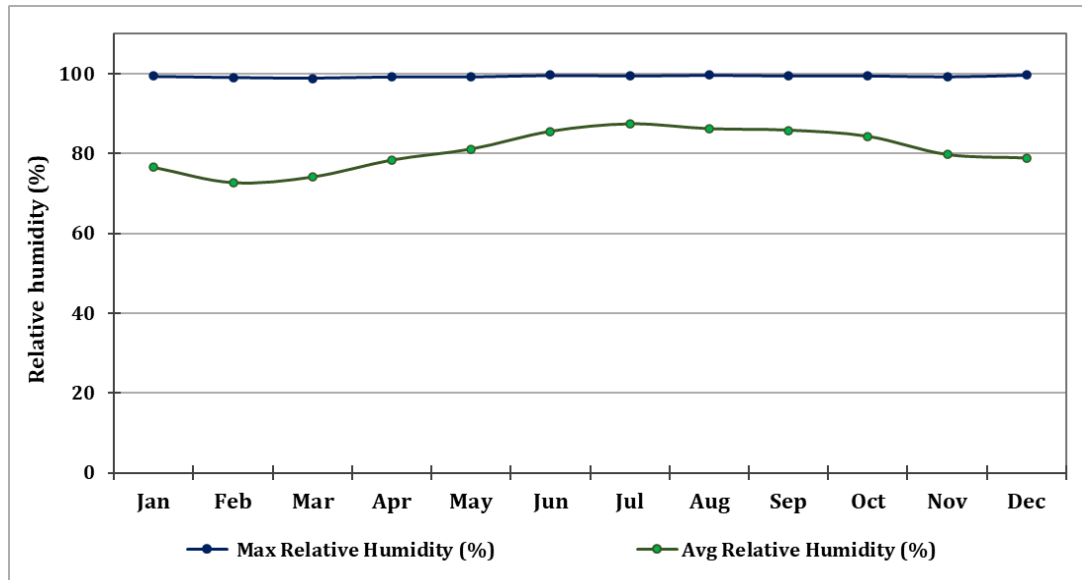


Figure 5: Monthly Relative Humidity at Feni BMD station

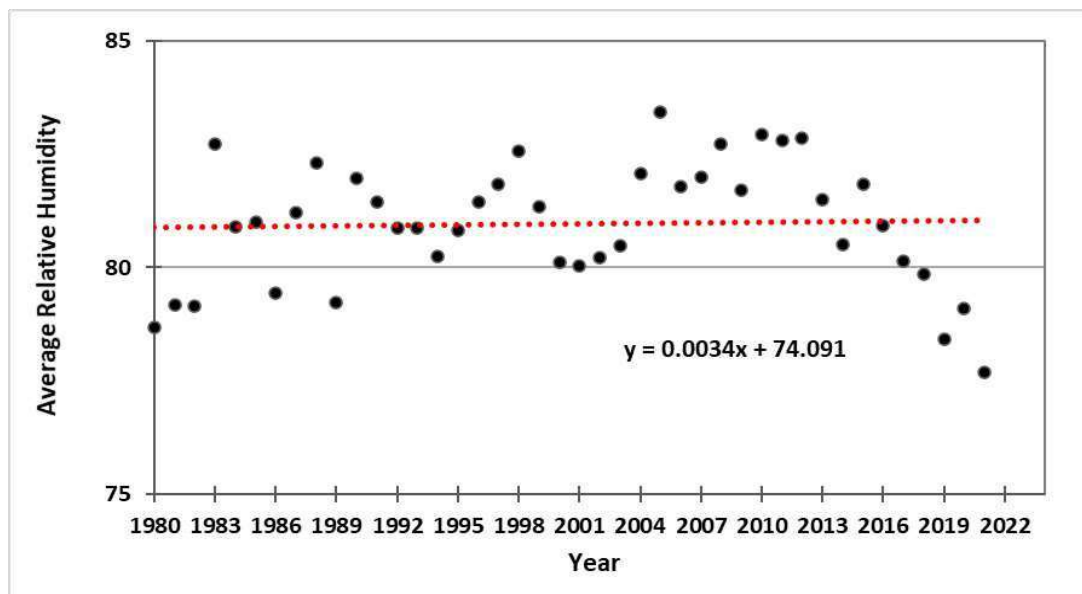


Figure 6: Trend of Relative Humidity at Feni BMD station

12.6.1.1.1.4 Wind

Monthly average wind speed of Feni has been analysed for the period 1980-2022. The monthly average wind speed in Feni varies between 11 km/hr. to 25.5 km/hr. Maximum wind speed ranges from 33.4 km/hr. and reaches up to 127.8 km/hr. as the area is close to the Bay of Bengal and cyclone prone.

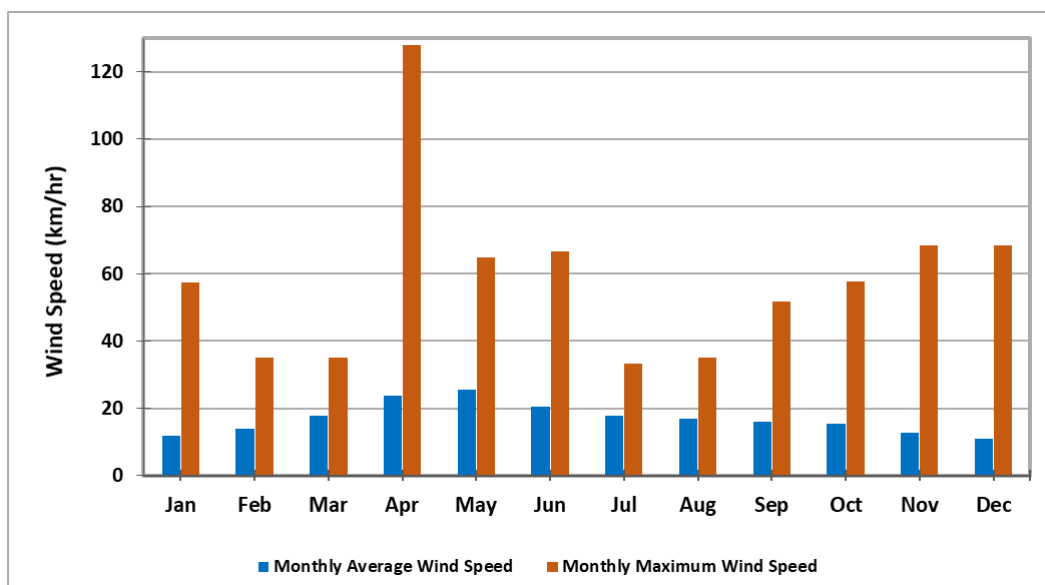


Figure 7: Monthly variation of Wind speed at Feni BMD station

12.6.1.1.1.5 Hydrologic Condition

Analysis of tidal water level during 1971 to 2009 has been done for BWDB stations at Companyganj (SW182), Malipur (SW257), Sonapur (SW87). These locations represent the water level situation in nearby rivers of Little Feni, Selonia and Feni river respectively. At companyganj station the highest maximum high tide was observed in August (7.16 mPWD), followed by May (7.01 mPWD) and the lowest of maximum high tide was recorded in February (4.71 mPWD), indicating seasonal influences.

On the other hand, the lowest minimum low tide occurred in April (-0.71 mPWD) and the highest minimum low tide was observed in October (0.4 mPWD).

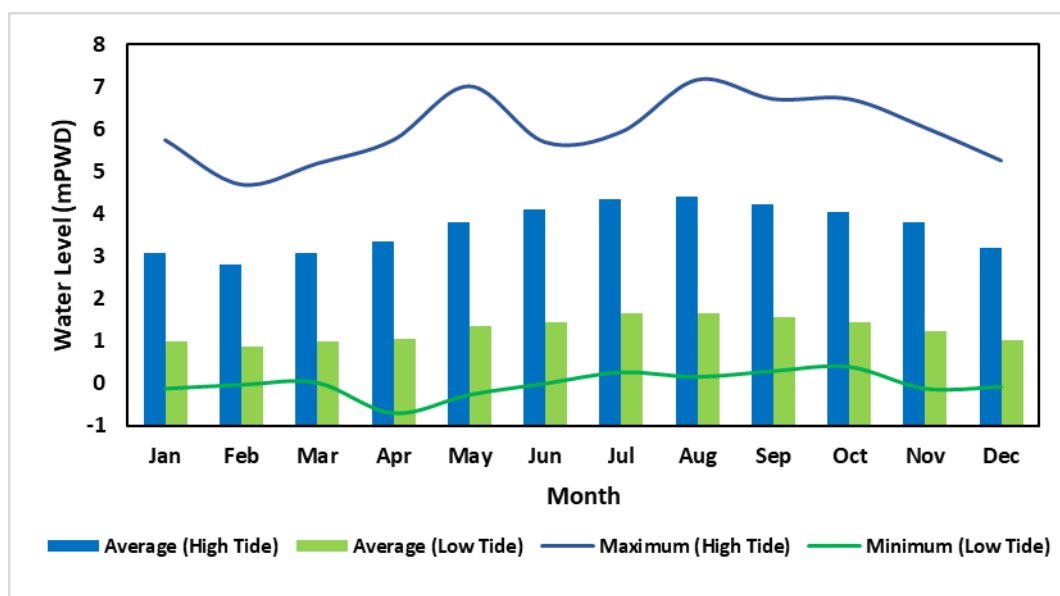


Figure 8: Monthly Variation at Companyganj, Little Feni River

At Malipur station of Selonia river, the highest maximum of high tide was observed in June (7.42 mPWD), followed by July (7.15 mPWD) and May (6.25 mPWD). On the other hand, the lowest maximum high tide was recorded in January (4.86 mPWD). The lowest minimum low

tide occurred in March (1.62 mPWD), while the highest minimum low tide was observed in December (2.56 mPWD).

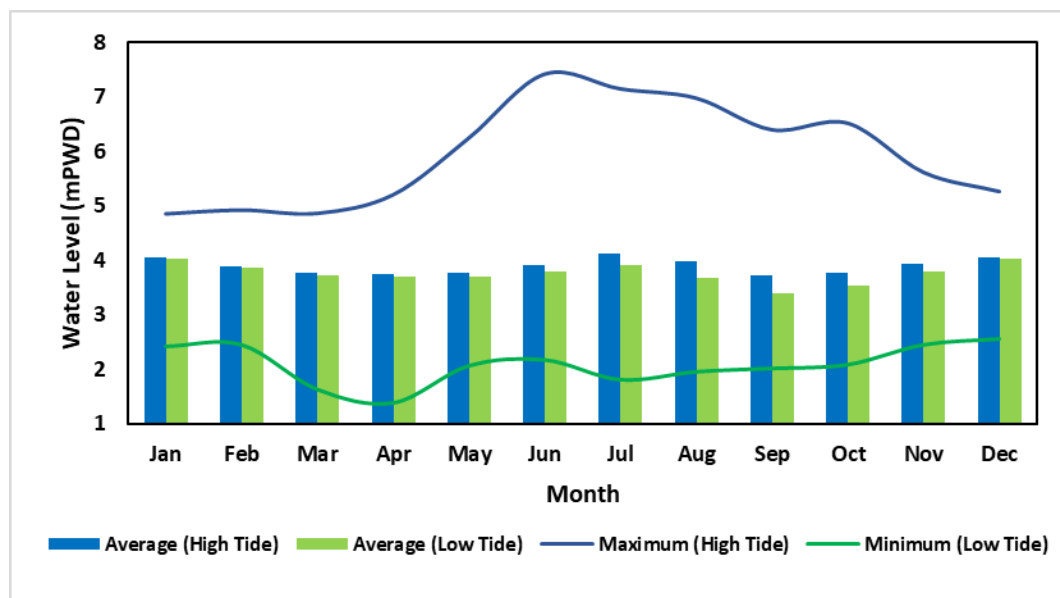


Figure 9: Monthly Variation at Malipur, Selonia River

At the Sonapur station of Feni river, the highest maximum high tide was observed in the month of August (7.85 mPWD), followed by July (7.76 mPWD), and the lowest maximum high tide was recorded in January (5.24 mPWD), indicating seasonal influences. On the other hand, the lowest minimum low tide occurred in February (-0.69 mPWD), while the highest minimum low tide was observed in August (0.42 mPWD).

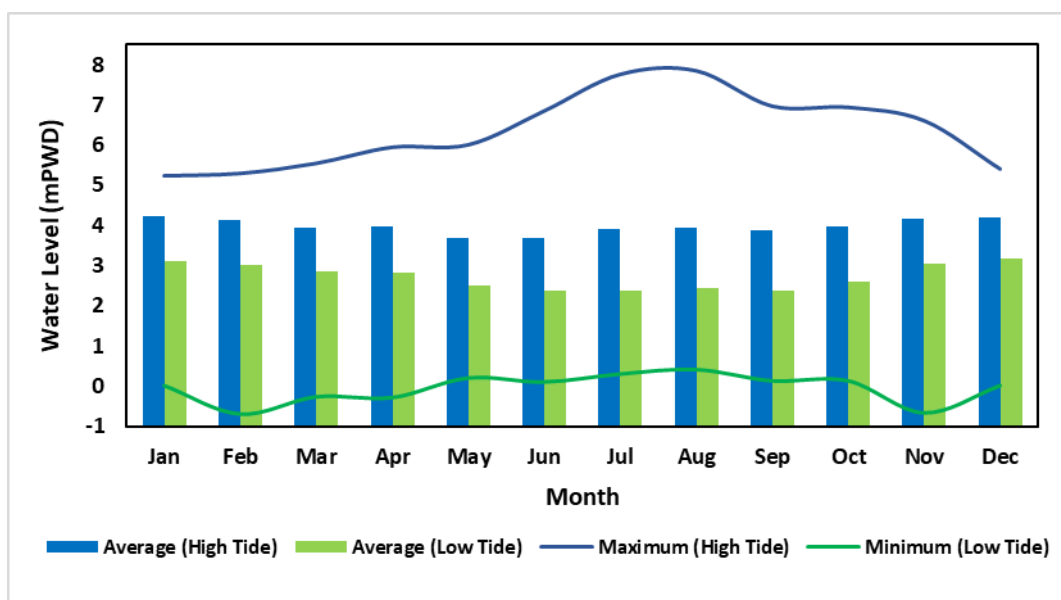


Figure 10: Monthly Variation at Sonapur, Feni River

12.6.1.1.2 Future Climate Projection

12.6.1.1.2.1 Future Temperature and Rainfall Projections

Due to the geographic location, Bangladesh is one of the countries around the world that is most susceptible to climate change. Unpredictable patterns and changes of rainfall and

temperature due to climate change is one of the most concerning issues as it has significant impacts on socio-economic condition of the local population. Based on IPCC AR6 based downscaling model results, the annual changes in temperature and rainfall during 2030s and 2050s under low (SSP1-2.6) and high (SSP5- 8.5) emission climate scenario are prepared in NAP (MoEFCC, 2022) and presented in the **Tables 2-3**. According to projection, considering extreme climate change scenario SSP5-8.5 the mean annual maximum temperature may increase up to 1.65°C and minimum temperature may increase up to 2.11°C in 2050s. The rate of increase of minimum temperature would be higher than maximum temperature, which depict higher range of climate variability over the study area.

Table 2: Projected Annual Surface Warming (°C) in Temperature

Climate Parameter	Base(°C)	SSP1-2.6		SSP5-8.5	
	1981-2010	2030s	2050s	2030s	2050s
Maximum Temperature	29.25	0.66	1.27	0.31	1.65
Minimum Temperature	22.21	0.67	1.32	0.58	2.11

On the other hand, rainfall will decrease for moderate climate scenario during near future (**Table 2**). Under the extreme climate scenario, slight decrease in annual rainfall is expected by 2030s, while, annual rainfall will increase by 3% during 2050s. So, the rainfall variability will further increase and become more uncertain.

Table 3: Projected Annual Change (%) in Rainfall

Base (mm)	SSP1-2.6		SSP5-8.5	
1981-2010	2030s	2050s	2030s	2050s
2380	-0.42	2.34	0.39	3.12

12.6.1.1.3 Potential Impacts of climate change

Climate change is responsible for rising temperatures, changing precipitation patterns, sea level rise and intensifying extreme events, such as cyclonic storms and droughts. The following sections describe the potential impacts of climate change for the study area.

12.6.1.1.3.1 Sea Level Rise

Sea level rise poses a serious threat to coastal life around the world. Consequences include increased intensity of storm surges, flooding, and damage to coastal areas. In many cases, this is where large population centres are located, in addition to fragile wildlife habitats. Therefore, people may become displaced and will need to seek safer homes. Even life farther inland is threatened because rising seas can contaminate soil and groundwater with salt. Predicting how high the sea levels will rise is difficult. However, it is an issue that must be carefully monitored so coastal areas can be prepared for the consequences.

The coast of Bangladesh experiences highly seasonal salinity intrusion. Due to the tremendous flow of fresh water throughout the rainy season (June to October), saline water intrusion is minimal. However, during the dry season, particularly during the winter, saline water gradually rises.

As indicated in the BDP2100, the accelerated sea level rise is expected to be 1 meter or more by the year 2100. The Future projections of IPCC on sea level rise at hiron point suggests 0.23-0.27 m rise by 2050s and 0.54-0.86 m rise by 2085s for the SSP1-2.6 (low climate

change scenario) and SSP5-8.5 scenario (extreme climate change scenario) (Figure 11). There is substantial uncertainty in the long- term projections of sea level rise according to IPCC. As a result of the sea level rise, salinity in the region will further increase and intrude further inwards in the future. During dry season, the fresh water supply might be seriously affected due to climate change.

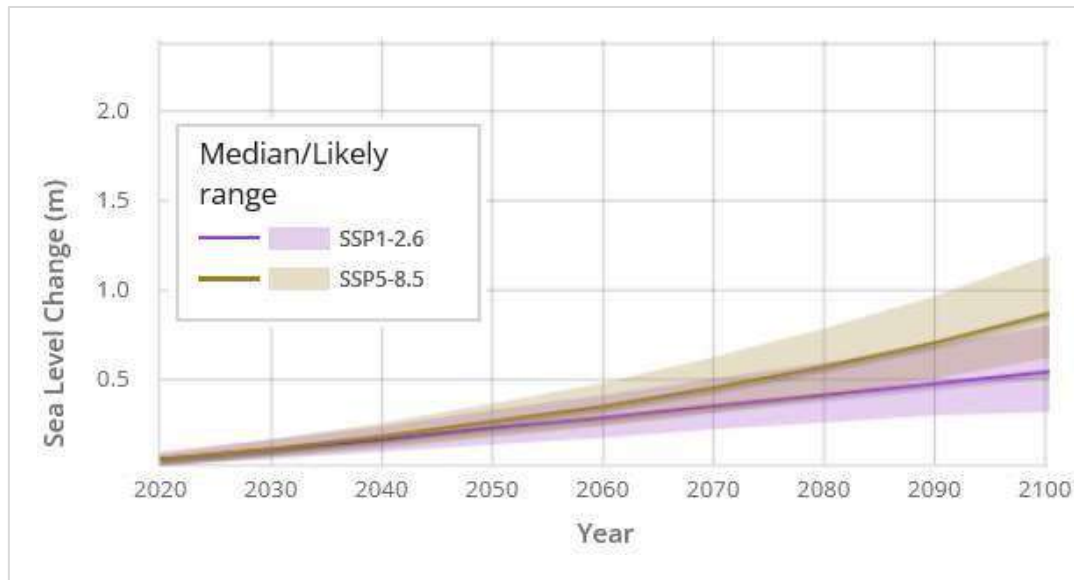


Figure 11: Sea level rise due to future climate change in the Bay of Bengal

The following figure illustrates the inundation pattern in the study area. From the figure it can be seen that, around 30-40% of the area can be flooded under sea level rise scenario.

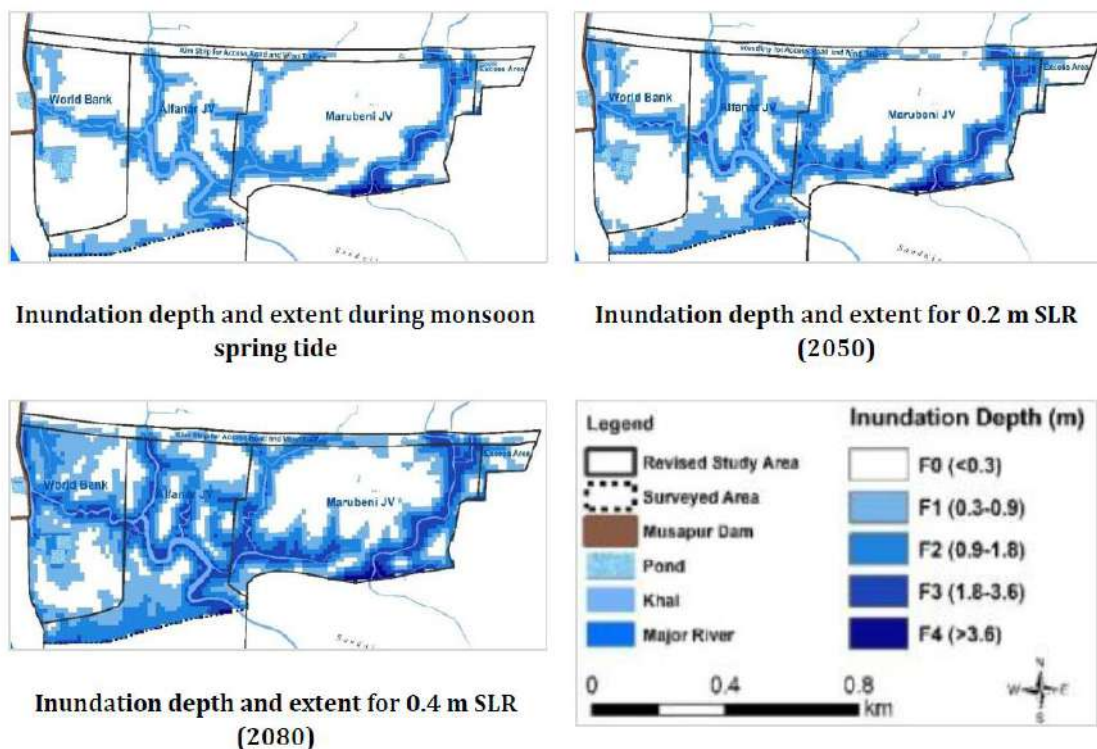


Figure 12: Inundation in the Study area due to Sea level rise

12.6.1.1.3.2 Cyclone and storm surge

During the pre-monsoon and post-monsoon seasons, the entire coastal region is vulnerable to strong storms and tropical cyclones. Since 1820, cyclones have killed almost a million people in Bangladesh. The significant number of coastal residents who live in poverty in poorly constructed housing, the shortage of cyclone shelters, the inefficient cyclone forecasting and warning systems, and the extremely low-lying ground in the coastal zones are all contributing factors to the tremendous loss of life from cyclones.

The disastrous impact of cyclones is measured not only by the severity of the cyclone but also from the loss and damage to human life and its property. As sea surface temperature is one of the main criteria for forming cyclones, there is an increasing number of cyclones anticipated due to global warming. In relation to that out of 508 cyclones that formed in Bay of Bengal, 17% of made their landfall in Bangladesh over last 100 years. Compared to other cyclone hotspot countries, the frequency of cyclone is not unusual in Bangladesh. But it faced one extreme cyclone every three years leaving its catastrophic footsteps. From 1877 to 1995 Bangladesh was hit by 0.93% of world's total tropical cyclone (Ali, 1999). About 53% (16 out of 35) of the cyclones that claimed more than 5,000 lives took place in Bangladesh (GoB, 2008). Sidr hit the country in 2007 with heavy rains, strong winds and storm surge. Around 3,000 people lost their lives, and damages amounting to \$450 million were reported. In 1970 and 1991, cyclones caused high waves leading to flooding of coastal regions in Bangladesh and causing the death of over 500,000 and 138,000 people respectively.

At least 70 major cyclones hit the coastal belt of Bangladesh from the past 200 years (Islam, 2004). Every year around 80 tropical cyclone forms in world's water, out of which 5.5% are formed in Bay of Bengal. But this number is decreasing day by day. The following Figure 1.2.12 illustrates the frequency of occurrence of cyclone in the coastal area of Bangladesh. It shows that number of cyclones hitting Bangladesh coastline is decreasing gradually in recent decades. In 1960s number of cyclones hitting Bangladesh coast was 24 which reduce to only 13 in 2010s.

Bangladesh Meteorological Department (BMD) has mentioned that there were thirty-three Major cyclones hit Bangladesh coast among which twenty-five (85%) cyclones have made their landfall on South-East coast. **Figure 13** shows the distribution of 33 cyclones in different direction of Bangladesh Coast.

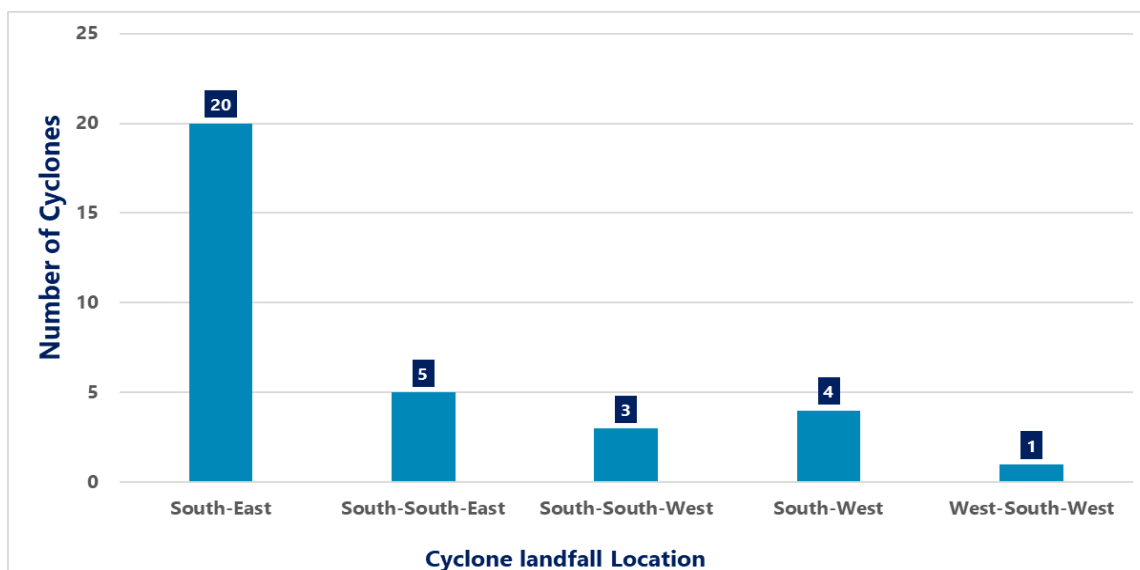


Figure 13: Distribution of Cyclone Over Bangladesh Coast (1960-2019)

Low lying areas of coastal region are highly vulnerable to cyclones, which pose serious threat to lives and properties of the region. Furthermore, triangular shape at the head of the Bay of Bengal, which helps to funnel sea water pushed by the wind towards the coast, causing further surge amplification. Nearly every year, cyclones hit the country's coastal region, and a severe cyclone strikes the country every three years, on average.

Previous records indicate that the greatest damage during cyclones has resulted from the inundation caused by cyclone-induced storm surges. Though time-series records of storm-surge height are scarce, existing literature indicates a 1.5 m to 9 m height range during various severe cyclones (Dasgupta et al., 2010).

According to Dasgupta et al. (2013), in extreme scenario, the areas vulnerable to inundation depths more than 1 m and 3 m, respectively would be 14 and 69 percent higher than the baseline scenario. A 10-year-return period cyclone in extreme scenario will be more intense by 2050 and cover 43 percent of the vulnerable area, 17 percent more than the current coverage. Climate change results in greater frequency and intensity of cyclonic storms. Intensity of cyclonic storm surges as well as depth and extent of storm surge induced coastal inundation are likely to increase in changing climate through rising sea surface temperature (SST) and sea level (IWTC 2006; Hansen and Sato 2011). The IPCC further indicates that future cyclonic storm surges and related coastal floods in Bangladesh will likely become more severe as future tropical cyclones increase in intensity (Knutson et al, 2021).

The following figure illustrates the inundation pattern in the study area. From the figure it can be seen that, around 30-40 % of the area will be deeply flooded under such scenario. The whole area will get flooding due to storm surge. Based on these outcomes the feasibility study has already proposed mitigation measures like sea dyke, marginal dyke, khal excavation, artificial drainage management measures and land development in the project site up to certain level etc.

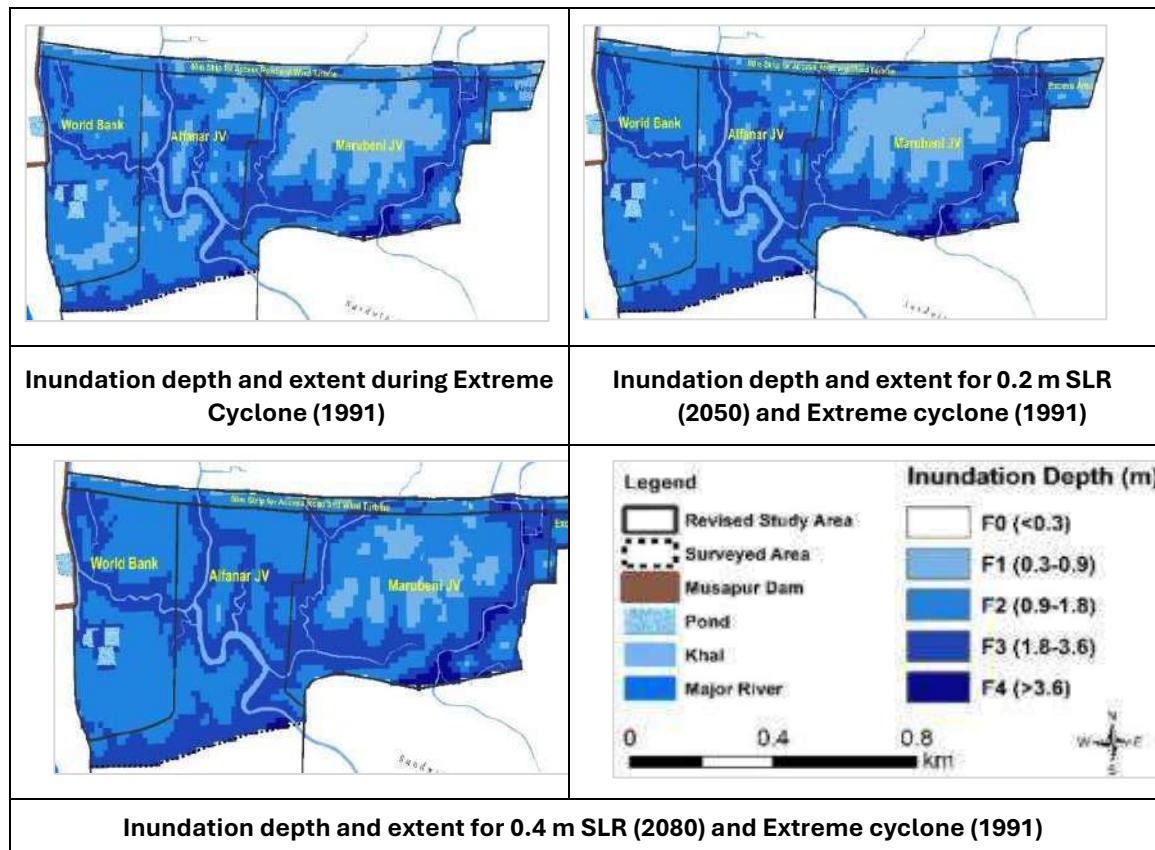


Figure 14: Inundation in the Study area due to Sea level rise

12.6.1.1.3.3 Erosion

Due to a combination of estuary and Bay of Bengal tidal effects, the region around the project site experiences severe morphological and hydrological changes over time. **Figure 15** show the historic erosion pattern and bank line shifting for the nearby rivers. The vulnerable locations along the banks of both the Little Feni and the Feni Rivers have been assessed. The meandering bend development or migration along the left bank of the Little Feni River and the right bank of the Feni River are more sensitive for the project site.

Based on the morphological analysis of the shifting pattern of the two rivers, it was concluded that bank line shifting will not affect the project site.

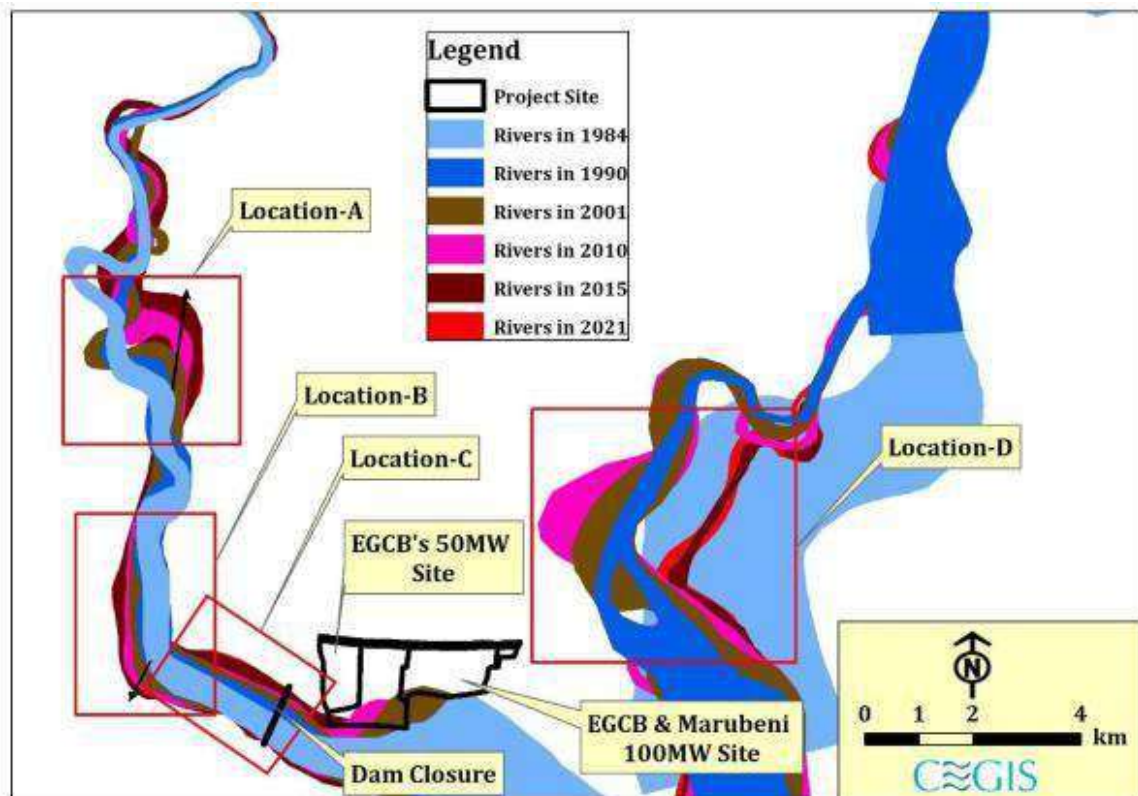


Figure 15: Erosion pattern around the study area

12.6.1.1.3.4 Salinity Intrusion

The study area is prone to salinity intrusion more than the inland areas. Due to climate change, the sea level is projected to rise and the rise in sea level causes salinity intrusion to increase as well. The increasing salinity level in the area lowers the quality of water. Drinking water scarcity may prevail in the area in future, especially in dry season. Lowering of quality of irrigation water will hamper agricultural activities in the island. Increase in salinity also poses a threat to health and safety of the local inhabitants. This will lead to migration out of the coastal zone to increase in the future as well.

12.6.1.2 References

- Ali, A. (1999). Climate change impacts and adaptation assessment in Bangladesh. *Climate Research*, 12(2/3), 109-116.
- Bhuiyan, J. A. and D. Dutta, 2012, Analysis of flood vulnerability and assessment of the impacts in coastal zones of Bangladesh due to potential sea level rise. *Nat. Hazards* 61, 729–743.
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- Dasgupta, S., Kamal, F.A., Khan, Z.H., Choudhury, S & Nishat, A. (2015). “River Salinity and Climate Change: Evidence from Coastal Bangladesh”. *World Scientific Reference on Asia and the World Economy*, pp 205-242
- DFID (Department for International Development) (2007). *Investigating the Impact of Relative Sea-Level Rise on Coastal Communities and their Livelihoods in Bangladesh*. DFID, United Kingdom.
- DoE (2016), “Assessment of Sea Level Rise on Bangladesh Coast through Trend Analysis”, *Climate Change Cell (CCC)*, Department of Environment, Ministry of Environment and Forests, Bangladesh
- Suntrace (2022), *Feasibility Study Report for 220 MWac PVPP at Sonagazi, Feni District, Bangladesh*

Appendix VII: Lab Report

12.7 Lab Report

Form No. QSF-22
জীবনের জন্য বিজ্ঞান

Revision No. 12

Revision Date: 04 November, 2022
“শেখ হাসিনার দর্শন, সব মানুষের উন্নয়ন”





বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No.

Lab/Sample ID

Client's Details

: IN-302 of Analytical Service Cell, BCSIR-07/05/2024

: A-752-753

: মোহাম্মদ মোস্তাফিজুজ্জামান
পরিচালক (ভারপ্রাপ্ত)
পাওয়ার এনার্জি এন্ড মিনারেল রিসোর্সেস ডিভিশন।

Center For Environmental And Geographic Information Service (CEGIS)
House No. 06, Road No. 23/C, Gulshan-01, Dhaka-1212

Number of Sample

Sample Description

: 02 (Two) Surface Water

: সাংযুক্ত পানির নমুনা পরীক্ষণ প্রসংগে, সূত্র নং-৪২.০৬.২৬২৬.১১৯.০৯.০০১.২৪.০১৬১৯
তারিখঃ ০৭/০৫/২০২৪ ইং।

Test Commencement Date

Test Completion Date

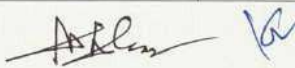
: 07/05/2024

: 06/06/2024

Lab ID	Particulars of supplied sample	Parameter	Results	Test Method (APHA)
A-752	Surface Water (SW-01, Sonagazi Feni)	Phenol	Less than 0.1 mg/L	5530.D
		Chloride (Cl)	13.9 mg/L	4110.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Zinc (Zn)	Less than 0.05 mg/L	3111.B
		Total Phosphorus (P)	Less than 0.5 mg/L	4500-P.C
		Total Nitrogen	Less than 1.0 mg/L	KJELDHAL



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Analytical Service Cell
Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
Telephone: 9671108, Fax: 88-02-9671108 E-mail: asc@bcsir.gov.bd Website: www.bcsir.gov.bd

Form No. QSF-22

Revision No. 12

Revision Date: 04 November, 2022

জীবনের জন্য বিজ্ঞান



"শেখ হাসিনার দর্শন, সব মানুষের উন্নয়ন"



বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameter	Results	Test Method (APHA)
A-753	Surface Water (SW-02, Project Site)	Phenol	Less than 0.1 mg/L	5530.D
		Chloride (Cl)	9.94 mg/L	4110.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Zinc (Zn)	Less than 0.05 mg/L	3111.B
		Total Phosphorus (P)	Less than 0.5 mg/L	4500-P.C
		Total Nitrogen	Less than 1.0 mg/L	KJELDHAL

[Signature]
05.06.24

Analyst

Mehedi Hasan
Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR, Dhaka-1205

[Signature]
06.06.24

Supervisor

Dr. Muhammad Abdullah Al-Mamun
Principal Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR, Dhaka-1205

[Signature]
06.06.24

Director

Sarker Kamruzzaman
Director (Addl. Charge)
Institute of National Analytical
Research & Service (INARS)
BCSIR, Dhaka-1205

Page 2 of 2

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-302 of Analytical Service Cell, BCSIR-07/05/2024

Lab/Sample ID : A-754-755

Client's Details : মোহাম্মদ মোক্কারজ্জামান, পরিচালক (অরপ্রাণ্ড)
পাওয়ার এনার্জি এন্ড মিনারেল রিসোর্সেস ডিভিশন।

Center For Environmental And Geographic Information Service (CEGIS)

House No. 06, Road No. 23/C, Gulshan-01, Dhaka-1212

Number of Sample : 02 (Two) Ground Water

Sample Description : সংগ্রহকৃত পানির নমুনা পরীক্ষণ প্রসঙ্গে, সূত্র নং-৪২.০৬.২৬২৬.১১৯.০৯.০০১.২৪.০১৬১৯
তারিখঃ ০৭/০৫/২০২৪ ইং।

Test Commencement Date : 07/05/2024

Test Completion Date : 06/06/2024

Lab ID	Particulars of supplied sample	Parameter	Results	Test Method (APHA)
A-754	Ground Water (GW-01, Project Site)	Odour	Agreeable	In-house
		Taste	Unobjectionable	In-house
		Aluminium (Al)	Less than 0.03 mg/L	3113.B
		Chloride (Cl)	3.59 mg/L	4110.B
		Free Residual Chlorine	Less than 0.2 mg/L	TITRIMETRIC
		Mineral Oil	Less than 2.0 mg/L	5520.B
		Phenolic Compounds	Less than 0.1 mg/L	5530.D
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Cyanide (Cn)	Not detectable	In-house
		Chromium (Cr)	Less than 0.005 mg/L	3111.B

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameter	Results	Test Method (APHA)
A-755	Ground Water (GW-02, পূর্ব বড়ঘলী সোনাগাজী ফেনী)	Odour	Agreeable	In-house
		Taste	Unobjectionable	In-house
		Aluminium (Al)	Less than 0.03 mg/L	3113.B
		Chloride (Cl)	119 mg/L	4110.B
		Free Residual Chlorine	Less than 0.2 mg/L	TITRIMETRIC
		Mineral Oil	Less than 2.0 mg/L	5520.B
		Phenolic Compounds	Less than 0.1 mg/L	5530.D
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Cyanide (Cn)	Not detectable	In-house
		Chromium (Cr)	Less than 0.005 mg/L	3111.B

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Page 2 of 4

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Lab ID	Particulars of supplied sample	Parameters	Results (µg/L)	Test Method (APHA)
A-754	Ground Water (GW-01, Project Site) Polychlorinated Biphenyls (PCB)	2,2',3,4,4',5,5'-Hexachlorobiphenyl	Not detectable	6630.B
		2,2',3,4,4',5'-Hexachlorobiphenyl	Not detectable	6630.B
		2,2',4,4',5,5'-Hexachlorobiphenyl	Not detectable	6630.B
		2,2',5,5'-Tetrachlorobiphenyl	Not detectable	6630.B
		2,4,4'-Tetrachlorobiphenyl	Not detectable	6630.B
		2,6-Dichlorobiphenyl	Not detectable	6630.B
A-754	Ground Water (GW-01, Project Site) Polynuclear Aromatic Hydrocarbon (PAH)	Acenaphthene	Not detectable	6440.B
		Acenaphthylene	Not detectable	6440.B
		Anthracene	Not detectable	6440.B
		Benzo[A]Anthracene	Not detectable	6440.B
		Benzo[B]Fluoranthene	Not detectable	6440.B
		Benzo[K]Fluoranthene	Not detectable	6440.B
		Benzo[G,H,I]Perilene	Not detectable	6440.B
		Benzo[A]Pyrene	Not detectable	6440.B
		Chrysene	Not detectable	6440.B
		Dibenzo[A,H]Anthracene	Not detectable	6440.B
		Fluoranthene	Not detectable	6440.B
		Fluorene	Not detectable	6440.B
		Indeno[1,2,3-CD]Pyrene	Not detectable	6440.B
		Naphthalene	Not detectable	6440.B
		Phenanthrene	Not detectable	6440.B
		Pyrene	Not detectable	6440.B

[Signature]

Page 3 of 4

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Results (µg/L)	Test Method (APHA)
A-755	Ground Water (GW-02, পূর্ব বড়খালী সোনাগাজী ফেনী) Polychlorinated Biphenyls (PCB)	2,2',3,4,4',5,5' -Hexachlorobiphenyl	Not detectable	6630.B
		2,2',3,4,4',5'-Hexachlorobiphenyl	Not detectable	6630.B
		2,2',4,4',5,5' -Hexachlorobiphenyl	Not detectable	6630.B
		2,2',5,5'-Tetrachlorobiphenyl	Not detectable	6630.B
		2,4,4'-Tetrachlorobiphenyl	Not detectable	6630.B
		2,6-Dichlorobiphenyl	Not detectable	6630.B
A-755	Ground Water (GW-02, পূর্ব বড়খালী সোনাগাজী ফেনী) Polynuclear Aromatic Hydrocarbon (PAH)	Acenaphthene	Not detectable	6440.B
		Acenaphthylene	Not detectable	6440.B
		Anthracene	Not detectable	6440.B
		Benzo[A]Anthracene	Not detectable	6440.B
		Benzo[B]Fluoranthene	Not detectable	6440.B
		Benzo[K]Fluoranthene	Not detectable	6440.B
		Benzo[G,H,I]Perilene	Not detectable	6440.B
		Benzo[A]Pyrene	Not detectable	6440.B
		Chrysene	Not detectable	6440.B
		Dibenzo[A,H]Anthracene	Not detectable	6440.B
		Fluoranthene	Not detectable	6440.B
		Fluorene	Not detectable	6440.B
		Indeno[1,2,3-CD]Pyrene	Not detectable	6440.B
		Naphthalene	Not detectable	6440.B
		Phenanthrene	Not detectable	6440.B
		Pyrene	Not detectable	6440.B

06.06.24

Analyst

Mehedi Hasan

Scientific Officer
Institute of National Analytical
Research & Service (INARS)
Note: BCSIR, Dhaka-1205

06.06.24

Supervisor

Dr. Muhammad Abdullah Al-Mansur
Principal Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR, Dhaka-1205

06.06.24

Director

Sarker Kamruzzaman
Director (Addl. Charge)
Institute of National Analytical
Research & Service (INARS)
BCSIR, Dhaka-1205

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Telephone: 9671108, Fax: 88-02-9671108 E-mail: asc@bcsir.gov.bd Website: www.bcsir.gov.bd

	Government of the People's Republic of Bangladesh Office of the Chief Chemist Department of Public Health Engineering Central Lab, 38-39, Mohakhali C/A, Dhaka-1212 Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	

Lab Memo: 1244/ CC, DPHE, CL, Dhaka

Date: 26-05-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

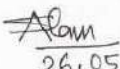
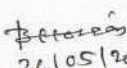
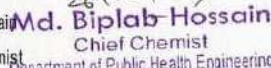
Sample ID: CEN2024050113	Sample Receiving date: 09-04-2024
Ref. Memo No: 42.06.2626.119.37.001.24-01269 & Dated: 09-04-2024	Sample Source: Surface Water
Sent by: Mohammed Mukteruzzaman, Director, P, E & Mineral Resources Division, CEGIS, Gulshan-1, Dhaka.	Dist/Fenl, Upa:
Care Taker: CEGIS (Sample ID : SW-01)	Union:, Vill.:
Sample Collection date:	Date of Testing: 09/04/2024-26/05/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Alkalinity	-	500	mg/L	Titrimetic	-
2	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
3	Biochemical Oxygen Demand (BOD)	0.2	96	mg/L	5 days Incubation	0.1
4	Chemical Oxygen Demand (COD)	4.0	456	mg/L	CRM	4.0
5	Coliform (Faecal)	0	64	N/100ml	MFM	-
6	Coliform (Total)	0	136	N/100ml	MFM	-
7	Hardness	200-500	3600	mg/L	Titrimetic	-
8	Nitrogen (Nitrate)	10.0	1.5	mg/L	UVS	0.10
9	Phosphate	5.0	0.80	mg/L	UVS	0.10
10	Potassium (K)	12.0	127	mg/L	AAS	-
11	Sodium (Na)	200	2516	mg/L	AAS	0.34
12	Zinc (Zn)	5.0	0.03	mg/L	AAS	0.03

Comments: Sample was collected & supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS - UV-Visible Spectrophotometer, MFM-Membrane Filtration Method, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by: 1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer Signature:  26.05.2024 2.) Name: Taslima Akhter Designation: Sample Analyzer Signature:  26-05-2024	Countersigned/Approved by: 1.) Name: Mita Sarker Designation: Senior Chemist Signature:  26/05/2024 2.) Name: Md. Biplab Hossain Designation: Chief Chemist Signature:  26/05/2024 Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

	Government of the People's Republic of Bangladesh Office of the Chief Chemist Department of Public Health Engineering Central Lab, 38-39, Mohakhali C/A, Dhaka-1212 Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	

Lab Memo: 1244/ CC, DPHE, CL, Dhaka

Date: 26-05-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

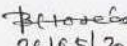
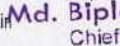
Sample ID: CEN2024050114	Sample Receiving date: 09-04-2024
Ref. Memo No: 42.06.2626.119.37.001.24-01269 & Dated: 09-04-2024	Sample Source: Surface Water
Sent by: Mohammed Mukteruzzaman, Director, P, E & Mineral Resources Division, CEGIS, Gulshan-1, Dhaka.	Dist/Feni, Upa:
Care Taker: CEGIS (Sample ID : SW-02)	Union:, Vill.:
Sample Collection date:	Date of Testing: 09/04/2024-26/05/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Alkalinity	-	200	mg/L	Titrimetic	-
2	Arsenic (As)	0.05	0.004	mg/L	AAS	0.001
3	Biochemical Oxygen Demand (BOD)	0.2	88	mg/L	5 days Incubation	0.1
4	Chemical Oxygen Demand (COD)	4.0	440	mg/L	CRM	4.0
5	Coliform (Faecal)	0	80	N/100ml	MFM	-
6	Coliform (Total)	0	164	N/100ml	MFM	-
7	Hardness	200-500	2200	mg/L	Titrimetic	-
8	Nitrogen (Nitrate)	10.0	13.4	mg/L	UVS	0.10
9	Phosphate	6.0	0.70	mg/L	UVS	0.10
10	Potassium (K)	12.0	131	mg/L	AAS	-
11	Sodium (Na)	200	1578	mg/L	AAS	0.34
12	Zinc (Zn)	5.0	0.03	mg/L	AAS	0.03

Comments: Sample was collected & supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS - UV-Visible Spectrophotometer, MFM-Membrane Filtration Method, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 26.05.2024	1.) Name: Mita Sarker Designation: Senior Chemist	 26/05/2024
2.) Name: Taslima Akhter Designation: Sample Analyzer	 26.05.2024	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 26/05/2024

Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory, Mohakhali, Dhaka

	Government of the People's Republic of Bangladesh Office of the Chief Chemist Department of Public Health Engineering Central Lab, 38-39, Mohakhali C/A, Dhaka-1212 Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	

Lab Memo: 1244/ CC, DPHE, CL, Dhaka

Date: 26-05-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

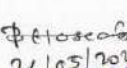
Sample ID: CEN2024050115	Sample Receiving date: 09-04-2024
Ref. Memo No: 42.06.2626.119.37.001.24-01269 & Dated: 09-04-2024	Sample Source: Ground Water
Sent by: Mohammed Mukteruzzaman, Director, P, E & Mineral Resources Division, CEGIS, Gulshan-1, Dhaka.	Dist: Feni, Upa:
Care Taker: CEGIS (Sample ID : GW-01)	Union:, Vill.:
Sample Collection date:	Date of Testing: 09/04/2024-26/05/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Alkalinity	-	210	mg/L	Titrimetic	-
2	Ammonia	0.5	0.30	mg/L	UVS	0.10
3	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
4	Barium (Ba)	0.01	0.090	mg/L	AAS	-
5	Boron (B)	1.0	0.23	mg/L	UVS	0.20
6	Calcium (Ca)	75	22	mg/L	AAS	0.17
7	Coliform (Faecal)	0	0	N/100ml	MFM	-
8	Coliform (Total)	0	0	N/100ml	MFM	-
9	Colour	15	1.6	Hazen	UVS	-
10	Hardness	200-500	230	mg/L	Titrimetic	-
11	Magnesium (Mg)	30-35	17	mg/L	AAS	0.05
12	Zinc (Zn)	5.0	0.03	mg/L	AAS	0.03

Comments: Sample was collected & supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS - UV-Visible Spectrophotometer, MFM-Membrane Filtration Method, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by: 1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer Signature:  26.05.2024 2.) Name: Taslima Akhter Designation: Sample Analyzer Signature:  26.05.2024	Countersigned/Approved by: 1.) Name: Mita Sarker Designation: Senior Chemist Signature:  26.05.2024 2.) Name: Md. Biplab Hossain Designation: Chief Chemist Signature:  26.05.2024 Department of Public Health Engineering Central Laboratory, Mohakhali, Dhaka

	Government of the People's Republic of Bangladesh Office of the Chief Chemist Department of Public Health Engineering Central Lab, 38-39, Mohakhali C/A, Dhaka-1212 Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	

Lab Memo: 1244/ CC, DPHE, CL, Dhaka

Date: 26-05-2024

Physical /Chemical/ Bacteriological Analysis of Water Sample

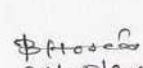
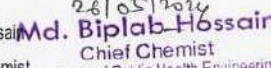
Sample ID: CEN2024050116	Sample Receiving date: 09-04-2024
Ref. Memo No: 42.06.2626.119.37.001.24-01269 & Dated: 09-04-2024	Sample Source: Ground Water
Sent by: Mohammed Mukteruzzaman, Director, P, E & Mineral Resources Division, CEGIS, Gulshan-1, Dhaka.	Dist: Feni, Upa:
Care Taker: CEGIS (Sample ID : GW-02)	Union:, Vill.:
Sample Collection date:	Date of Testing: 09/04/2024-26/05/2024

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Alkalinity	-	293	mg/L	Titrimetic	-
2	Ammonia	0.5	0.26	mg/L	UVS	0.10
3	Arsenic (As)	0.05	0.019	mg/L	AAS	0.001
4	Barium (Ba)	0.01	0.085	mg/L	AAS	-
5	Boron (B)	1.0	0.21	mg/L	UVS	0.20
6	Calcium (Ca)	75	42	mg/L	AAS	0.17
7	Coliform (Faecal)	0	0	N/100ml	MFM	-
8	Coliform (Total)	0	0	N/100ml	MFM	-
9	Colour	15	2.0	Hazen	UVS	-
10	Hardness	200-500	480	mg/L	Titrimetic	-
11	Magnesium (Mg)	30-35	68	mg/L	AAS	0.05
12	Zinc (Zn)	5.0	0.03	mg/L	AAS	0.03

Comments: Sample was collected & supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS - UV-Visible Spectrophotometer, MFM-Membrane Filtration Method, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by: 1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer  26.05.2024 2.) Name: Taslima Akhter Designation: Sample Analyzer  26.05.2024	Countersigned/Approved by: 1.) Name: Mita Sarker Designation: Senior Chemist  26/05/2024 2.) Name: Md. Biplab Hossain Designation: Chief Chemist  26/05/2024 Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka



Center for Environmental and Geographic Information Services
(A Public Trust under the Ministry of Water Resources)
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh.
Tel: 88 02 5861744-52; 592381, 5842531 Fax: 88 02 586128 e-mail: cegis@cegisbd.com http://www.cegisbd.com

Environmental Laboratory

Memo No. ELAB202402003596

Date: 07/05/2024

Test Report Physical/Chemical/Bacteriological Analysis of water

Project Name: Environmental and Social Advisory services for a 100 MW solar Power Plant at Feni.

Code: MAP001

Sample Type: Surface Water

ID: MAP001_001

Collection Date: 28/03-04/04/2024

Location: Sonagazi, Feni.

Received From: Bilkis Sultana

Received Date: 22/04/2024

Testing Date: 23/04-07/ 05/2024

Laboratory Test Results:

SL.	Name of Sample	Water quality parameters	Bangladesh Standard ECR/2023						Concentration Present	Unit	Analysis Method	Min ^m Detection Limit (MDL)
			Drinking		Fisheries	Irrigation	Recreational	By Various Process and Cooling Industries				
			After Conventional treatment	After Disinfecting Process								
01	SW-01	Nitrate (NO ₃)	7.0	7.0	7.0	5.0	7.0	-	8.9182	ppm	UV-VIS	0.05008
02		Sulphate (SO ₄ ²⁻)	-	-	-	-	-	-	228.85	ppm	UV-VIS	0.02
03		Iron (Fe)	-	-	-	-	-	-	1.7258	ppm	UV-VIS	0.00124
04		Copper (Cu)	-	-	-	-	-	-	0.6766	ppm	UV-VIS	0.03443
05		Chromium (Cr ⁶⁺)	-	-	-	-	-	-	0.0035	ppm	UV-VIS	0.000247
06		Manganese (Mn)	-	-	-	-	-	-	Undetectable	ppm	UV-VIS	0.00454
07		Fluoride (F)	-	-	-	-	-	-	1.2619	ppm	UV-VIS	0.00328
08		Nickel (Ni)	-	-	-	-	-	-	Undetectable	ppm	UV-VIS	0.000195
09		Total Suspended Solid (TSS)	1000	1000	1000	1000	1000	1000	366.66	mg/L	Gravimetric	-

N.B: UV-VIS: Ultra Violet - 1800 Visible Spectrophotometer, Report is valid only for supplied sample tested.

Test Performed by & Checked by

Name: Rafiqul Islam & Md. Rafiqul Alam

Designation: Research Associate & Scientific Instrument In-Charge (addl.) and Laboratory Expert

Signature:

Compiled & Approved by

Name: Md. Rafiqul Alam

Designation: Laboratory Expert

Signature:



Center for Environmental and Geographic Information Services
(A Public Trust under the Ministry of Water Resources)
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Tel: 88 02 5861748-52; 9842581, 9842551 Fax: 88 02 9843378 e-mail: cegis@cegisbd.com http://www.cegisbd.com

Environmental Laboratory

Memo No. ELAB202402003597

Date: 07/05/2024

Test Report Physical/Chemical/Bacteriological Analysis of water

Project Name: Environmental and Social Advisory services for a 100 MW solar Power Plant at Feni.

Code: MAP001

Sample Type: Surface Water

ID: MAP001_002

Collection Date: 28/03-04/04/2024

Location: Sonagazi, Feni.

Received From: Bilkis Sultana.

Received Date: 22/04/2024

Testing Date: 23/04-07/05/2024

Laboratory Test Results:

SL.	Name of Sample	Water quality parameters	Bangladesh Standard ECR/2023						Concentration Present	Unit	Analysis Method	Min ^m Detection Limit (MDL)
			Drinking		Fisheries	Irrigation	Recreational	By Various Process and Cooling Industries				
			After Conventional treatment	After Disinfecting Process								
01	SW-02	Nitrate (NO ₃)	7.0	7.0	7.0	5.0	7.0	-	3.3250	ppm	UV-VIS	0.05008
02		Sulphate (SO ₄ ²⁻)	-	-	-	-	-	-	220.65	ppm	UV-VIS	0.02
03		Iron (Fe)	-	-	-	-	-	-	3.8934	ppm	UV-VIS	0.00124
04		Copper (Cu)	-	-	-	-	-	-	1.0676	ppm	UV-VIS	0.03443
05		Chromium (Cr ⁶⁺)	-	-	-	-	-	-	0.0045	ppm	UV-VIS	0.000247
06		Manganeese (Mn)	-	-	-	-	-	-	Undetectable	ppm	UV-VIS	0.00154
07		Fluoride (F)	-	-	-	-	-	-	0.8909	ppm	UV-VIS	0.00328
08		Nickel (Ni)	-	-	-	-	-	-	Undetectable	ppm	UV-VIS	0.000195
09		Total Suspended Solid (TSS)	1000	1000	1000	1000	1000	1000	266.66	mg/L	Gravimetric	-

N.B: UV-VIS: Ultra Violet - 1800 Visible Spectrophotometer, Report is valid only for supplied sample tested

Test Performed by & Checked by

Name: Rafiqul Islam & Md. Rafiqul Alam

Designation: Research Associate & Scientific Instrument In-Charge (addl.) and Laboratory Expert

Signature:

Compiled & Approved by

Name: Md. Rafiqul Alam

Designation: Laboratory Expert

Signature:

Environmental Laboratory

Memo No. ELAB202402003604

Date: 07/05/2024

Test Report Physical/Chemical/Bacteriological Analysis of water

Project Name: Environmental and Social Advisory services for a 100 MW solar Power Plant at Feni.

Code: MAP001

Sample Type: Drinking Water (GW)

ID: MAP001_003

Collection Date: 28/03-04/04/2024

Location: Sonagazi, Feni.

Received From: Billkis Sultana.

Received Date: 22/04/2024

Testing Date: 23/04-07/05/2024

Laboratory Test Results:

SL.	Name of Sample	Water quality parameters	Bangladesh Standard ECR/2023					Concentration Present	Unit	Analysis Method	Min ^m Detection Limit (MDL)
			Drinking	Fisheries	Irrigation	Recreational	By Various Process and Cooling Industries				
01	GW-01	Nitrate (NO ₃ ⁻)	45	-	-	-	-	1.0331	ppm	UV-VIS	0.05008
02		Phosphate (PO ₄ ³⁻)	-	-	-	-	-	1.2153	ppm	UV-VIS	0.0003
03		Sulphate (SO ₄ ²⁻)	250	-	-	-	-	0.9727	ppm	UV-VIS	0.02
04		Iron (Fe)	0.3-1.0	-	-	-	-	1.1208	ppm	UV-VIS	0.00124
05		Copper (Cu)	1.5	-	-	-	-	1.7638	ppm	UV-VIS	0.03443
06		Manganese (Mn)	0.4	-	-	-	-	2.1168	ppm	UV-VIS	0.00454
07		Fluoride (F)	1.0	-	-	-	-	0.1359	ppm	UV-VIS	0.00328

N.B: UV-VIS: Ultra Violet - 1800 Visible Spectrophotometer, Report is valid only for supplied sample tested.

Test Performed by & Checked by

Name: Rafiqul Islam & Md. Rafiqul Alam

Designation: Research Associate & Scientific Instrument In-Charge (addl.) and Laboratory Expert

Signature:

Compiled & Approved by

Name: Md. Rafiqul Alam

Designation: Laboratory Expert

Signature:



Center for Environmental and Geographic Information Services
[A Public Trust under the Ministry of Water Resources]
House 6, Road 23/C, Gulshan-I, Dhaka-1212, Bangladesh.
Tel: 88 02 38617447/32: 3842581, 3842531 Fax: 88 02 7843138 e-mail: cegis@cegisbd.com http://www.cegisbd.com

Environmental Laboratory

Memo No. ELAB202402003605

Date: 07/05/2024

Test Report

Physical/Chemical/Bacteriological Analysis of water

Project Name: Environmental and Social Advisory services for a 100 MW solar Power Plant at Feni.

Code: MAP001

Sample Type: Drinking Water(GW)

ID: MAP001_004

Collection Date: 28/03-04/04/2024

Location: Sonagazi, Feni.

Received From: Bilkis Sultana.

Received Date: 22/04/2024

Testing Date: 23/04-07/05/2024

Laboratory Test Results:

SL.	Name of Sample	Water quality parameters	Bangladesh Standard ECR/2023					Concentration Present	Unit	Analysis Method	Min ^m Detection Limit (MDL)
			Drinking	Fisheries	Irrigation	Recreational	By Varicus Process and Cooling Industries				
01	GW-02	Nitrate (NO ₃ ⁻)	45	-	-	-	-	2.0003	ppm	UV-VIS	0.05008
02		Phosphate (PO ₄ ³⁻)	-	-	-	-	-	0.8198	ppm	UV-VIS	0.0003
03		Sulphate (SO ₄ ²⁻)	-	-	-	-	- q	8.3048	ppm	UV-VIS	0.02
04		Iron (Fe)	0.3-1.0	-	-	-	-	0.6166	ppm	UV-VIS	0.00124
05		Copper (Cu)	1.5	-	-	-	-	2.2209	ppm	UV-VIS	0.03443
06		Manganese (Mn)	0.4	-	-	-	-	2.1883	ppm	UV-VIS	0.00454
07		Fluoride (F)	1.0	-	-	-	-	0.0371	ppm	UV-VIS	0.00328

N.B: UV-VIS: Ultra Violet - 1800 Visible Spectrophotometer, Report is valid only for supplied sample tested.

Test Performed by & Checked by

Name: Rafiqul Islam & Md. Rafiqul Alam

Designation: Research Associate & Scientific Instrument In-Charge (addl.) and Laboratory Expert

Signature:

Compiled & Approved by

Name: Md. Rafiqul Alam

Designation: Laboratory Expert

Signature:

Mitra S. K. Bangladesh (Pvt.) Ltd.

House # 02, 5th Floor, Road # 32,
Dhanmondi, Dhaka-1209
Bangladesh.

T : +88 02 5815 3195, +88 01973 167 777
E : mskdhaka@mitrask.com
W : www.mitrask.com

**TEST REPORT**

Name & Address of the Customer:	Report No.	: MSKGL/ED/2024-25/01/0014
Center for Environmental and Geographic Information Services (CEGIS) House No.-06, Road No. 23/C, Gulshan-1 Dhaka-1212, Bangladesh	Sample No.	: MSKGL/ED/2024-25/05/01282 & 01283
	Date of Report	: 10.06.2023
	Submitted Date	: 26.05.2024

ANALYSIS RESULTS

S.N	Parameters	Unit	Near Project Site	Purbaborodhali, Sonagazi,Feni	Method
1	Anionic Detergents (as MBAS)	mg/l	<0.02	<0.02	APHA (24th Edition), 5540 C
2	Chloramines (as Cl ₂)	mg/l	<0.3	<0.3	IS 3025 (Part 26)- 1986; Rffm: 2003 (O)
3	Sulphide	mg/l	<0.1	<0.1	APHA (24th Edition), 4500 S ₂ -D

Mitra S.K. Bangladesh (Pvt.) Limited



Registered Office: 19 Green Road, Kalabagan, Dhaka-1205, Bangladesh.

Department of Zoology
University of Dhaka
Analysis of Benthos Samples

No of Samples : 2
Sample received on : 2nd April 2024
Sampling procedure : Standard
Locations : 6 No. Charcandia Union Parishad, Sonagazi Upazila, Feni district
Client : CEGIS
Working reference : Canals under Sonagazi Upazila of Feni District

No	Sample ID	Location	Benthos diversity	Counting	Comments (if any)
1	B-1	Canal Near Project Site, Running water 22° 47' 03"N 91° 22' 32"E	<i>Paramaecium</i> (Protozoan)- 3 <i>Chironomid</i> larva (Insecta)-1	915 protozoans/ cubic meter 305 insect larva/ cubic meter	Black Organic materials presence in sample water. Representing fauna of organic pollutant water.
2	B-2	Canal Inside the Project Area, Running water 22° 47' 08"N 91° 23' 21"E	<i>Paramaecium</i> (Protozoan)- 4 <i>Chironomid</i> larva (Insecta)-1 Copepoda (Broken parts), (Crustacean)- 1	1220 protozoans/ cubic meter 610 aquatic arthropods/ cubic meter	Black Organic materials presence in sample water. More organic pollution than the outside samples.


Dr Md. Niamul Naser



**Department of Zoology
University of Dhaka
Analysis of Plankton Samples**

No of Samples : 2
Sample received on : 2nd April 2024
Sampling procedure : Sample supplied
Locations : 6 No. Charcandia Union Parishad, Sonagazi Upazila, Feni district
Client : CEGIS
Working reference : Canals under Sonagazi Upazila of Feni District

No	Sample ID	Location	Plankton diversity	Total Count (individual/liter of water)	Comments (if any)
1	P-1	Canal Near Project Site, Running water 22° 47' 03''N 91° 22' 32''E	<i>Paramecium</i> (Protozoan)- 8 <i>Diaptomus</i> (Crustacea)- 1	900 indiv. /L	Organic debris presence in the sample water.
2	P-2	Canal Inside the Project Area, Running water 22° 47' 08''N 91° 23' 21''E	<i>Paramecium</i> (Protozoan)- 12 <i>Cyclops</i> (Crustacea)- 2	1400 indiv. /L	Organic debris presence in the sample water.



Md. Niamul Naser PhD



মৃত্তিকা, পানি ও পরিবেশ বিভাগ
ঢাকা বিশ্ববিদ্যালয়, ঢাকা ১০০০, বাংলাদেশ



**Department of Soil
Water and Environment**
University of Dhaka, Dhaka 1000, Bangladesh

May 19, 2024

Mr. Mohammed Mukteruzzaman
Senior Specialist and Director
Power, Energy and Mineral Resources Division
CEGIS, F-14/E, Agargaon Administrative Area
Sher-E-Bangla Nagar
Dhaka 1207.

Subject: Soil Sample Analysis
Ref: 42.06.2626.105.09.001.24.01297 Dated: 16/04/2024

As per your request, the supplied soil samples have been analyzed and the following results have been found.

Sample no.	Locations	Sodium (Na ⁺) %	Chlorine (Cl) ppm	Fluorine (F) ppm	CEC ^a meq/ 100 gm soil	Porosity %	Permeability (cm/hr)	Infiltration (mm/hr)
01	Boro Douli, Sonagazi, Feni	0.20	334.27	179.12	4.31	48.90	19.94	10.0
02	Purbo Boro Douli, Sonagazi	0.23	369.72	198.12	4.21	45.00	0.533	9.0
03	Char Chandia	0.17	430.50	230.69	5.07	46.55	16.28	9.0
04	Borodouli, Sonagazi	0.15	293.75	157.41	4.86	51.38	0.466	10.0

*Cation Exchange Capacity

Thanks and regards,

(Professor Dr. Md. Harunor Rashid Khan)
Chairman

Telephone : 9661920-73/7470, Fax: (880-2) 9667222, e-mail: swed@du.ac.bd

মৃত্তিকা নমুনার বিশ্লেষিত									
উপাদানের নাম									
পিএইচ	বুনট		লবণাক্ততা	জৈব পদার্থ	মোট নাইট্রোজেন	ফসফরাস		(meq)	
			(ডিএস/ মিটার)	(%)	সহজলভ্য (ppm)				
	৮.১	পলি	বালি- ০৪.৭৪% পলি- ৯২.৬৯% কর্দম-২.৫৭%	০.৯৩	০.৮৭	০.০৯	৫.৫২		৮৯.১০
৮.১২২	৮.৪ দোআঁশ	পলি- ০৮.৪৪% পলি- ৬৮.৬৭% কর্দম-১২.৮৯%	০.৮১	১.২৭	০.১২	৬.০২			
		৮.১২৩	৭.৯ দোআঁশ	বালি- ০৭.৭০% পলি- ৬৮.৫৭% কর্দম-২৩.৭৩%	০.৮৭	১.১৯	০.১২	৭.২৫	
				বালি- ০৭.৬০% পলি- ৮৯.৭৬% কর্দম-০২.৬৪%	০.৫৭	১.৩৮	০.১৩	৪.৩৩	

C&GIS Center for Environmental and Geographic Information Services
(A Public Inst under the Ministry of Natural Resources)
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh.
Tel: 88 02 5887464-52 9842581 9842581 Fax: 98 02 9843128 e-mail: cegis@cegisbd.com http://www.cegisbd.com

Environmental Laboratory

Ref No. ELAB202404000075-1

Date: 26/05/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°47'59"N; 91°21'29"E Sampling ID: AQ-01 Sampling Date: 28/03/2024

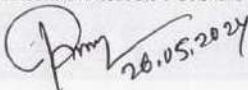
Monitoring Location (Administrative): Adarsha gram Darul Ulum Madrasha, Sonagazi, Feni
Weather Condition: Rainy

Analysis Results:

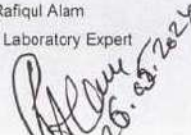
Sl. No.	Air Pollutants	Unit	Concentration Present	Value exposures	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	49.42	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	32.12	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	85.99	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.35	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	22.58	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	14.57	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	19.14	08 hrs (average)	100 (08Hrs)	G-100 IT1-150	

Note: *IT- Interim Target, G- Guideline; **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

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Environmental Laboratory

Ref No. ELAB202404000075-2

Date: 26/05/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°47'27"N; 91°22'18"E Sampling ID: AQ-02 Sampling Date: 29/03/2024

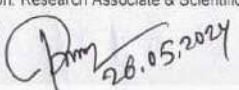
Monitoring Location (Administrative): Near to the Project Site, Sonagazi, Feni
Weather Condition: Overcast

Analysis Results:

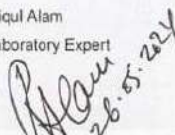
Sl. No.	Air Pollutants	Unit	Concentration Present	Value exposures	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	80.91	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	64.72	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	121.36	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.20	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	10.37	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	13.43	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	20.57	08 hrs (average)	100 (08Hrs)	G-100 IT1-160	

Note: *IT- Interim Target, G- Guideline; **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

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Environmental Laboratory

Ref No. ELAB202404000075-3

Date: 26/05/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°48'11"N; 91°22'53"E Sampling ID: AQ-03 Sampling Date: 30/03/2024

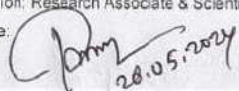
Monitoring Location (Administrative): Darul Ulum Ahmadiya Madrasha, Bhuiya Bazar, Sonagazi, Feni
Weather Condition: Sunny

Analysis Results:

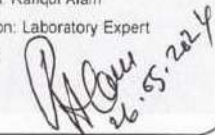
Sl. No.	Air Pollutants	Unit	Concentration Present	Value exposures	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	46.93	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	30.50	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	77.53	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.22	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	14.15	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	13.19	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	18.25	08 hrs (average)	100 (08Hrs)	G-100 IT1-150	

Note: *IT- Interim Target, G- Guideline; **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

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Environmental Laboratory

Ref No. ELAB202404000075-4

Date: 26/05/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°48'46"N 91°22'26"E Sampling ID: AQ-04 Sampling Date: 31/03/2024

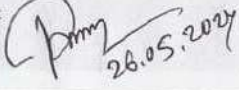
Monitoring Location (Administrative): Purba borodhali, Bunia market, Sonagazi, Feni
Weather Condition: Sunny

Analysis Results:

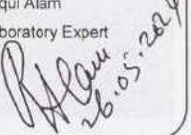
Sl. NO.	Air Pollutants	Unit	Concentration Present	Value exposures	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	29.93	24 hrs (average)	150 (24Hrs)	G-50 IT 1-150 IT 2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	20.95	24 hrs (average)	65 (24Hrs)	G-25 IT 1-75 IT 2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	50.88	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.20	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	7.84	24 hrs (average)	80 (24Hrs)	G-20 IT 1-125 IT 2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	12.36	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	19.11	08 hrs (average)	100 (08Hrs)	G-100 IT 1-160	

Note: *IT- Interim Target, G- Guideline; **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment: AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

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Environmental Laboratory

Ref No. ELAB202404000075-5

Date: 26/05/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°47'46"N 91°23'19"E Sampling ID: AQ-05 Sampling Date: 01/04/2024

Monitoring Location (Administrative): Hafej lokman House, Madina Bazar, Sonagazi, Feni
Weather Condition: Sunny

Analysis Results:

Sl. No.	Air Pollutants	Unit	Concentration Present	Value exposures 24 hrs (average)	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	25.57	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	15.34	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	40.91	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.22	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	5.22	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	13.19	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	19.68	08 hrs (average)	100 (08Hrs)	G-100 IT1-160	

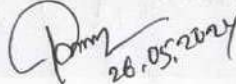
Note: *IT- Interim Target, G- Guideline; **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

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Signature:

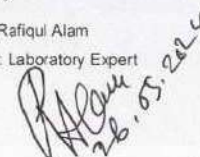


Approved by

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Environmental Laboratory

Ref No. ELAB202404000075-6

Date: 26/05/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°48'39"N 91°23'34"E Sampling ID: AQ-06 Sampling Date: 02/04/2024

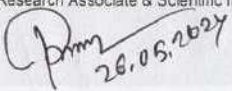
Monitoring Location (Administrative): Hazi Mustofa Iondoni Bari, Boroshali, Sonagazi, Feni
Weather Condition: Sunny

Analysis Results:

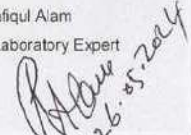
Sl. No.	Air Pollutants	Unit	Concentration Present	Value exposures 24 hrs (average)	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	34.50	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	18.97	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	53.47	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.23	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	6.41	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	13.29	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	18.73	08 hrs (average)	100 (08Hrs)	G-100 IT1-160	

Note: *IT- Interim Target, G- Guideline; **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

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Environmental Laboratory

Ref No. ELAB202407000078-5

Date: 30/07/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°48'39"N 91°23'34"E Sampling ID: AQ-06 Sampling Date: 17/07/2024

Monitoring Location (Administrative): Hazi Mustofa Londoni Bari, Boroshali, Sonagazi, Feni
Weather Condition: Sunny

Analysis Results:

Sl. No.	Air Pollutants	Unit	Concentration Present	Value exposures	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	8.25	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	6.19	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	12.13	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.365	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	7.38	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	10.89	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	15.90	08 hrs (average)	100 (08Hrs)	G-100 IT1-160	

Note: *IT- Interim Target, G- Guideline; **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

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30.07.24

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30.07.24

Environmental Laboratory

Ref No. ELAB202407000078-5

Date: 30/07/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°47'45"N 91°23'19"E Sampling ID: AQ-05 Sampling Date: 16/07/2024

Monitoring Location (Administrative): Hafej lokman House, Madina Bazar, Sonagazi, Feni
Weather Condition: Overcast

Analysis Results:

SL NO	Air Pollutants	Unit	Concentration Present	Value exposures	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	7.36	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	4.12	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	8.98	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.79	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	5.38	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	12.25	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	21.13	08 hrs (average)	100 (08Hrs)	G-100 IT1-160	

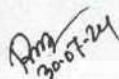
Note: *IT- Interim Target, G- Guideline; **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

Prepared by

Name: Md. Rafiqul Islam

Designation: Research Associate & Scientific Instrument In-Charge (addl.)

Signature:

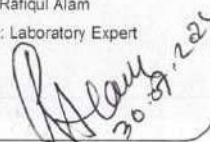


Approved by

Name: Md. Rafiqul Alam

Designation: Laboratory Expert

Signature:



Environmental Laboratory

Ref No. ELAB202407000078-4

Date: 30/07/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°48'46"N 91°22'26"E Sampling ID: AQ-04 Sampling Date: 15/07/2024

Monitoring Location (Administrative): Purba borodhali, Bunia market, Sonagazi, Feni

Weather Condition: Rainy

Analysis Results:

SL NO	Air Pollutants	Unit	Concentration Present	Value exposures	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	6.72	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	3.70	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	9.46	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.221	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	5.76	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	9.09	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	19.11	08 hrs (average)	100 (08Hrs)	G-100 IT1-160	

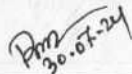
Note: *IT- Interim Target, G- Guideline. **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

Prepared by

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Signature:

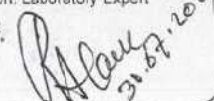


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Designation: Laboratory Expert

Signature:



Environmental Laboratory

Ref No. ELAB202407000078-3

Date: 30/07/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°48'11"N; 91°22'53"E Sampling ID: AQ-03 Sampling Date: 14/07/2024

Monitoring Location (Administrative): Darul Ulum Ahmadiya Madrasa, Bhuiya Bazar, Sonagazi, Feni
Weather Condition: Sunny

Analysis Results:

SL NO	Air Pollutants	Unit	Concentration Present	Value exposures	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	21.86	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	15.08	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	27.33	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.291	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	10.45	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	13.10	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	18.60	08 hrs (average)	100 (08Hrs)	G-100 IT1-160	

Note: *IT- Interim Target, G- Guideline; **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

Prepared by

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30.07.2024

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Environmental Laboratory

Ref No. ELAB202407000078-2

Date: 30/07/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°47'27"N; 91°22'18"E Sampling ID: AQ-02 Sampling Date: 13/07/2024

Monitoring Location (Administrative): Near to the Project Site, Sonagazi, Feni
Weather Condition: Rainy

Analysis Results:

SL. NO.	Air Pollutants	Unit	Concentration Present	Value exposures 24 hrs (average)	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	12.51	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	7.88	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	16.68	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	0.27	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	9.81	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	18.46	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	19.59	08 hrs (average)	100 (08Hrs)	G-100 IT1-160	

Note: *IT- Interim Target, G- Guideline; **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

Prepared by

Name: Md. Rafiqul Islam
Designation: Research Associate & Scientific Instrument In-Charge (addl.)
Signature:

Rafiqul Islam
30.07.24

Approved by

Name: Md. Rafiqul Alam
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Signature:

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30.07.2024

Environmental Laboratory

Ref No. ELAB202407000678-1

Date: 30/07/2024

Test Report Analysis of Ambient Air Quality Monitoring Report

Project Name: Environmental & Social Advisory services for a 100 MW Solar Power Plant at Feni. Project Code: MAP001

Location (Geographic): 22°47'59"N; 91°21'29"E Sampling ID: AQ-01 Sampling Date: 11-12/07/2024

Monitoring Location (Administrative): Adarsha gram Darul Ulum Madrasha, Sonagazi, Feni
Weather Condition: Sunny

Analysis Results:

Sl. NO.	Air Pollutants	Unit	Concentration Present	Value exposures	Bangladesh (DoE) Standard	IFC, 2007	Method
01	Particulate Matter (PM ₁₀)	µg/m ³	13.41	24 hrs (average)	150 (24Hrs)	G-50 IT1-150 IT2-100	Sensor based instrumentation method
02	Particulate Matter (PM _{2.5})	µg/m ³	8.72	24 hrs (average)	65 (24Hrs)	G-25 IT1-75 IT2-50	
03	Suspended Particulate Matter (SPM)	µg/m ³	15.78	24 hrs (average)	-	-	
04	Carbon Monoxide (CO)	mg/m ³	1.4	08 hrs (average)	05 (08 Hrs)	-	
05	Sulphur dioxide (SO ₂)	µg/m ³	9.41	24 hrs (average)	80 (24Hrs)	G-20 IT1-125 IT2-50	
06	Nitrogen dioxide (NO ₂)	µg/m ³	18.31	24 hrs (average)	80 (24Hrs)	-	
07	Ozone (O ₃)	µg/m ³	19.69	08 hrs (average)	100 (08Hrs)	G-100 IT1-160	

Note: *IT- Interim Target, G- Guideline. **Bold value** is applicable for Bangladesh context. US EPA approved Monitoring Equipment- AirSENCE Continuous Ambient Air Quality Micro Monitoring Station, Model-ELITE (Canada)

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30-07-24

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Name: Md. Rafiqul Alam
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30-07-2024

Appendix VIII: List of Identified Fish Species in the Study Area

12.8 List of Identified Fish Species in the Study Area

Order	Family	Scientific name	Common Name	Local name	Availability	IUCN regional	IUCN Global
Anguilliformes	Ophichthidae	<i>Pisodonophis cancrivorus</i>	Longfin Snake-Eel	Idura	Less Abundant	LC	LC
	Congridae	<i>Conger cinereus</i>	Longfin African Conger	Kailla/ Kamila	Less Abundant	NE	LC
Clupeiformes	Engraulidae	<i>Setipinna taty</i>	Scaly Hairfin Anchovy	Phaisa	Abundant	LC	LC
	Engraulidae	<i>Coilia reynaldi</i>	Reynald's Grenadier Anchovy	Olua	Abundant	NE	LC
	Pristigasteridae	<i>Raconda russeliana</i>	Raconda	Modhu Paia	Abundant	NE	LC
	Dorosomatidae	<i>Sardinella fimbriata</i>	Fringescale Sardinella	Kochuna/ Khaira	Less Abundant	NE	LC
	Engraulidae	<i>Coilia dussumieri</i>	Goldspotted Grenadier Anchovy	Olua	Most Abundant	LC	LC
	Dorosomatidae	<i>Escualosa thoracata</i>	White Sardine	Moila	Rare	NE	LC
Cypriniformes	Cobitidae	<i>Canthophrys gongota</i>	Gongota Loach	Pahari Gutum	Less Abundant	NT	LC
	Danionidae	<i>Chela laubuca</i>	Indian Glass Barb	Laubuca	Most Abundant	LC	NT
Gobiiformes	Oxudercidae	<i>Apocryptes bato</i>	Gobies	Ful Ciring	Abundant	LC	LC
	Gobiidae	<i>Trypauchen vagina</i>	Gobies	Sada Cheua	Less Abundant	LC	LC
	Gobiidae	<i>Odontamblyopus rubicundus</i>	Gobies	Cheua	Most Abundant	LC	LC
Mugiliformes	Mugilidae	<i>Mugil cephalus</i>	Flathead Grey Mullet	Khorul Bata	Abundant	LC	LC
	Mugilidae	<i>Rhinomugil corsula</i>	Corsula	Bata	Abundant	LC	LC
	Mugilidae	<i>Planiliza subviridis</i>	Greenback Mullet	Bata/ Sonali Bata	Most Abundant	NE	LC
	Mugilidae	<i>Planiliza parsia</i>	Goldspot Mullet	Faissa Bata	Most Abundant	NE	LC
	Sciaenidae	<i>Otolithoides pama</i>	Pama Croaker	Payra Poa	Abundant	LC	DD



Order	Family	Scientific name	Common Name	Local name	Availability	IUCN regional	IUCN Global
Perciformes	Polynemidae	<i>Polynemus paradiseus</i>	Paradise Threadfin	Topsi/Rilsha	Abundant	LC	LC
	Sillaginidae	<i>Sillaginopsis panijus</i>	Flathead Sillago	Hundura	Abundant	LC	NE
	Sciaenidae	<i>Johnius belangerii</i>	Belanger's Croaker	Lalpoa, Rupali	Abundant	NE	LC
	Sciaenidae	<i>Dendrophysa russelii</i>	Goatee Croaker	Dhari Poa/ Poa	Less Abundant	LC	LC
	Sciaenidae	<i>Johnius coitor</i>	Coitor Croaker	Coitor Poa	Less Abundant	NE	LC
	Sciaenidae	<i>Otolithes ruber</i>	Tigertooth Croaker	Poa	Most Abundant	NE	LC
	Cynoglossidae	<i>Paraplagusia bilineata</i>	Doblelined Tonguesole	Duirekha Kukur Jib	Abundant	LC	LC
	Cynoglossidae	<i>Cynoglossus cynoglossus</i>	Bengal Tongue Sole	Kukur Jeeb/ Churboti	Most Abundant	LC	LC
	Paralichthyidae	<i>Pseudorhombus elevatus</i>	Deep Flounder	Fali Sherboti	Most Abundant	NE	LC
	Platycephalidae	<i>Platycephalus indicus</i>	Bartail Flathead	Murbaila	Less Abundant	LC	DD
	Ariidae	<i>Osteogeneiosus militaris</i>	Soldier Catfish	Apuaia	Abundant	LC	LC
	Heteropneustidae	<i>Heteropneustes fossilis</i>	Stinging Catfish	Shinghi	Abundant	LC	LC
	Siluridae	<i>Wallago attu</i>	Wallago	Boal	Less Abundant	VU	VU
	Ailiidae	<i>Eutropiichthys vacha</i>	Vacha	Baacha	Most Abundant	LC	LC
	Bagridae	<i>Mystus vittatus</i>	Striped Dwarf Catfish	Tengra	Rare	LC	LC
	Ariidae	<i>Arius gajaga</i>	Gajaga Catfish	Kata Mach/ Gora Mach	Rare	NE	NT
	Bagridae	<i>Mystus cavasius</i>	Gangetic Mystus	Gulsha Tengra	Rare	NT	LC
	Mastacembelidae	<i>Macrognathus aculeatus</i>	Lesser Spiny Eel	Tara Baim	Rare	NT	LC

Appendix IX: Participants List of the PCM and FGDs

12.9 Participants List of the PCM and FGDs

Attendance sheet of PCM




স্থানঃ উপজেলা পরিষদ সভাকক্ষ, সোনাগাজী, ফেনী

তারিখঃ ০৪ জুলাই, ২০২৪ ইং

প্রস্তাবিত ফেনী জেলার সোনাগাজী উপজেলায় প্রস্তাবিত ১০০ মেগাওয়াট সোলার পাওয়ার প্লান্ট নির্মাণ প্রকল্পের পরিবেশগত ও সামাজিক প্রভাব নিরূপণ বিষয়ক

অবহিতকরণ ও মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

Sl. No.	Name	Designation	Age	Phone	Email	Signature
	Zahiruddin Muhammad Lipton	Upazila Chairman	50	01711324450	zumlipton@gmail.com	
	Dr. Rabindranath (Kokor)	Mayor Sonagazi	51	01819193650		
	Khadiza Khatun (Sonagazi)	Visa Chairman	40	01921913564		
	Tania Akter Lubna	Assistant Commissioner (Land)		01816633272		
	MAIN UDDIN AHMED	Upazila Agriculture Officer, Sonagazi	35	01714435804	uao.sonagazi@yahoo.com	
	Eng. Rafiqul Islam	RA, CEGIS PEMRD		01710564066		

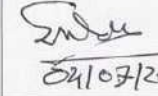
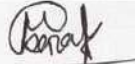
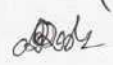


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তারিখঃ ০৪ জুলাই, ২০২৪ ইং

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Sl. No.	Name	Designation	Age	Phone	Email	Signature
	শ্রীঃ মোঃ মাহবুব হোসেন	প্রকল্প পরিচালক শ্রীঃ মোঃ মাহবুব হোসেন ফোনঃ ১৭০	৭৮	০৮ ৮২১৫০৮৪৪১১		
	ASIF MD IMRAN	MANAGER MARUBENI CORP.	41	01713189972		
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স্থানঃ উপজেলা পরিষদ সভাকক্ষ, সোনাগাজী, ফেনী

তারিখঃ ০৪ জুলাই, ২০২৪ ইং

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অবহিতকরণ ও মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

Sl. No.	Name	Designation	Age	Phone	Email	Signature
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	md. ibrahim	number 3. No		01852105143		
	মোঃ হান্নান হোসেন	ম্যানেজিং ব্যাংকিং অফিসার		01820066051		
	Baharullah Bahar	ইন্সপেক্টর সোনাগাজী অফিস		01789665181		
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	মোহাম্মদ হামিদ	অতিরিক্ত দৈনিক কানেকশন	35	01717959592		



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স্থান: উপজেলা পরিষদ সভাকক্ষ, সোনাগাজী, ফেনী

তারিখ: ০৪ জুলাই, ২০২৪ ইং

প্রস্তাবিত ফেনী জেলার সোনাগাজী উপজেলায় প্রস্তাবিত ১০০ মেগাওয়াট সোলার পাওয়ার প্লান্ট নির্মাণ প্রকল্পের পরিবেশগত ও সামাজিক প্রভাব নিরূপণ বিষয়ক
অবহিতকরণ ও মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

Sl. No.	Name	Designation	Age	Phone	Email	Signature
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	Mohammad Jafar ul Haq	Prin	43	01772987873	torubel@gmail.com	
	Md. Nazim Nabi	Teacher,	61	01815-840958		
	Jamir Uddin	Business		01768 387632		jamirire



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স্থানঃ উপজেলা পরিষদ সভাকক্ষ, সোনাগাজী, ফেনী

তারিখঃ ০৪ জুলাই, ২০২৪ ইং

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Sl. No.	Name	Designation	Age	Phone	Email	Signature
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	Md. Mosharof Hossain Milon	Chairman - 6. No. Charachay dia	32	01817384526	Mosharof milon2@gmail.com	
	Jamil Ahmmed	Station Officer Fire service	32	01733100665	Sonagazi.firm2018@gmail.com	
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স্থানঃ উপজেলা পরিষদ সভাকক্ষ, সোনাগাজী, ফেনী

তারিখঃ ০৪ জুলাই, ২০২৪ ইং

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Sl. No.	Name	Designation	Age	Phone	Email	Signature
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	Mr. Eusuf Sarker	Research Consultant		01746 78424		
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	এবিএম	Office Assistant		01703 627217		এবিএম
	Mohi Uddin	IT technician Upazila Sonagazi Union Office		0183 2670117		Mohi
	হাসানুল	Assistant Accountant		0182 5583658		হাসানুল



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স্থানঃ উপজেলা পরিষদ সভাকক্ষ, সোনাগাজী, ফেনী

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অবহিতকরণ ও মতবিনিময় সভায় অংশগ্রহণকারীদের তালিকা

Sl. No.	Name	Designation	Age	Phone	Email	Signature
	Md. Nurul Haque	Administrative Officer, Sonagazi Upazila		০১৫২১৩১৭৭২৭		Nurul Haque
	Khokan Chandrea Das	Deputy-Administrative Officer		০১৫১৫৫৩৫৬৭০		Khokan Chandrea Das
	মোঃ ইকবাল হোসেন সহকারী প্রকৌশলী	সহকারী প্রকৌশলী আবহিমানবিক বিভাগ		০১৫৭৫৩১৩৪৫		ইকবাল হোসেন

Attendance sheet of FGD with Farmer group

Participant list of Focus Group Discussion
ESIA Study of Proposed Feni 100 MW Solar Power Plant

Location: দাঃ ৫০ ফার্মার গ্রুপ (সোনগাজি, ব্রাহ্মণবাড়ী, চাঁদপুর) Date: ২০/০৮/২০

Farmer Group

Sl. No	Name	Occupation	Address/Mobile no.	Signature
১	শ্রী ৩ মনু	কৃষক	০১৮২৪৪১০১০৬	শ্রী ৩ মনু
২	শ্রী ৩ মনু	কৃষক	০১৮৬৪১৪২৮৩৬	শ্রী ৩ মনু
৩	শ্রী ৩ মনু	কৃষক	০১৮২৯৭৭৭৮৪৩	শ্রী ৩ মনু
৪	শ্রী ৩ মনু	কৃষক	০১৮২৫৪৫৪০৭৭	শ্রী ৩ মনু
৫	শ্রী ৩ মনু	কৃষক	-	শ্রী ৩ মনু
৬	শ্রী ৩ মনু	কৃষক	০১৮৬৭০৮৫০২	শ্রী ৩ মনু
৭	শ্রী ৩ মনু	কৃষক	-	শ্রী ৩ মনু
৮	শ্রী ৩ মনু	কৃষক	০১৮১৩৮৭১৭৩	শ্রী ৩ মনু
৯	শ্রী ৩ মনু	কৃষক	০১৮৫৫৫১৩৬৫১	শ্রী ৩ মনু
১০	শ্রী ৩ মনু	কৃষক	০১৮১১১১১১১১	শ্রী ৩ মনু



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House No. 6, Road No. 23/C, Gulshan-1, Dhaka-1212, Bangladesh

Participant list of Focus Group Discussion
ESIA Study of Proposed Feni 100 MW Solar Power Plant

Location: Date:

Sl. No	Name	Occupation	Address/Mobile no.	Signature
১১	শ্রী ৩ মনু	কৃষক	০১৮২০ ৮৮৮ ৮৮৮	শ্রী ৩ মনু
১২	শ্রী ৩ মনু	কৃষক	০১৮১৭ ০৭৬২৬৭	শ্রী ৩ মনু



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Attendance sheet of FGD with Labor group

Participant list of Focus Group Discussion
ESIA Study of Proposed Feni 100 MW Solar Power Plant

Location: সুপার মার্কেট, পি.এম.ই.এ. রোড, সোনাগাজি, (সোনগাজি) Date: ২০/০৪/১৮

labor group

Sl. No	Name	Occupation	Address/Mobile no.	Signature
০১	মিস্টার সোহাগ	কৃষিকর্ম	-	স্বাক্ষর
০২	মিস্টার সোহাগ	"	০১৪২০ ২৪৪ ৭৭২	স্বাক্ষর
০৩	মিস্টার সোহাগ	"	-	স্বাক্ষর
০৪	মিস্টার সোহাগ	"	-	স্বাক্ষর
০৫	মিস্টার সোহাগ	কৃষি + শ্রমিক	-	-
০৬	মিস্টার সোহাগ	কৃষি	০১৪৫৭ ৭৭৭ ৭৭২	স্বাক্ষর
০৭	মিস্টার সোহাগ	শ্রমিক	০১৪৪৭২ ৭৫৭ ৭৭	স্বাক্ষর
০৮	মিস্টার সোহাগ	শ্রমিক	০১৪২৭ ৫৭৪৪০৭	স্বাক্ষর
০৯	মিস্টার সোহাগ	শ্রমিক	-	স্বাক্ষর
১০	মিস্টার সোহাগ	শ্রমিক	০১৪৫৬৬ ১১৭৬৭	স্বাক্ষর

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(A Public Trust under The Ministry of Water Resources)
House No. 6, Road No. 23/C, Gulshan-1, Dhaka-1212, Bangladesh

Participant list of Focus Group Discussion
ESIA Study of Proposed Feni 100 MW Solar Power Plant

Location: _____ Date: _____

Sl. No	Name	Occupation	Address/Mobile no.	Signature
০১	মিস্টার সোহাগ	কৃষি + শ্রমিক	০১৪৭২-৫৭৫৪৫৩	- স্বাক্ষর
০২	মিস্টার সোহাগ	কৃষিকর্ম	-	-
০৩	মিস্টার সোহাগ	কৃষিকর্ম	০১৪৬৬ ৭২৭৬৩৭	-
০৪	মিস্টার সোহাগ	কৃষি + শ্রমিক	০১৪২০-২৬৩১৭১	স্বাক্ষর

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Attendance sheet of FGD with Women group

Women Group

Participant list of Focus Group Discussion
ESIA Study of Proposed Feni 100 MW Solar Power Plant

Location: Purua Baradhuli Date: 29.05.24

Sl. No	Name	Occupation	Address/Mobile no.	Signature
01.	আলোয়ারা বেগম	গৃহিণী	01859339576	আলোয়ারা বেগম
02.	সাহিন আক্তার	গৃহিণী	01887-031648	সাহিন আক্তার
03.	জোয়াব্বা বেগম	গৃহিণী	01824042043	জোয়াব্বা বেগম
04.	রাতিয়া বেগম	গৃহিণী	01850257665	রাতিয়া বেগম
05.	সাহিন আক্তার খাতুন	গৃহিণী	01825681516	সাহিন আক্তার
06.	আলম	গৃহিণী	01880465843	আলম
07.	কোরনা আক্তার	গৃহিণী	01880125552	কোরনা
08.	বিবি কল্যাণ	গৃহিণী	01889511882	বিবি কল্যাণ
09.	সাহিন	গৃহিণী	01883271978	সাহিন
10.	নুসরাত জাহান	গৃহিণী	0189977843	নুসরাত জাহান

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Participant list of Focus Group Discussion
ESIA Study of Proposed Feni 100 MW Solar Power Plant

Location: _____ Date: _____

Sl. No	Name	Occupation	Address/Mobile no.	Signature
১	নুসরাত জাহান			
২	বিবি আক্তার	গৃহিণী	01854045866	বিবি আক্তার
৩	বিবি আক্তার	গৃহিণী	01869137928	বিবি আক্তার
৪	নুসরাত জাহান	গৃহিণী	01606915635	নুসরাত জাহান
৫	ইসরাত জাহান	গৃহিণী	01892739367	ইসরাত জাহান
৬	আনজু	গৃহিণী	01331029812	আনজু
৭	আক্তার	গৃহিণী	01897161090	আক্তার
৮	আক্তার	গৃহিণী	01887964233	আক্তার
৯	নুসরাত জাহান	গৃহিণী	01890874146	নুসরাত জাহান
১০	বিবি আক্তার	গৃহিণী	01862943186	বিবি আক্তার

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Participants list of FGD with Mixed Group

"Development of Solar PV Project at Sonagazi, Feni, Bangladesh"



List of Participants in Focus Group Discussion (FGD)

Address: সুজা বজাৰী, ২৪৪৬৬৬৬৬, (মাদারগাঁও, ঢাকা)
 GPS: ২২.৪০২৭৭৭, ৭১.৩৭২৭১১
 Date: ২৩/১২/২৪ Time: ১০:৩৫ am

SL No.	Participant's Name	Age	Occupation	Telephone No.	Signature
1	Md. Manik	65	Farmer	—	মানিক
2	Rubei	32		01856230936	রুবী
3	Riyad	32		01845546369	রিয়াদ
4	Md. Saif Uddin	45		01813385527	ম. সাইফ উদ্দিন
5	Mahin Uddin	40	Business	01874303630	মাহিন উদ্দিন
6	Saifur Islam	26	Farmer	01892984075	সাইফুর ইসলাম
7	Md. Ekramul Haque	36		01819675904	একরাম হােক
8	Abul khayer	52		—	আবুল খায়ের
9	Mamun	35	Driver	01874141632	মামুন
10	Abul Basmat	55	Farmer	—	আবুল বাসমত
11	Shagon	22	Misthi	01890033753	শাগন
12	Md. Al-mamun	32	EGCB Service	01945112061	ম. আল মামুন
13	Badsha Mia	31	Business	01811115312	ম. বাদশা মিয়া
14	Dulal Hossain	30	Farmer	—	দুলাল হোসেন
15	Anwar Hossain	45		01897101887	আনোয়ার হোসেন
16	Khatishid Alam	40	Fisherman	01892970024	খাতিশিদ আলম

Facilitated By Md. Faruk Rahman

Signature [Signature]



"Development of Solar PV Project at Sonagazi, Feni, Bangladesh"

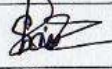
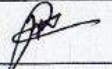
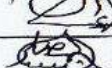
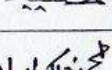
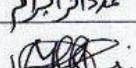
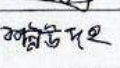


List of Participants in Focus Group Discussion (FGD)

Address: Adonskogram Danu ulum Asmatia madrasa and Orphanage, Sonagazi, Feni

GPS: 22.800022, 91.359818

Date: 23/12/24 Time: 11:40 Am

SL No.	Participant's Name	Age	Occupation	Telephone No.	Signature
1	Mawlana Abu Toiyob	40	Madrasa Head Teacher	01811221769	
2	Shohid Alam	32	Teacher	01821504218	
3	Abdur Rahim	40	Business	01622509063	
4	Nizam Uddin	39	Grammar Doctor	01835279524	N. uddin
5	Dr. Mohammad Mostafa	60	Madrasa President	01827962476	
6	Abdul Haque	35	Teacher	01822480423	
7	Hafiz Imran	22	Imam	01731280796	
8	Mawlana Asan Hossain	36	Teacher	01812782574	
9	Md. Jakir Abdur	20	II	01605284356	
10	MD. FARHAD ALI	42	Govt Job	0171751568	
11	md Al-mamun	43	EGCB service	01945112061	
12	Md. Shohidul Molah	45	Farmer	—	

Facilitated By: Md. Bappy Rahman

Signature: 

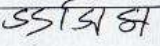
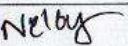
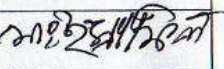
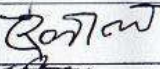
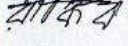
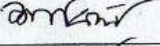
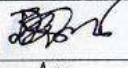


"Development of Solar PV Project at Sonagazi, Feni, Bangladesh"



List of Participants in Focus Group Discussion (FGD)

Address: Adanshayan, Sultan Shoudayan Shop, Sonagazi, Feni
GPS: 22.802851, 91.363723
Date: 23/12/24 Time: 09:45 am

SL No.	Participant's Name	Age	Occupation	Telephone No.	Signature
1	Foyez Kabin	29	Farmer	01859439903	
2	Md. Joshim Uddin	50	Business	01875902021	
3	Niloy	22	Student	01872132211	
4	Arman	20	Student	01822946142	
5	Rakib	16	Student	—	
6	Md. Ismail	27	Business	01864029619	
7	Iqbal Hossain	52	"	01626070953	
8	Rakib	22	"	01754686081	
9	Md. Al-raman	32	Electric Service	01945112061	
10	Shakil	20	Farmer	01838032358	
11	Master Md. Mofizul Haque	59	Assistant Head Teacher	0181916508	
12	Moniruzzaman	33	Farmer	01915842455	
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14					
15					
16					

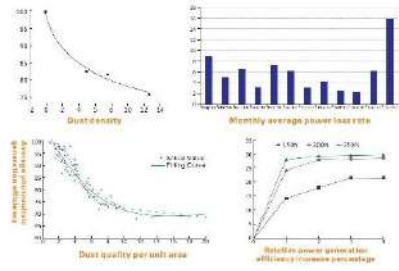
Facilitated By Md. Bappy Rahman

Signature 



Appendix X: Technical Description of Solar Cleaning System

12.10 Technical Description of Solar Cleaning System

 Technological aspects of solar panel cleaning system and water usage Scube Technologies Ltd. 74, Mirpur Road (2nd Floor), Dharmindal, Dhaka-1205 	 Introduction As the adoption of solar energy continues to grow, the maintenance of solar panels becomes increasingly important to ensure optimal efficiency. This report explores the technological aspects of semi-automatic solar panel cleaning systems and their implications for water usage. Importance of Solar Cleaning System One of the main elements influencing the production efficiency of solar energy is dust. The energy output of photovoltaic power plants will be significantly reduced by dust pollution. At least 5% annually is estimated. The global installation capacity is projected to reach 500 GW by 2025, based on estimations, up to \$5 billion will be lost economically each year because of the reduction in dust in electricity generation. This loss will increase in severity as the power plants' installed capacity rises. The estimated cost of the economic losses due to dust is \$1.3 billion by 2030, when the global installation capacity reaches 1,400 GW.  Scube Technologies Limited Registered Office : 74, Mirpur Road (2nd Floor), Dharmindal, Dhaka-1205, Bangladesh g.scube@scubetechnologies.com.bd  
 According to measurements, the dust and dirt on the surface of the modules caused an average annual reduction in power efficiency of 6%. During periods of lack of rain, the power efficiency loss can reach 15% or more due to accumulated dirt on the modules. Semi-Automatic Cleaning System Semi-automatic cleaning systems typically involve a combination of manual intervention and automated processes. Operators may guide cleaning tools or equipment across the surface of solar panels, enhancing the efficiency of cleaning while reducing the need for extensive manual labor. Cleaning Mechanisms Semi-automatic cleaning systems often employ rotating brushes or soft bristles to remove dirt and debris from the surface of solar panels. These brushes may be manually operated or integrated into automatic cleaning equipment. Water Usage Optimization Semi-automatic cleaning systems aim to optimize water usage by delivering water precisely to the areas requiring cleaning, which can greatly save water, save costs, and improve cleaning efficiency in Bangladesh weather conditions. Techniques such as targeted spraying help conserve water while effectively removing dirt from solar panels. Recirculation and filtration These semi-automatic systems incorporate water recirculation and filtration mechanisms to minimize water consumption and maintain water quality. Recycled water can be filtered and reused for subsequent cleaning cycles, reducing the overall water demand. Data analysis Scube Technologies Limited Registered Office : 74, Mirpur Road (2nd Floor), Dharmindal, Dhaka-1205, Bangladesh g.scube@scubetechnologies.com.bd  	 By collecting data on cleaning cycles, water consumption, and panel performance, semi-automatic systems enable operators to analyze trends and identify opportunities for further optimization, enhancing overall efficiency and sustainability. The project of Western Mangrove Solar Power Limited (WM/SPL) will be installed on an island in Gashat, Hail Hat Union, Mangrove Island, Mangrove, Bhola, Bangladesh. The area has a low dust ratio, which means that the solar panels will require less cleaning and less water consumption compared to other regions in Bangladesh. That's why we are choosing this type of semi-automatic solar cleaning system, which reduces water consumption as well as easily maintains the cleaning cycle for better output. Also, these semi-automatic cleaning systems' spare parts are available in local markets, making maintenance easier. Conclusion Semi-automatic solar panel cleaning systems offer a balance between manual intervention and automation, providing efficient solutions for maintaining the cleanliness and performance of solar energy systems. By optimizing water usage and incorporating advanced monitoring capabilities, these systems contribute to the sustainability and effectiveness of solar energy as a renewable resource. Scube Technologies Limited Registered Office : 74, Mirpur Road (2nd Floor), Dharmindal, Dhaka-1205, Bangladesh g.scube@scubetechnologies.com.bd  

Solar Cleaning Machine One of the key factors affecting the efficiency of solar power generation is dust pollution. It will greatly reduce the energy generation of photovoltaic power plants, estimated at about 3% per year. Scube Technologies Limited Powering Solarly Why Clean Solar Solar panels work by allowing light into them to work. The more light that hits the panels, the more power they produce. Due to the upward angle of solar panels, they are more prone to dust and dirt. This dust will reduce the amount of light hitting the panels and reduce the output. As the projected energy figures claimed by solar panel manufacturers are based on the optimum performance of clean solar panels, this build-up of dirt can severely affect the panels' ability to meet the project goals. So it is important to clean solar panels in order to protect and maximize your investment. Regular solar panel cleaning will also help you to make the most of the government feed-in tariff. While solar panel cleaning is the world's relatively new, in other parts of the world solar panel cleaning has been around for a long time. This long experience has made us know that if the solar panel cleaning is done regularly, they would get up at their optimum performance. Dry Cleaning The water during brush has the characteristic of low water consumption, strong adaptability and high conversion rate, which can greatly save water resources and improve economic efficiency. Increase Power Generation in winter It can increase the power generation of photovoltaic power plants in winter, increase the power generation income of power stations in winter, and reduce the loss caused by snow on the ground heating system. Cleaning Bird Droppings The brush head is light, the point of attachment is accurate, the dust falls off power lines and the cleaning process is simple. ☎ +86 0358625149 📍 24, Mingpu Road, Duanmenli, Daxia 1105 ✉ info@scube.com.cn	Solar Cleaning Machine (STL-SCM01) Technical Parameter <table border="1"> <tr><td>Maximum pole length number of machine</td><td>5.4m</td></tr> <tr><td>Max. length</td><td>8m</td></tr> <tr><td>Max. diameter of telescopic pole</td><td>140mm</td></tr> <tr><td>Length of pole pipe</td><td>2m</td></tr> <tr><td>Cleaning Width</td><td>1050mm</td></tr> <tr><td>Polishing and W.C. thickness</td><td>2mm</td></tr> <tr><td>Motor</td><td>12V 200W 24V 400W 36V 600W 48V 800W 60V 1000W 72V 1200W 96V 1600W 110V 2000W 120V 2200W 144V 2800W 168V 3600W 192V 4800W 216V 6000W 240V 7200W 288V 8640W 312V 9360W 336V 10080W 360V 10800W 384V 11520W 408V 12288W 432V 12960W 456V 13632W 480V 14400W 504V 15120W 528V 15840W 552V 16512W 576V 17280W 600V 18000W 624V 18720W 648V 19440W 672V 20160W 696V 20832W 720V 21600W 744V 22368W 768V 23040W 792V 23616W 816V 24192W 840V 24768W 864V 25344W 888V 25920W 912V 26496W 936V 27072W 960V 27648W 984V 28224W 1008V 28800W 1032V 29376W 1056V 29952W 1080V 30528W 1104V 31104W 1128V 31680W 1152V 32256W 1176V 32832W 1200V 33408W 1224V 33984W 1248V 34560W 1272V 35136W 1296V 35712W 1320V 36288W 1344V 36864W 1368V 37440W 1392V 38016W 1416V 38592W 1440V 39168W 1464V 39744W 1488V 40320W 1512V 40896W 1536V 41472W 1560V 42048W 1584V 42624W 1608V 43200W 1632V 43776W 1656V 44352W 1680V 44928W 1704V 45504W 1728V 46080W 1752V 46656W 1776V 47232W 1800V 47808W 1824V 48384W 1848V 48960W 1872V 49536W 1896V 50112W 1920V 50688W 1944V 51264W 1968V 51840W 1992V 52416W 2016V 53000W 2040V 53584W 2064V 54168W 2088V 54752W 2112V 55336W 2136V 55920W 2160V 56504W 2184V 57088W 2208V 57672W 2232V 58256W 2256V 58840W 2280V 59424W 2304V 60008W 2328V 60592W 2352V 61176W 2376V 61760W 2400V 62344W 2424V 62928W 2448V 63512W 2472V 64096W 2496V 64680W 2520V 65264W 2544V 65848W 2568V 66432W 2592V 67016W 2616V 67600W 2640V 68184W 2664V 68768W 2688V 69352W 2712V 69936W 2736V 70520W 2760V 71104W 2784V 71688W 2808V 72272W 2832V 72856W 2856V 73440W 2880V 74024W 2904V 74608W 2928V 75192W 2952V 75776W 2976V 76360W 3000V 76944W 3024V 77528W 3048V 78112W 3072V 78696W 3096V 79280W 3120V 79864W 3144V 80448W 3168V 81032W 3192V 81616W 3216V 82200W 3240V 82784W 3264V 83368W 3288V 83952W 3312V 84536W 3336V 85120W 3360V 85704W 3384V 86288W 3408V 86872W 3432V 87456W 3456V 88040W 3480V 88624W 3504V 89208W 3528V 89792W 3552V 90376W 3576V 90960W 3600V 91544W 3624V 92128W 3648V 92712W 3672V 93296W 3696V 93880W 3720V 94464W 3744V 95048W 3768V 95632W 3792V 96216W 3816V 96800W 3840V 97384W 3864V 97968W 3888V 98552W 3912V 99136W 3936V 99720W 3960V 100304W 3984V 100888W 4008V 101472W 4032V 102056W 4056V 102640W 4080V 103224W 4104V 103808W 4128V 104392W 4152V 104976W 4176V 105560W 4200V 106144W 4224V 106728W 4248V 107312W 4272V 107896W 4296V 108480W 4320V 109064W 4344V 109648W 4368V 110232W 4392V 110816W 4416V 111400W 4440V 111984W 4464V 112568W 4488V 113152W 4512V 113736W 4536V 114320W 4560V 114904W 4584V 115488W 4608V 116072W 4632V 116656W 4656V 117240W 4680V 117824W 4704V 118408W 4728V 118992W 4752V 119576W 4776V 120160W 4800V 120744W 4824V 121328W 4848V 121912W 4872V 122496W 4896V 123080W 4920V 123664W 4944V 124248W 4968V 124832W 4992V 125416W 5016V 126000W 5040V 126584W 5064V 127168W 5088V 127752W 5112V 128336W 5136V 128920W 5160V 129504W 5184V 130088W 5208V 130672W 5232V 131256W 5256V 131840W 5280V 132424W 5304V 133008W 5328V 133592W 5352V 134176W 5376V 134760W 5400V 135344W 5424V 135928W 5448V 136512W 5472V 137096W 5496V 137680W 5520V 138264W 5544V 138848W 5568V 139432W 5592V 140016W 5616V 140600W 5640V 141184W 5664V 141768W 5688V 142352W 5712V 142936W 5736V 143520W 5760V 144104W 5784V 144688W 5808V 145272W 5832V 145856W 5856V 146440W 5880V 147024W 5904V 147608W 5928V 148192W 5952V 148776W 5976V 149360W 6000V 149944W 6024V 150528W 6048V 151112W 6072V 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193160W 7800V 193744W 7824V 194328W 7848V 194912W 7872V 195496W 7896V 196080W 7920V 196664W 7944V 197248W 7968V 197832W 7992V 198416W 8016V 199000W 8040V 199584W 8064V 200168W 8088V 200752W 8112V 201336W 8136V 201920W 8160V 202504W 8184V 203088W 8208V 203672W 8232V 204256W 8256V 204840W 8280V 205424W 8304V 206008W 8328V 206592W 8352V 207176W 8376V 207760W 8400V 208344W 8424V 208928W 8448V 209512W 8472V 210096W 8496V 210680W 8520V 211264W 8544V 211848W 8568V 212432W 8592V 213016W 8616V 213600W 8640V 214184W 8664V 214768W 8688V 215352W 8712V 215936W 8736V 216520W 8760V 217104W 8784V 217688W 8808V 218272W 8832V 218856W 8856V 219440W 8880V 220024W 8904V 220608W 8928V 221192W 8952V 221776W 8976V 222360W 9000V 222944W 9024V 223528W 9048V 224112W 9072V 224696W 9096V 225280W 9120V 225864W 9144V 226448W 9168V 227032W 9192V 227616W 9216V 228200W 9240V 228784W 9264V 229368W 9288V 230000W 9312V 230584W 9336V 231168W 9360V 231752W 9384V 232336W 9408V 232920W 9432V 233504W 9456V 234088W 9480V 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12728V 313512W 12752V 314096W 12776V 314680W 12800V 315264W 12824V 315848W 12848V 316432W 12872V 317016W 12896V 317600W 12920V 318184W 12944V 318768W 12968V 319352W 12992V 319936W 13016V 320520W 13040V 321104W 13064V 321688W 13088V 322272W 13112V 322856W 13136V 323440W 13160V 324024W 13184V 324608W 13208V 325192W 13232V 325776W 13256V 326360W 13280V 326944W 13304V 327528W 13328V 328112W 13352V 328696W 13376V 329280W 13400V 329864W 13424V 330448W 13448V 331032W 13472V 331616W 13496V 332200W 13520V 332784W 13544V 333368W 13568V 333952W 13592V 334536W 13616V 335120W 13640V 335704W 13664V 336288W 13688V 336872W 13712V 337456W 13736V 338040W 13760V 338624W 13784V 339208W 13808V 339792W 13832V 340376W 13856V 340960W 13880V 341544W 13904V 342128W 13928V 342712W 13952V 343296W 13976V 343880W 14000V 344464W 14024V 345048W 14048V 345632W 14072V 346216W 14096V 346800W 14120V 347384W 14144V 347968W 14168V 348552W 14192V 349136W 14216V 349720W 14240V 350304W 14264V 350888W 14288V 351472W 14312V 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19112V 468856W 19136V 469440W 19160V 470024W 19184V 470608W 19208V 471192W 19232V 471776W 19</td></tr></table>	Maximum pole length number of machine	5.4m	Max. length	8m	Max. diameter of telescopic pole	140mm	Length of pole pipe	2m	Cleaning Width	1050mm	Polishing and W.C. thickness	2mm	Motor	12V 200W 24V 400W 36V 600W 48V 800W 60V 1000W 72V 1200W 96V 1600W 110V 2000W 120V 2200W 144V 2800W 168V 3600W 192V 4800W 216V 6000W 240V 7200W 288V 8640W 312V 9360W 336V 10080W 360V 10800W 384V 11520W 408V 12288W 432V 12960W 456V 13632W 480V 14400W 504V 15120W 528V 15840W 552V 16512W 576V 17280W 600V 18000W 624V 18720W 648V 19440W 672V 20160W 696V 20832W 720V 21600W 744V 22368W 768V 23040W 792V 23616W 816V 24192W 840V 24768W 864V 25344W 888V 25920W 912V 26496W 936V 27072W 960V 27648W 984V 28224W 1008V 28800W 1032V 29376W 1056V 29952W 1080V 30528W 1104V 31104W 1128V 31680W 1152V 32256W 1176V 32832W 1200V 33408W 1224V 33984W 1248V 34560W 1272V 35136W 1296V 35712W 1320V 36288W 1344V 36864W 1368V 37440W 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Maximum pole length number of machine	5.4m														
Max. length	8m														
Max. diameter of telescopic pole	140mm														
Length of pole pipe	2m														
Cleaning Width	1050mm														
Polishing and W.C. thickness	2mm														
Motor	12V 200W 24V 400W 36V 600W 48V 800W 60V 1000W 72V 1200W 96V 1600W 110V 2000W 120V 2200W 144V 2800W 168V 3600W 192V 4800W 216V 6000W 240V 7200W 288V 8640W 312V 9360W 336V 10080W 360V 10800W 384V 11520W 408V 12288W 432V 12960W 456V 13632W 480V 14400W 504V 15120W 528V 15840W 552V 16512W 576V 17280W 600V 18000W 624V 18720W 648V 19440W 672V 20160W 696V 20832W 720V 21600W 744V 22368W 768V 23040W 792V 23616W 816V 24192W 840V 24768W 864V 25344W 888V 25920W 912V 26496W 936V 27072W 960V 27648W 984V 28224W 1008V 28800W 1032V 29376W 1056V 29952W 1080V 30528W 1104V 31104W 1128V 31680W 1152V 32256W 1176V 32832W 1200V 33408W 1224V 33984W 1248V 34560W 1272V 35136W 1296V 35712W 1320V 36288W 1344V 36864W 1368V 37440W 1392V 38016W 1416V 38592W 1440V 39168W 1464V 39744W 1488V 40320W 1512V 40896W 1536V 41472W 1560V 42048W 1584V 42624W 1608V 43200W 1632V 43776W 1656V 44352W 1680V 44928W 1704V 45504W 1728V 46080W 1752V 46656W 1776V 47232W 1800V 47808W 1824V 48384W 1848V 48960W 1872V 49536W 1896V 50112W 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455424W 18584V 456008W 18608V 456592W 18632V 457176W 18656V 457760W 18680V 458344W 18704V 458928W 18728V 459512W 18752V 460096W 18776V 460680W 18800V 461264W 18824V 461848W 18848V 462432W 18872V 463016W 18896V 463600W 18920V 464184W 18944V 464768W 18968V 465352W 18992V 465936W 19016V 466520W 19040V 467104W 19064V 467688W 19088V 468272W 19112V 468856W 19136V 469440W 19160V 470024W 19184V 470608W 19208V 471192W 19232V 471776W 19														



Solar Cleaning Machine (STL-SCM04)

Technical Parameter

Product Size (mm)	950*1200*1100
Size	400mm*240mm*160mm
Load Capacity	250kg
Cleaning Efficiency	40-50%/hour
Roll Length	100m
Load Capacity	250kg
Motor Voltage (V)	220V
Power (kW)	2.2
Operating Voltage	110/220V
Output Voltage	1-4

Product Feature

- High quality, strong, durable materials.
- Simple to use, easy to clean with manual operation.
- Other features as standard or as required.
- High efficiency and low maintenance.

Product Description



Electronic cable

Universal cable

Universal cable

Universal cable



Appendix XI: PV Panel Decommissioning & Associated Waste Management Procedures by Suppliers

12.11 PV Panel Decommissioning & Associated Waste Management Procedures by Suppliers



Instructions to prepare the Collection: - It is strongly advised to use the PV panels and components in the PV cycle collection bins only. Do not use the bins for other waste. - Before PV cycle collection, ensure the waste is properly packed in the bins. The bins should be properly sealed and labeled. - PV panels and components should be properly packed in the bins. The bins should be properly sealed and labeled. - PV panels and components should be properly packed in the bins. The bins should be properly sealed and labeled.	Safety instructions: Preventing accidents helps everyone's safety and health. Do not drink or eat from the bins. Do not use the bins for other waste. Do not use the bins for other waste. Do not use the bins for other waste. 	Examples of properly packed PV panel waste  PV panels and components should be properly packed in the bins. The bins should be properly sealed and labeled.
Examples of incorrectly packed PV Panel waste  PV panels and components should be properly packed in the bins. The bins should be properly sealed and labeled.	What do we NOT collect?  Batteries and solar inverters are not collected.	SPECIAL CASES?  PV panels and components should be properly packed in the bins. The bins should be properly sealed and labeled.