

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

of

2.517 MWp Solar Roof-top Project of Fakhruddin Textile Mills Limited

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Prepared By



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Abbreviations

AAQ	Ambient Air Quality
AC	Alternative Current
AEZs	Agro-ecological Zones
ARC	Anti-Reflective Coating
BBS	Bangladesh Bureau of Statistics
BNBC	Bangladesh National Building Code
BOD	Biological Oxygen Demand
BOD ₅	Biological Oxygen Demand in %5days
CdTe	Cadmium Telluride
CEAP	Construction Environmental Action Plan
CIS	Copper Indium Di Selenide
CITES	Convention on International Trade in Endangered Species
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
DC	Direct Current
DDP	Development Project Proposal
DIA	Disaster Impact Assessment
DO	Dissolved Oxygen
DoE	Department of Environment
DPHE	Department of Public health Engineering
DPP	Department of Public health Engineering
ECA	Environment Conservation Act
ECA'95	Environment Conservation Act 1995
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
EHS	Environmental, Health, and Safety
EIA	Environmental Impact Assessment
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EPI	Expanded Programme on Immunization
EQS	Environment Quality Standards
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 Plan
ESS	Environmental and Social Standards

FGD	Focus Group Discussion
FTML	Fakhruddin Textile Mills Limited
GaAs	Gallium Arsenide
GHGs	Greenhouse Gases
GIS	Geographical Information System
GoB	Government of Bangladesh
GPS	Global Positioning System
GW	Ground Water
IDCOL	Infrastructure Development Company Limited
IEE	Initial Environmental Examination
IFC	International Finance Corporation
ILC	International Labor Conventions
IPCC	Intergovernmental Panel on Climate Change
IPF	Investment Project Financing
IUCN	International Union for Conservation of Nature
KPI	Key performance indicators
LGED	Local Government Engineering Department
MFF	Multitranches financing facility
MoEFCC	Ministry of Environment, Forest and Climate Change
MSDS	Material Safety Data Sheet
NAPA	National Adaptation Programme on Action
NCS	National Conservation Strategy
NEM	Net Energy Metering
NEMAP	National Environmental Management Action Plan
NEP	National Energy Policy
NOC	No Objection Certificate
NO _x	Oxides of Nitrogen
OSHA	Occupational Safety and Health Administration
PBBs	Polybrominated Biphenyls
PBDEs	Brominated Di-Phenyl Ethers
PM	Particulate Matter
PM	Project Manager
PMU	Project Management Unit
PPE	personal Protective Equipment
PSMP	Power Sector Master Plan
PV	Photovoltaic
RAJUK	Rajdhani Unnayan Karttripakkha
SEP	Stakeholders' Engagement Plan

SLM	Sound Level Meter
SO _x	Oxides of Sulphur
SPM	Suspended particulate matter
SREDA	Sustainable and Renewable Energy Development Agency
TMP	Traffic Management Plan
ToR	Terms of References
TSS	Total Suspended Solids
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank

Executive Summary

Introduction

One important goal for any developing country is to establish and provide electric power for its citizens; an aim initiated by the Government of Bangladesh many years ago. Renewable energy is a key component for development and Bangladesh has already made significant expand in reaching most of the country's population; both in Urban and Rural areas.

With the invention of solar based technologies and the current global trend of reduction in solar panel costs, electricity generated using solar based technologies is expected to become cheaper than electricity generated from traditional sources. Thus, different industries are being encouraged to install solar PV based power plants to save electricity expenses in future. Current electricity cost from solar plant is almost similar to grid tariff which is expected to be cheaper than grid tariff in future due to the constant fall in price in solar based technologies vs expected rise in grid tariff to minimize gap between generation cost and tariff.

The government is gradually meeting part of the lighting and cooling load of public offices by installing solar panels. The national capacity of solar power development currently exceeds 150 MW. Most of the capacity addition is from Solar Home Systems (SHS) implemented by Infrastructure Development Company Limited (IDCOL), a government-owned financial institution. Until recently, more than 3 million SHSs have been installed with aggregated capacity of about 135 MW. The unutilized solar energy can also be feed to the grid. The Net meter will record that export of electric energy to the grid. End of the month the industry will be charged for the net.

Project Description

The project is located at Gargaria, Masterbai, Sreepur, Gazipur, Bangladesh. It can be reached in this direction from Dhaka to project site via Gazipur Chowrasta. The project will be carried out on the Fakhruddin Textile Mills Ltd.'s rooftop. The factory is steel-structured, and the rooftop is made up of tin sheds, with a total accessible space of 311,917 square feet. The plant capacity of a roof-top solar power project is primarily determined by available space and load with other considerations including shading effect, building orientation, tilt angle, load-bearing capability, and backup generator capacity.

The factory proposed a project of 2.517 MWp rooftop solar project on their industrial rooftop. In the proposed system two main equipment will be used which are panels and inverters. Sun shines on the solar panels to generate DC electricity. The DC electricity produced from the solar panel will be converted to 'Zero Export Controller' will be used to ensure 'Net Zero Export' The aggregated installed capacity of the project will be 2.517 MWp 440V 3-phase AC using the inverters. Then, the energy will be fed into the bus bars of industry.

Methodology

As there is limited secondary information on the environmental quality and ecology of the study area, the Consultant used a variety of approaches and procedures to examine the planned project's environmental challenges. These included desktop review of the background information, GIS mapping, reconnaissance survey, consultation with stakeholders and community members and professional judgment. Geographical Information Systems (GIS) was used as a specialized analysis and presentation tool. A review was conducted of the physical, biological and legal literature relevant to the project. The review of secondary sources and informal initial field investigations were undertaken in order to prepare a preliminary assessment of the physical and social environment, biodiversity and conservation significance of the identified study area. This preliminary literature review also assisted in identifying data gaps, which would require collection of additional primary information through physical field survey. Primary data of physical, biological and sociocultural environment was collected to comprehensively evaluate the existing project area baseline conditions. The environmental quality assessment in the project influence area

has been carried out. The sampling focused on air quality, noise, surface water and groundwater quality. The resulting data provided information on existing conditions against which predictions of changes and field measurements during the construction period will be compared in order to assess change and its significance.

Legal and Policy Framework

Legislative bases for Environmental Impact Assessment (EIA) in Bangladesh are the Environment Conservation Act 1995 (ECA'95, as amended in 2010) and the Environment Conservation Rules 1997 (ECR'97). Department of Environment (DoE), under the Ministry of Environment, Forest & Climate Change (MoEFCC) is the regulatory body responsible for enforcing the ECA'95 and ECR'97. It is the responsibility of the proponent to conduct an Environmental Assessment (EA) of development proposal and the responsibility to review EIAs for the purpose of issuing Environmental Clearance Certificate (ECC) from the DOE. According to the Gazette on 24th December 2017 under Environment Division-3 of Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, the 2.517 MWp Industrial Rooftop solar system project (above 1MW) is considered as the **"Orange B category"**.

Description of the Baseline Environment

This section describes the environmental baseline status of 2.517 MW Solar PV Project study area, covering both the natural and social environments. Information was gathered on the existing physical environment related to physiography, geology, topography, climate, soils, surface water quality, groundwater quality, air quality noise level etc.

The region has a tropical climate with three main seasons; pre-monsoon hot season, the rainy season and the cool dry winter season. April is the hottest month. The rainy monsoon season is characterized by southerly or south-westerly winds. The winter season is characterized by low temperatures, cool air blowing from the west or northwest. The project area is located at the nearby Mymensingh station. So, the information was analyzed according to that station from 1989 to 2019 statistical records. During the monsoon, the temperature varies between 35.59°C and 34.82°C. The temperature falls below 18°C in winter. The maximum monthly rainfall during May to September varies from 308.75 mm to 310.78 mm. In October to January, it shows 2.68 to 2.31 ms⁻¹ wind speed in Mymensingh station, which is maximum in the year. From May to September the highest humidity ranges from 80.91% to 85.94% over the year. The ambient air quality in the project site can be stated as in good condition. The nearby river named 'Shaldaha River' which is 15.8 km far from the project location. The surface and groundwater quality nearby to the project location was satisfactory except a low number of parameters were found beyond the DoE standard. The factory has washing and dyeing departments which also cause noise enhancement. The soil type of the project area is deep red brown terrace soil. These soils are well to moderately well drained, reddish brown to yellow-brown. The project area falls in the junction of Madhupur Tract physiographic unit. Madhupur Tract measures about 4,105 square km. The Madhupur jungle contains 'Shal' trees. The topography of the specific project location is 11.27 m to 18.59 m a.m.'s. topographically the cluster of the project location is almost flat. The project area falls in the geological zone named Madhupur clay residuum. Madhupur clay residuum is composed of light-yellowish-gray, orange and light to brick-red, and greyish-white, micaceous silty clay to sandy clay. The project area is in the zone-3 comprising the central part of Bangladesh represents severe seismic intensity. Climate change may therefore affect PV power generation and its temporal stability for a given panel fleet. Survey was conducted in October for flora and faunal diversity in the study area. Fishing survey was carried out in the local bazar beside the project location. Focus Group discussion (FGD) and face to face interaction were also undertaken with project proponent, local people and Fakhruddin Textile Mills Ltd. officials. The total population of Sreepur Upazila is 122872. The main religion is Muslim. The major part which is 59.91% of the Sreepur Upazila, where the project area is located is being used for agricultural purposes. Main sources of income are commerce, employment, rent and remittance, transport and communication, industry,

agricultural and non-agricultural labor, construction and others. Majority of the people of the area use sanitary latrine but most of them are without water seal which is not environmentally hygienic. The literacy rate of Sreepur Upazila is 63.3%. However, there are mosques, schools, college, madrasa, temple were nearby to the project location.

Anticipated Environmental Impacts and Mitigation Measures

The potential environmental impacts that are associated with the proposed project activities are classified as: (i) impacts during pre-construction and construction phase ii) impacts during operation phase and (iii) impacts during decommissioning phase.

During pre-construction phase, the impacts associated with the land use only. The project initiator will implement the project in their own industry rooftop. Therefore, there are no anticipated impacts during the planning phase of the project.

During construction phases, the major impact associated with environmental quality like air, noise, water, soil quality might be degraded due to improper management of the generated waste. Dust generated from construction machineries and gaseous emissions from vehicular transport as well as machineries may deteriorate the air quality of the local area. Noise quality can be deteriorated due to the operation of various machineries and equipment. Various grease and oily substances may be released from the construction machineries may deteriorate the natural water of the project site. All the impacts will be very much localized in nature. The project contractor is to take responsibility of minimizing environmental impact on the surroundings during construction phases by following the project's environmental and social management plan (ESMP). Other social impacts associated with the visual amenity, health safety of the labors, cultural resources, employment opportunity etc. such type of impacts will be localized in nature and not anticipate to the project. The contractor should follow the rules and guidelines related to the environmental and social mentioned in the ESMP.

During the operation period, the main impact is associated with heat generation and PV panel wash. The heat may be transferred by convection, radiation and conduction method. PV panels should be washed regularly with preventing any risk. To mitigate the impacts the developer should follow the ESMP properly.

Information Disclosure and Public Consultation

This chapter will go over the steps related on involving stakeholders during project design and planning, including information sharing and engagement with affected people and other stakeholders. It will also include views and feedback received from project affected people and other stakeholders, as well as how these opinions were considered in project design and mitigation measures, with special emphasis devoted to the project affected peoples' needs and concerns. The purpose of public consultation is to make sure that a participation methodology is used, which in turn documents the concerns of all stakeholder groups and ensures that such concerns are considered, addressed, and incorporated into the development's decision-making process.

Two stakeholder consultations were held, one with workers from the textile mill factory, another with the residents living near the factory. The focus of the consultations was on community members' willingness to participate, as well as their perceptions and concerns about the project's positive and negative social impacts, including impacts on livelihoods. The feedback received from the consultation meeting will be used by the project executing agencies to carry out necessary revisions to the technical designs in order to minimize the impacts.

Environmental and Social Management and Monitoring Plan

Environmental and Social Management Plan (ESMP) has been developed for addressing all adverse impacts pertaining to the implementation of the project. The plan presented in tabular form includes impacts, their sources of occurrence, their mitigation measures, actors responsible for implementation of mitigation measures and their responsibilities.

Environmental and Social Monitoring Plan (ESMoP) has incorporated key environmental components and parameters to be monitored their indicators, frequency, timing and locations of monitoring and the actors responsible for carrying out such monitoring.

Fakhruddin Textile Mills Limited is responsible for overall project implementation and will establish a Project Management Unit (PMU) to manage the project on their behalf. A project manager (PM), supported by technical staff who will design the infrastructure, manage selection of contractors, and supervise construction will lead this.

Supervision is the responsibility of Fakhruddin Textile Mills Limited and IDCOL both. The contractor engaged by the project authority will implement the ESMP along with mitigation measures, as part of the contractual obligation, and the PMU will supervise the work. The budget of the total implementation and operation is 3,83,900 BDT. This budget does not include the decommissioning stage since the minimum operation period is 5 years and the rate will vary largely from the present. The cost for environmental mitigation measures and monitoring will be included in the DPP and allocated of fund will made accordingly.

Disaster Impact Assessment

The Disaster Impact Assessment methodology is used to evaluate development projects from the perspective of disaster risk reduction by identifying project improvement areas. Based on the study, the project will be revised to reduce disaster risks and mitigate adverse effects related to and resulting from project activities. This section contains an initial draft of the framework for assessing the impact of natural catastrophes. The framework's goal is to assist crisis managers in estimating the effects of disasters in various industries.

The project area located in Sreepur Upazila may experience hazards like minimal floods and earthquake as it is situated in the middle of country in Gazipur district. Some mitigations need to be examined during these impacts. Because of urbanization waterlogging is an important issue during heavy rainfall. Rainwater infiltration can be improved by using flexible paving materials and grading away from structures, as well as incorporating berms, wetlands, and swales into the landscape. Though the project area is in severe risk of earthquake. So, the operating workers and other essential personnel for the proposed project must be trained to handle emergency scenarios in the event of an earthquake.

Institutional Arrangements

The project will require the implementation of multi-year mitigative and monitoring actions, as defined in the Environmental and Social Impact Assessment. FTML and IDCOL will be responsible for ensuring the construction and operation period mitigative and monitoring tasks. During the construction period, the management content includes design, construction, installation, equipment transport, debugging, connection to the grid and completion.

Local persons may have complaints about the subproject's activities or the ineffective implementation of various components of the ESMP. A Grievance Redress Mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected people's concerns, complaints, and grievances about the social and environmental performance of the project. The project proponent will make the public aware of the GRM through public awareness campaigns. The contractor must provide a compliance box, which will be secured and collected by the Civil Service Commission (CSC).

Conclusion

Based on visualization and analysis, it is possible to reach in a conclusion that the project stands environmentally sound and sustainable when the recommended mitigation measure and environmental management processes are adopted properly.

Being post-monsoon period, severe weather conditions like moderate rain would have an impact on the construction activities. The construction activities may even have to be stopped during these periods. So, it is recommended that commencing construction in early winter season may help to reap the benefit of full dry spell of the season.

In order to enhance the occupational health and worker safety during the construction period, construction equipment would have to be kept in good order. Adequate safety measures should be taken and safety related equipment including personal protective and safety equipment (PPE), firefighting equipment etc. must be provided in order to reduce the potential for any kind of accidents.

1 Introduction

1.1 Project Background and Rationale

In Bangladesh, load shedding is a problematic subject. It has an impact on the entire country for several hours each day. This problem is caused by the misuse of electricity. Load shedding is also caused by unauthorized electricity connections. Even during peak power use hours, about half of the available power goes unused. However, even in the winter, many individuals do not have access to electricity. In order to secure energy sources in 2022 especially oil, gas and coal, alternate energy sources such as wind, hydro and solar energy has been brought into consideration.

Currently, the economy of Bangladesh is booming. It has an average growth rate of 8%, and demand for electricity is rising fast in a rocketing speed. The total need for electricity in Bangladesh at present is more than 2800 MW. The highest load shedding so far recorded is 500 MW. Bangladesh wants to decarbonize and is opening major new solar projects in addition to expanding the use of solar systems. The government has already taken different kinds of projects to produce desired amount of power by using this solar energy potential. Power generated using solar based technologies is predicted to become cheaper than electricity generated from traditional sources, due to the availability and easy installation of solar based technologies.

Bangladesh is gifted with reasonably good solar energy potential. Bangladesh is situated between the latitudes of 20.300° and 26.380° north. As Straddling the Tropic of Cancer, Bangladesh is blessed to get average 5 kWh/m² radiated solar energy throughout the annum. But due to heavy rainfall, winter fog and other calamities approximately 65 days per annum are subtracted from the above calculation. Total land area of Bangladesh is 1,47,570 km² and it is very suitable to get maximum solar energy from the sun. By observing we can get maximum solar intensity between the months March to April and minimum solar intensity throughout December to January.

The industrial sector is the largest consumer of power in Bangladesh. Around 47.8% of total energy in Bangladesh are being consumed in the industrial sector. Up to June 2019, total 286,469 industries introduced rooftop solar on their vacant roof in Bangladesh. Besides economic benefits, rooftop solar enriches green credentials of industries while indicating environmental accountability to stakeholders. Rooftop solar expose enormous chances for industrial consumers to make use of their idle roof spaces for ample solar power generation at comfort with least maintenance, thereby decreasing use of grid electricity. The textile sector is considered as one of the maximum energy consumers in the industrial sector of Bangladesh. The sector represents 81% of aggregate revenue of the country. Presently, the textile industry in Bangladesh has more than 5600 factories, which is likely to increase further.

Fakhruddin Textile Mills Ltd. proposed a project of a 2.517 MWp rooftop solar project on their industrial rooftop. In the proposed system two main equipment will be used which are panels and inverters. Sun shines on the solar panels to generate DC electricity. The DC electricity produced from the solar panel will be converted to A Zero Export Controller will be used to ensure 'Net Zero Export' The aggregated installed capacity of the project will be 2.517 MWp 440V 3-phase AC using the inverters. Then, the energy will be fed into the bus bars of industry.

This Terms of Reference is being established in order to perform a complete Environmental and Social Impact Assessment (ESIA) assessment for a rooftop solar project on Fakhruddin Textile Mills Ltd.'s rooftop. The project proponent will create an Environmental and Social Management Plan (ESMP) as a part of the ESIA. The mitigation measures suggested, environmental and social monitoring and reporting requirements, emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, and performance indicators will all be included in the ESMP. Where impacts and risks cannot be avoided or minimized, mitigating measures

and activities will be established in order for the project to be planned, constructed, and operated in accordance with applicable laws and regulations and to meet the requirements set forth in this document

1.2 Project Objectives

The main objective of the Environmental and Social Impact Assessment (ESIA) study is to assess both positive and negative environmental impacts due to the project (Roof Top Solar Project) activities. Assess the impacts and recommend appropriate mitigation measures during preconstruction, construction, and operation phases to minimize negative impacts of the project to acceptable levels. The ESIA will be used as a decision-making tool to ensure that the project design and implementation activities are environmentally sound and sustainable. During the implementation phase, the prepared Environmental and Social Management Plan (ESMP) shall serve as a framework for strengthening the mitigation, enhancement and environmental monitoring measures and system of the rooftop solar project. In the preparation phase, The ESIA must fulfill the following objectives:

- To establish the environmental and social baseline in the study area, and to identify any significant environmental issue;
- To assess, quantify, and design project activities with environmental and social impacts in mind;
- To incorporate social and environmental concerns into project planning and design;
- To identify and assess the project impact associated with proposed development;
- To prepare an inventory of biodiversity (Flora and Fauna) in the region and those likely to be affected due to project activity;
- To create a suitable management plan for implementing, monitoring, and reporting on the recommended environmental and social mitigation and enhancement measures.

1.3 ESIA Approach and Methodology

1.3.1 Approach

The study has been conducted in accordance with Environment Conservation Rules, 1997, Government of Bangladesh (GoB) EIA Guidelines. The study is based on both primary and secondary data and information. The primary data includes data collected from field observations and secondary data includes review of the Bangladesh statistical and relevant information from Government Departments. Discussions were held with stakeholders including community representatives and a wide range of the locality. The main purpose of this approach was to obtain a fair impression on the people's perceptions of the project and its environmental impacts. The route map of this ESIA preparation is given in Figure 1-1.

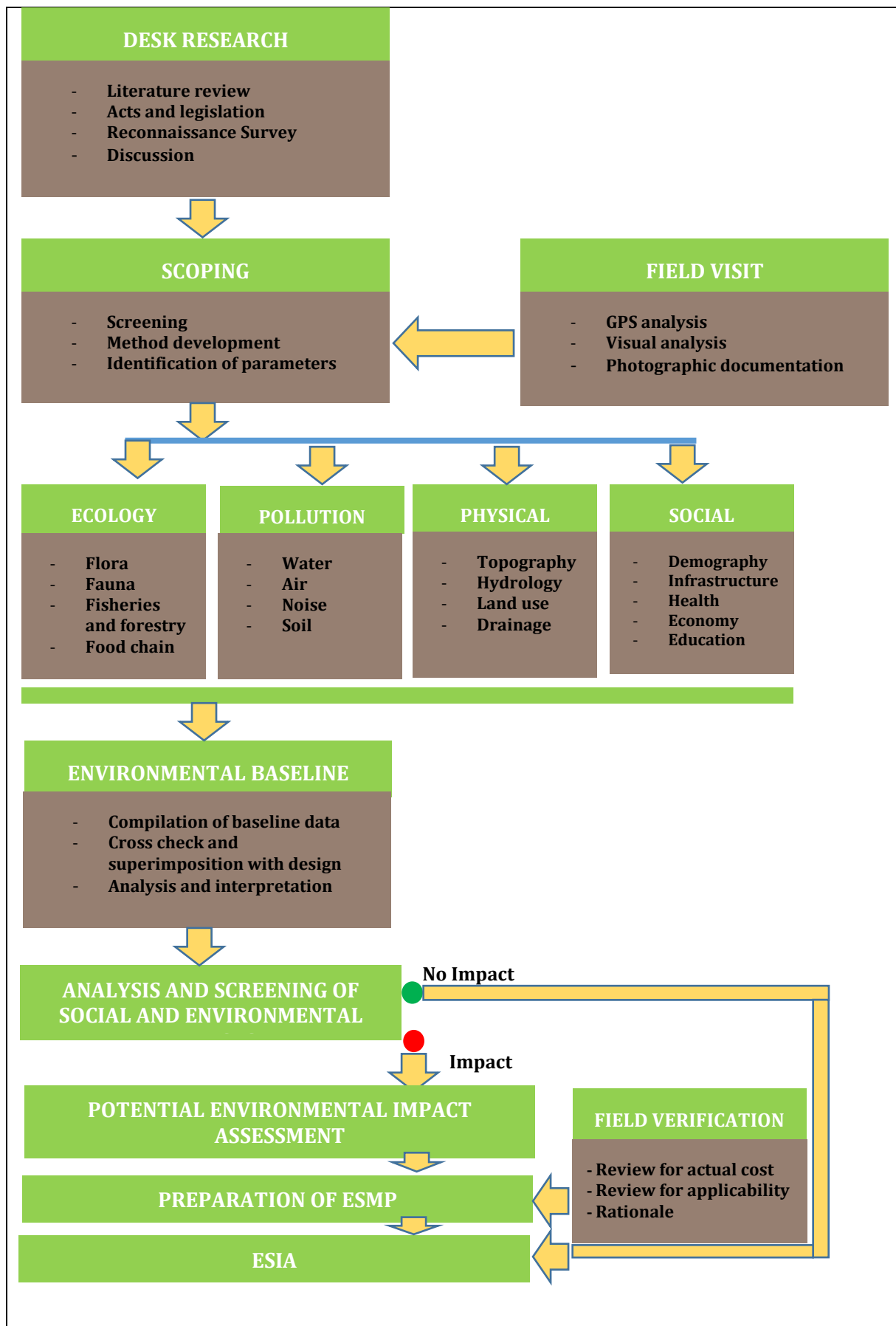


Figure 1-1: Route Map of Environmental and Social Impact Assessment (ESIA)

1.3.2 Methodology

Environmental and Social Impact Assessment (ESIA) will aim at expecting environmental and social impacts, both positive and negative, that might result from the venture or its other options, just as their likely size, reversibility, span, nature and so on. This covers all parts and phases of the project, and also indirect environmental and social consequences, combined effect and any environmental impacts that may be produced by accidents or malfunctions.

The research is based on both primary and secondary data and information. The primary data includes data collection from field observations and secondary data includes review of the statistical and relevant information from Government Departments of Bangladesh. The ESIA study was carried out using the following technique and methodology:

- Meetings and discussions were held among the members of the ESIA Team. This activity was aimed at achieving a common ground of understanding of various issues of the study
- Baseline information about the environmental, social, and economic conditions surrounding the project area; to determine the existing status and post project scenario in respect of these parameters.
- To better understand the appropriate local and national legislation and regulatory frameworks, a regulatory review was conducted.
- Field visit, stakeholder discussion, checklist preparation and project categorization according to quality standards. This step also follows some activities, such as:
 - Field Observations and Studies
 - Site Reconnaissance
 - Brief Research
 - Analysis of Maps and Plans
 - Laboratory Analysis
- Consequences, including cumulative impacts, are evaluated based on a thorough understanding of the project's actions and the current baseline status.
- Risk and hazard assessment for the proposed project and its management measures system overall.

1.3.2.1 Physical Environment

Information was collected on the existing physical environment, particularly as related to geology, topography, soils, hydrology and drainage, water quality, air quality and noise.

Air Quality

Ambient air quality measurements are essential to provide a description of the existing conditions, to provide a baseline against which changes can be measured and to assist in the determination of potential impacts of the proposed construction on air quality conditions. To monitor ambient air quality, carbon monoxide (CO), oxides of Sulphur (SO_x), oxides of nitrogen (NO_x) and particulate matter (PM₁₀ and PM_{2.5}) have been included for ambient air quality monitoring.

Surface Water Quality

Sampling and analysis of surface water quality has been carried out for the following parameters: Temperature, pH, Dissolved Oxygen (DO), Total Suspended Solids (TSS), Biological Oxygen Demand (BOD₅), Chemical Oxygen Demand (COD), Manganese (Mn), Turbidity, Ammonia.

Groundwater Quality

Sampling and analysis of groundwater quality has been carried out for the following parameters: Temperature, pH, Dissolved Oxygen (DO), Total Suspended Solids (TSS),

Biological Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), Manganese (Mn), Turbidity, Ammonia, Iron (Fe) and Arsenic (As).

Noise Measurement

The noise measurement was performed by a trained specialist, using a calibrated Sound Level Meter set to A-weighting, fast response and statistical analysis settings. The Sound Level Meter (SLM) was mounted on a tripod at a height of approximately 1.5 m, facing in the direction of the apparent predominant noise source. The SLM was programmed to record statistical noise levels and was calibrated before and after the survey; no significant drift was detected.

Geology, Topography, Soil

Data related to geology, topography and soil was collected from secondary sources (literature review, expert's opinion, stakeholder consultation) to establish the baseline of the project area and further to find out the impacts of the project during the construction and operational phases.

2 Project Description

2.1 Project Location

The project site is located at Gargaria, Master Bari under Sreepur Upazila within the Gazipur district under Dhaka Division. Sreepur is located in between 24°11'56" North Latitudes and 90°28'41.5" East Longitudes. The project site is located nearby Dhaka-Mymensingh highway which is 50.2 km far from the capital city. Around the project corridor there several number of mosques, two primary schools, one college. The majority of the people live in single-story buildings or low-rise buildings around the factory.

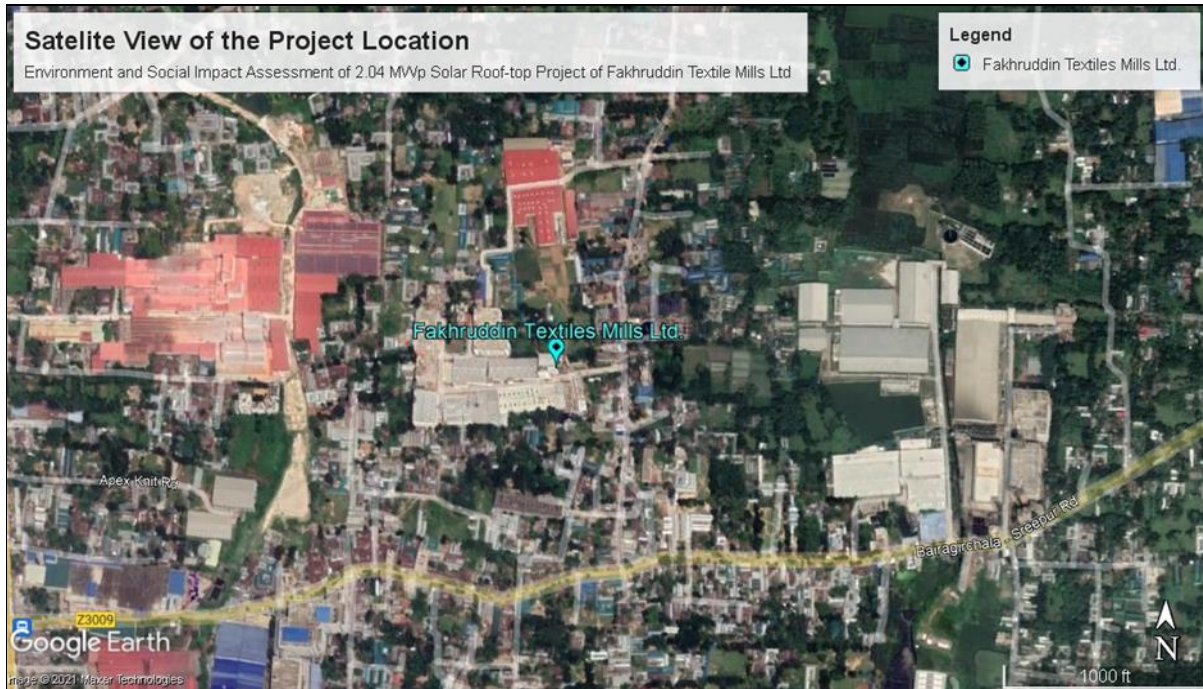


Figure 2-1: Satellite View of the Project Area

2.2 Design Details

The proposed project involves installation of PV based Rooftop Project at the rooftop of Fakhruddin Textile Mills Limited. The solar facility would use photovoltaic (PV) fixed-tilt rack electric generation system technology to produce solar energy, including inverters, and on-site substation. The project would include installation of individual fixed-tilt-mounted PV modules that would remain stationary on the support structures. The modules would not “track” the sun’s position in the sky. The PV modules would cover the majority of the area of the proposed facility. PV modules generate electricity by safely converting the energy of the sun’s photons into DC electrons. The PV modules are interconnected and arranged to increase overall reliability.

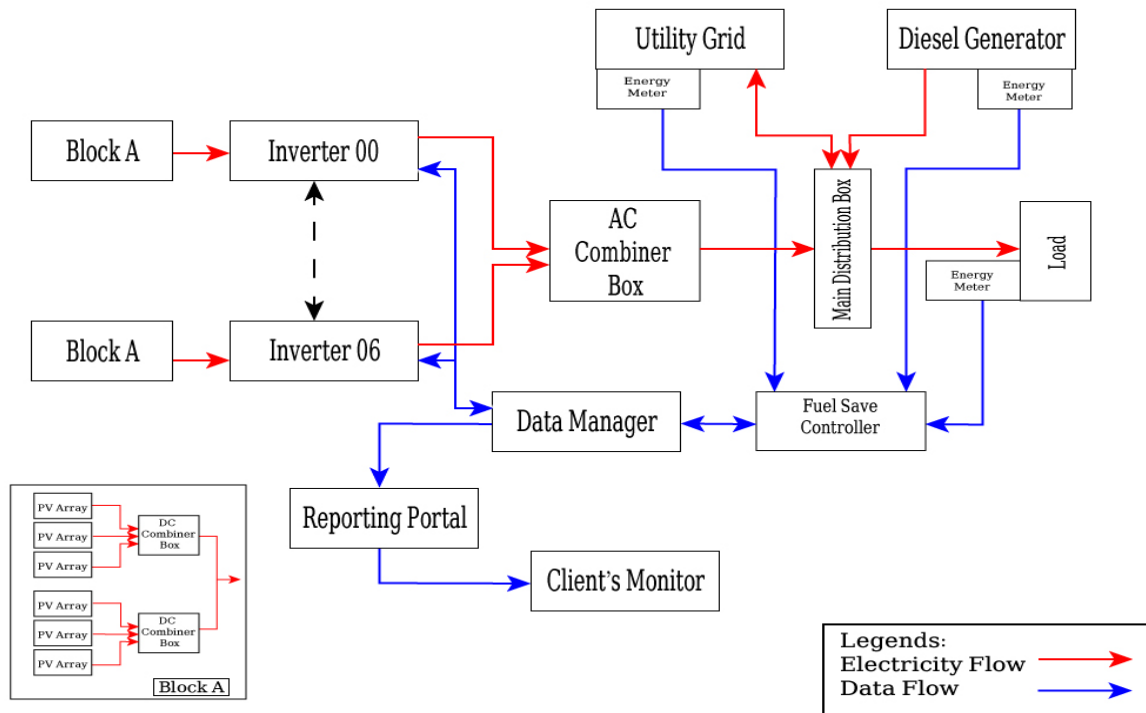


Figure 2-2: System Block Diagram of the Project

Inside the factory, the panel will be installed in both Unit-1 and Unit-2 building. The design layout is shown in the figure 2-3 and 2-4 respectively.

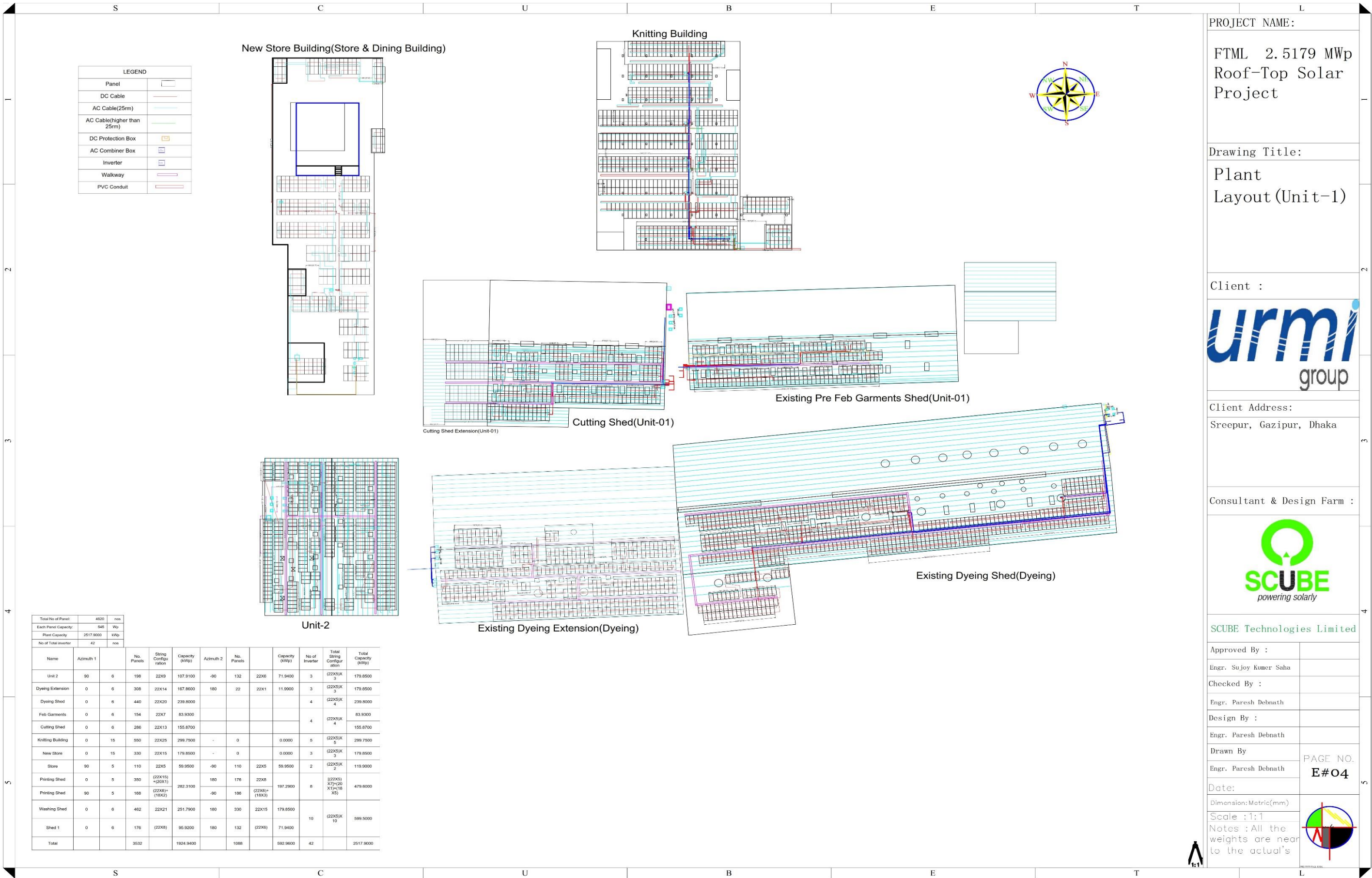
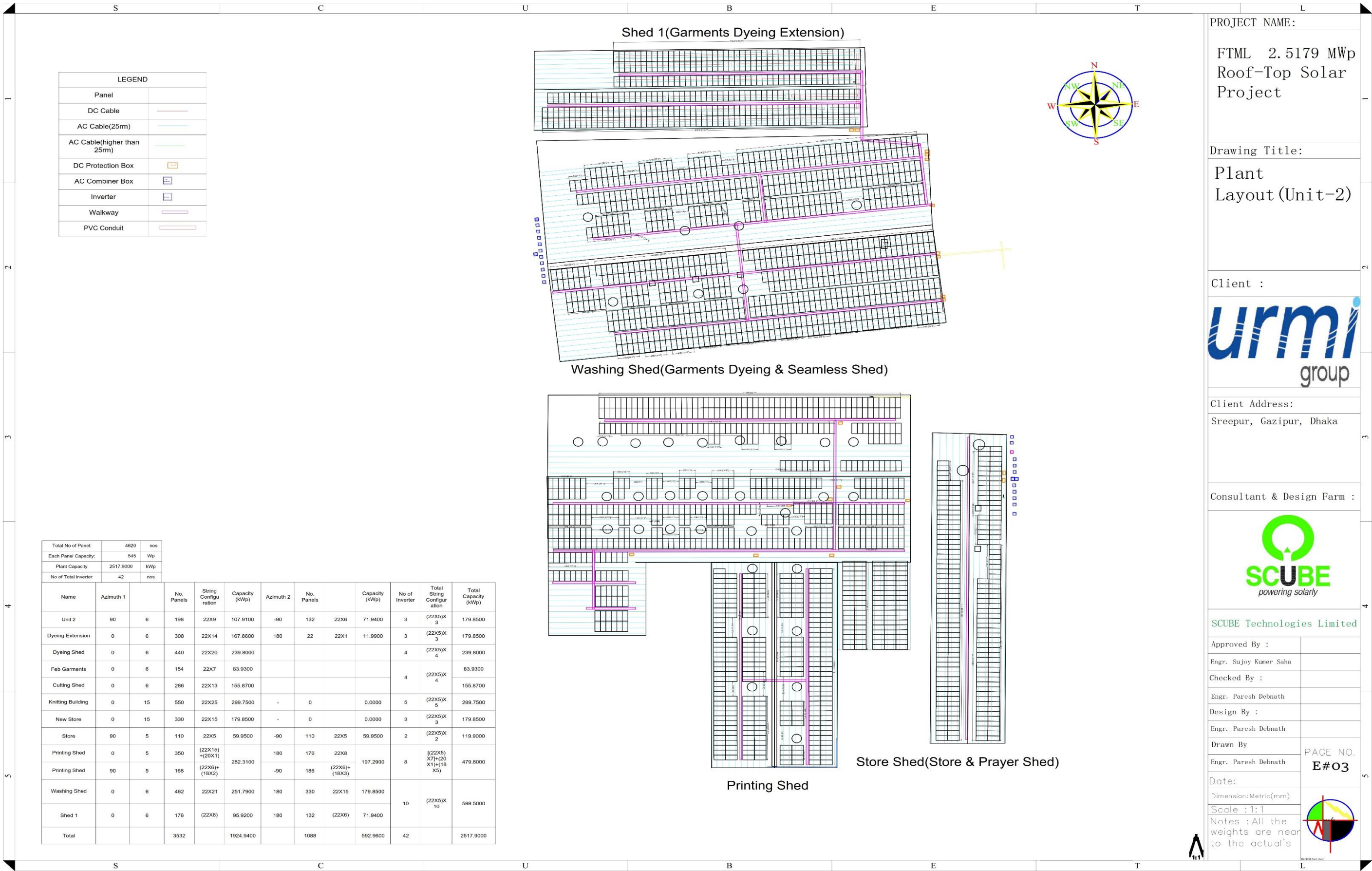


Figure 2-3: Panel Design Layout for Unit-1



2.3 Civil Work

The Contractor will ensure that all working platforms, supporting structures and edge protection are erected by competent personnel who possess the adequate training, knowledge and experience. All scaffolding is to be left at the end of each working day in a manner to prevent unauthorized access and use. Ladders are to be locked away or removed from site at the end of each working day.

The site is exposed to the elements, being outside. All personnel will be required to wear appropriate PPE to protect them from adverse weather conditions and will be encouraged to use sunscreen as required.

2.3.1 Deliveries

- The PV modules are delivered packaged in cardboard on pallets. The modules will be marked and identifiable into power bands;
- The framework will be delivered strapped together in bundles secured to pallets;
- All other goods will be delivered to the site secured and removable via tail lift or onsite plant;
- Deliveries will be made in a timely manner to avoid any delays in installation.

2.3.2 Distribution of Goods

- PV modules should remain in their packaging until they are installed onto the support framework. All packaging will be removed from site daily;
- The support framework and modules will need to be manually handled; protective gloves should be used for this.

2.3.3 Installation

- Gloves are to be worn by personnel whilst installing the framework to protect against sharp edges and hot / cold surfaces and final connections to complete works;
- Gloves should be worn when lifting and carrying modules to protect against sharp edges and corners;
- Modules are fixed to the mounting structures;
- PV modules only weigh approximately 28.5 kg, but have a large wind uplift area and so should be handled by 2 persons. Works may need to be discontinued in adverse weather conditions;
- PV modules are made of glass, and are therefore at risk of fracture or cracking. Care of handling is to be a priority;
- Any damaged modules are to be wrapped and repackaged to avoid any further damage and risk of injury to persons. They are to be clearly marked as damaged and returned to a storage area. The site manager must be notified;
- Once a module is exposed to daylight, it generates a DC voltage;
- The modules are pre-wired with touch-proof connectors which isolate the current, but care must be taken not to interfere with or expose the terminals. The voltage generated from one module is not considered dangerous (approximately 48 Volts). As the modules are connected to each other, the voltage increases and so does the risk of a harmful shock;
- Before each module is fixed into the framework, a simple voltage check should be carried out to ensure that the module is operating;
- Any suspected faulty modules should be set aside for return;
- Protect the cables from stress (i.e., ensure they are not trapped or trodden on) during installation as well as during storage prior to installation;
- All cables must be fitted with multi contact shielded connectors at both ends before connection to the modules is made to prevent the possibility of personnel being exposed to bare live conductors;

- As the modules are installed, they will be cabled up in series-connected strings. As each string is connected, a string voltage and polarity check will be carried out to ensure that all connections are sound,;

2.3.4 Discovery of Asbestos Based Materials

If any material is discovered during the course of any works, which are considered to possibly contain asbestos fibers, then works in that area will stop immediately.

- No materials will be disturbed or removed by site personnel at any time;
- A specialist asbestos removal sub-contractor will be appointed to analyze and remove any asbestos based materials;
- The specialist contractor will also submit a site-specific method statement and risk assessment prior to commencing works on site and
- If asbestos-based materials are found to be present on site the relevant notice will need to be issued to the Health and Safety Executive.

3 Legal and Policy Framework

According to DoE ECR, 1997 (amended in December 24, 2017), Solar subprojects of more than 1MW fall into the **Orange B** Category. For Orange B Category projects, ECC from DOE is mandatory for that particular sub-project. According to the country's national environmental legislation, all development activities in Bangladesh are subject to various legal and institutional limitations. As a result, before implementing the process or plan, each proposal or developer must research relevant legal laws, policies, methods, and institutional concerns. 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 Department of Environment (DoE), under the Ministry of Environment, Forest and Climate Change (MoEFCC) is the regulatory body responsible for enforcing environmental laws and regulations like ECA'95 (amended in 2010) and ECR'97.

Due to its inherent nature and adaptability, solar project activities have very little environmental and social impacts. Bangladesh's environmental and social policies have improved during the last decade as a result of both local demands and international duties.

For the project proponent, ESIA is a planning and decision-making tool. It allows for the identification and management of environmental impacts/issues that may develop during the building and operation of the project. An ESIA also specifies how the root causes mentioned in the Scoping and ESIA Reports will be handled, as well as how the parties involved will be contacted.

3.1 Applicable Policies

3.1.1 National Policies

3.1.1.1 The National Environmental Policy, 2018

The Bangladesh National Environment Policy 2018 sets out the basic framework for environmental action together with a set of broad sectoral action guidelines. Key elements of the policy are:

- Has the vision to ensure sustainable development through environmental conservation, pollution control, conservation of biodiversity and by combating the negative impacts of climate change.
- Has been set with 16 specific objectives that includes: maintaining natural balance and ensuring overall development of the country through conservation of environment and sustainable management; expansion of climate change adaptation programs to reduce its negative impacts; introduce and encourage wide-spread use of low carbon emitting technology; identification control of all types of pollution and degradation of environment; ensuring environment friendly development in all sectors.

3.1.1.2 National Environmental Management Action Plan (NEMAP), 1995

The National Environmental Management Action Plan (NEMAP) builds on the NEP and was developed to address specific issues and management requirements during the period 1995-2005. The plan includes a framework within which the recommendations of a National Conservation Strategy (NCS) are to be implemented. The NEMAP was formed with the following goals in mind:

- ✓ To identify actions to halt or reduce the rate of environmental degradation;
- ✓ To improve management of the natural environment;
- ✓ To identify key environmental issues affecting Bangladesh;

- ✓ To conserve and protect habitats and biodiversity;
- ✓ To promote sustainable development and
- ✓ To improve the quality of life.

3.1.1.3 Bangladesh Environment Conservation Rules, 1997

The Government of Bangladesh established the Environment Conservation Rules, 1997, in accordance with the authority granted by the Environment Conservation Act (Section 20), 1995. The following aspects, among others, are covered by these rules:

- ✓ Declaration of ecologically critical areas;
- ✓ Classification of industries and projects into four categories;
- ✓ Procedures for issuing the Environmental Clearance Certificate (ECC).

The last rule expresses the factors to be considered in declaring an area 'Ecologically Critical Area' (ECA) as per Section 5 of ECA'95. It empowers the Government to declare an area 'ECA', if it is satisfied that the ecosystem of the area has reached or is threatened to reach a critical state or condition due to environmental degradation. The Government is also empowered to specify which of the operations or processes shall be carried out or shall not be initiated in the ecologically critical area.

ECR'97 (Rule 7) classifies industrial units and projects into four categories depending on environmental impact and location for the purpose of issuance of ECC. These categories are:

- Green
- Orange A
- Orange B and
- Red

All existing industrial units and projects and proposed industrial units and projects, that are considered to be low polluting are categorized under **Green** and shall be granted Environmental clearance. For proposed industrial units and projects falling in the **Orange-A**, **Orange-B** and **Red** categories, firstly a site clearance certificate and thereafter an environmental clearance certificate will be issued. A detailed description of those four categories of industries has been given in Schedule-1 of ECR'97.

Department of Environment (DoE), under the Ministry of Environment, Forest and Climate Change (MoEFCC) is the regulatory body responsible for enforcing the ECA'95 and ECR'97. It is the responsibility of the proponent to conduct an Environmental Assessment (EA) of development proposal and the responsibility to review EIAs for the purpose of issuing Environmental Clearance Certificate (ECC) from the DOE. According to the Gazette on 24th December 2017 under Environment Division-3 of Ministry of Environment and Forest, Government of the Peoples Republic of Bangladesh, the 2.517 MWp Industrial Rooftop solar system project (more than 1MW) is considered as the "**Orange B category**".

3.1.1.4 The National Energy Policy, 2018

Presently, primary commercial energy resources include natural gas, oil, condensates, coal, peat and renewable energy resources. Biomass still plays an important role in the country's energy consumption in the rural area. Government is actively considering use of nuclear energy for electricity generation. The appreciable commercial energy resources of the country are a well-developed natural gas sector and an undeveloped coal sector. Prevailing constraints in the indigenous commercial energy sources limit the scope of widening the range of possible long-term national energy supplies. A long-term strategic plan is required for carrying out systematic exploration and proper appraisal of discoveries. Hydrocarbon resource assessment studies indicate good prospects for finding new hydrocarbon resources, especially in the offshore and deep-sea areas. Bangladesh is facing twin energy crises – an urban energy crisis characterized by power shortages and skyrocketing gas consumption and a rural energy crisis reflected in the increasing inability of the rural poor to have access even to low-valued traditional biomass. To overcome these crises, sector

reforms and additional investments are urgently needed for accelerated development, and thus improving basic livelihoods of urban and rural population. An earlier energy planning effort led to the formulation of the first National Energy Policy (NEP) in 1996, which brought Government attention to the urgency of ensuring proper exploration, production, distribution and rational use of energy sources to meet the growing energy demand of the country. With the rapid changes in global, as well as domestic conditions, the Energy & Mineral Resources Division (EMRD) has undertaken a comprehensive program for updating the National Energy Policy. The proposed updated policy will describe the role that the energy sector must play in order to meet its obligations for sustainable development of the country. This policy will also focus on implementation mechanisms and procedures for tracking results to ensure that the policies are reflected in practice.

3.1.1.5 Renewable Energy Policy of Bangladesh, 2008

The renewable energy policy of Bangladesh is a set of policies and programs set by the Government of Bangladesh to reach national goals in the field of renewable energy in the country. The Renewable Energy Policy of Bangladesh was released in 2008 by the Ministry of Power, Energy, and Mineral Resources. Bangladesh currently has a target of meeting 10% of power demand from renewable energy resources by 2020, although current generation of renewable energy is less than 1% of total electricity generation. The objectives of the Renewable Energy Policy for Bangladesh are to:

- ✓ To harness the potential of renewable energy resources and dissemination of renewable energy technologies in rural, peri-urban and urban areas;
- ✓ To enable, encourage and facilitate both public and private sector investment in renewable energy projects;
- ✓ To develop sustainable energy supplies to substitute indigenous non-renewable energy supplies;
- ✓ To scale up contributions of renewable energy to electricity production;
- ✓ To increase contributions of renewable energy to produce heat energy.

3.1.1.6 Guidelines for the Implementation of Solar Power Development Program, 2013

In order to meet the target, set in the renewable energy Policy, Government has taken program to generate 500 MW of solar by 2021. Social projects will be the public sector's projects financed by Government of Bangladesh and/or Development Partners and the electricity generated from the system would be used up by the organization itself. The following organizations will be considered for solar projects:

- Union Health Center;
- Educational Institutions in remote area;
- Union Information Service Center;
- Unconnected Religious Institution;
- Railway Stations in remote area;
- Government Offices in off-grid area.

According to the Renewable Energy Policy, investors who build solar mini grid projects with a capacity of up to 5 MW will not be required to get a waiver certificate, which is stated in the operational guidelines of the Solar Power Development Program (2013). Mini grid projects with a capacity of up to 250 MW will not need a waiver certificate or license, but the entrepreneur must inform the Commission by letter. A license for a minimum of 20 years with the option to renew every year may be awarded for the installation and operation of solar mini grid projects.

3.1.1.7 Guidelines for Net Energy Metering Policy in Bangladesh, 2018

'NEM' stands for Net Energy Metering, which is a policy that permits consumers to attach their renewable energy sources to the distribution grid. As a result, any excess electricity generated from renewable sources after self-consumption is supplied to the distribution grid,

and the individual can either import an equal amount of electricity from the grid or receive the price of the net amount of exported electricity at the end of the settlement period, according to this guideline.

Under the process of net metering electricity can flow in both directions via a bi-directional meter. Thus, the consumer gets to adjust the amount of electricity consumed from grid and any excess electricity after self-consumption that is produced by rooftop solar system or any other renewable energy sources, given that all the conditions stated in this guideline are met. The measured data can be stored in the meter or transferred to a centralized aggregator service. The customer's bill is calculated according to the net energy recorded on the meter; i.e., the aggregated energy drawn from the network minus the energy delivered to the network over the specified billing period. If the amount of electricity consumed from the grid is higher than the amount of electricity supplied to the grid from the rooftop solar PV system, the consumer has to pay the bill for net consumption. On the other hand, if the amount of electricity generated and exported from solar PV system or the renewable energy system to the grid is higher than the imported electricity, then the distribution utility shall allow all the credit (in terms of kWh) of the consumer to roll over to the next billing period.

By the end of the specified rolling cycle or settlement period, the consumer is compensated for all kWh credits as a rate prescribed in this guideline by the distribution utility, and on 1 July of every year credit account is set to zero. The rate at which the customer is billed is determined considering various factors such as the consumer tariff class, type of renewable energy technology, installed capacity and export limitations. While installing such connections, the prosumer must also abide by the interconnection technical requirements and safety regulations set by the concerned authority. The interconnection process, the mechanism by which net metered distributed energy systems may be legally and safely connected to the electricity grid, is critical to the success of net metering programs. Interconnection standards are typically outlined separately from net metering policy parameters, but are fundamental to the development of the NEM policy.

3.1.1.8 Bangladesh Labor Act, 2006

The law is fairly comprehensive and progressive. The law is a consolidation and updating of many separate acts. The comprehensive nature of the law can immediately be gleaned from its coverage -- conditions of service and employment, youth employment, maternity benefit, health and hygiene, safety, welfare, working hours and leave, wages and payment, workers' compensation for injury, trade unions and industrial relations, disputes, labor court, workers' participation in companies' profits, regulation of employment and safety of dock workers, provident funds, apprenticeship, penalty and procedure, administration, inspection, etc.

On the ILO core conventions, Bangladesh has ratified the following International Labor Conventions (ILCs):

- ✓ ILC 29 (Forced Labor),
- ✓ ILC 87 (Freedom of Association and Protection of the Right to Organize),
- ✓ ILC 98 (Right to Organize and Collective Bargaining),
- ✓ ILC 100 (Equal Remuneration),
- ✓ ILC 105 (Abolition of Forced Labor),
- ✓ ILC 111 (Discrimination in Employment and Occupation), and
- ✓ ILC 182 (Elimination of the Worst Forms of Child Labor).

3.1.1.9 Bangladesh National Building Code (BNBC)

The main purpose of the BNBC is to establish minimum standards for design, construction, quality of materials, use and occupancy, location and maintenance of all buildings within Bangladesh in order to safeguard, within achievable limits, life, limb, health, property and public welfare. The installation and use of certain equipment, services and appurtenances related, connected or attached to such buildings are also regulated herein to achieve the same purpose.

Chapter-3, part -7 of the BNBC has clarified the issue of safety of workers during construction and with relation to this, set out the details about the different safety tools of specified standard. In relation with the health hazards of the workers during construction, this chapter describes the nature of the different health hazards that normally occur in the site during construction and at the same time specifies the specific measures to be taken to prevent such health hazards. According to this chapter, exhaust ventilation, use of protective devices, medical checkups etc. are the measures to be taken by the particular employer to ensure a healthy workplace for the workers.

Chapter-1, part-7 of the BNBC, states the general duties of the employer to the public as well as workers - "All equipment and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, run way, barricade, chute, lift etc. shall be substantially constructed and erected so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them".

Chapter -1, Part-7 of the BNBC clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. According to section 1.2.1 of chapter 1 of part 7; "in a construction or demolition work, the terms of contract between the owner and the contractor and between a consultant and the owner shall be clearly defined and put in writing. These however will not absolve the owner from any of his responsibilities under the various provisions of this BNBC and other applicable regulations and byelaws. The terms of contract between the owner and the contractor will determine the responsibilities and liabilities of either party in the concerned matters, within the provisions of the relevant Acts and Codes (e.g.) the Employers' Liability Act, 1938, the Factories Act 1965, the Fatal Accident Act, 1955 and Workmen's Compensation Act 1923". (After the introduction of the Bangladesh Labor Act, 2006, these Acts have been repealed).

The proposed project will conduct several civil works including deliveries, distribution of goods, Installation of PV panels and discovery of Asbestos based materials. While conducting the civil works, the BNBC code should be followed properly.

3.1.1.10 Guidelines for the Implementation of Solar Power Development Program, 2013

It is clearly mentioned in the guidelines for the implementation of Solar Power Development Program (2013) that according to the Renewable Energy Policy, to establish a solar mini grid projects with a capacity up to 5 MW, entrepreneur will be exempted to get a waiver certificate. Mini grid projects with a capacity up to 250 kW will not be required any waiver certificate/license, but entrepreneur will have to inform the Commission by sending a letter. For implementation and operation of solar mini grid projects, license for a period of minimum 20 years may be issued with a condition to renew every year.

3.1.2 International Policies

3.1.2.1 World Bank's Guidelines on Environmental and Social Safeguards Policies

Since October 01, 2018, all WB funded Investment Project Financing (IPF) are required to follow the Environmental and Social Framework (ESF) consisting ten (10) Environmental and Social Standards (ESS). These ESSs set out their requirement for the borrowers relating to the identification and assessment of environmental and social risks and impacts associated with any project. The ESSs supports the borrowers in achieving good international practice relating to environmental and social sustainability, assist them in fulfilling their national and international environmental and social obligations, enhance transparency and accountability and ensure sustainable development outcome through ongoing stakeholder engagement.

Section below discusses the relevance of ESF Policy, each of the ten standards (ESS1 to 10) and associated Directive; their requirements are tabulated in Table 3.1. Additionally, it also discusses the relevance and requirements relating to other guidance notes of World

Bank. In case requirements of Bangladesh law differed from those of ESF, the more stringent requirements will apply.

Table 3-1: Applicability of the ESSs to the Project

World Bank ESS Policy, Standards, Directive	Objectives	Requirements
ESS-1 Assessment and Management of Environmental and Social Risks and Impacts	Identify, assess, evaluate, and manage environment and social risks and impacts in a manner consistent with the ESF. Adopt differentiated measures so that adverse impacts do not fall disproportionately on the disadvantaged or vulnerable, and they are not disadvantaged in sharing development benefits and opportunities	The types of E&S risk and impacts that should be considered in the environmental and social assessment. The use and strengthening of the Borrower's environmental and social framework for the assessment, development and implementation of World Bank financed projects where appropriate.
ESS-2 Labor-and-Working-Conditions	Promote safety and health at work. Promote the fair treatment, non-discrimination, and equal opportunity of project workers. Protect project workers, with particular emphasis on vulnerable workers. Prevent the use of all forms of forced labor and child labor. Support the principles of freedom of association and collective bargaining of project workers in a manner consistent with national law. Provide project workers with accessible means to raise workplace concerns.	Requirements for the Borrower to prepare and adopt labor management procedures. Provisions on the treatment of direct, contracted, community, and primary supply workers, and government civil servants. Requirements on terms and conditions of work, non-discrimination and equal opportunity and workers organizations. Provisions on child labor and forced labor. Requirements on occupational health and safety, in keeping with the World Bank Group's Environmental, Health, and Safety Guidelines (EHSG).
ESS-3 Resource-Efficiency-and-Pollution-Prevention-and-Management	Promote the sustainable use of resources, including energy, water, and raw materials. Avoid or minimize adverse impacts on human health and the environment caused by pollution from project activities. Avoid or minimize project-related emissions of short and long-lived climate pollutants. Avoid or minimize generation of hazardous and non-hazardous waste. Minimize and manage the risks and impacts associated with pesticide use. Requires technically and financially feasible measures to improve efficient consumption of energy, water, and raw materials, and introduces specific requirements for water efficiency where a project has high water demand.	Requires an estimate of gross greenhouse gas emissions resulting from project (unless minor), where technically and financially feasible. Requirements on management of wastes, chemical and hazardous materials, and contains provisions to address historical pollution. ESS-3 refers to national law and Good International Industry Practice, in the first instance the World Bank Groups' EHSGs.
ESS-4 Community-Health-and-Safety	Anticipate or avoid adverse impacts on the health and safety of project-affected communities during project life-cycle from routine and non-routine circumstances. Promote	Requirements on infrastructure, considering safety and climate change, and applying the concept of universal access, where technically and financially feasible.

World Bank ESS Policy, Standards, Directive	Objectives	Requirements
	quality, safety, and climate change considerations in infrastructure design and construction, including dams. Avoid or minimize community exposure to project-related traffic and road safety risks, diseases and hazardous materials. Have in place effective measures to address emergency events. Ensure that safeguarding of personnel and property is carried out in a manner that avoids or minimizes risks to the project-affected communities.	Requirements on traffic and road safety, including road safety assessments and monitoring. Addresses risks arising from impacts on provisioning and regulating ecosystem service. Measures to avoid or minimize the risk of water-related, communicable, and non-communicable diseases. Requirements to assess risks associated with security personnel, and review and report unlawful and abusive acts to relevant authorities.
ESS-5 Land-Acquisition- Restrictions-on-Land- Use-and-Involuntary- Resettlement	Avoid or minimize involuntary resettlement by exploring project design alternatives. Avoid forced eviction. Mitigate unavoidable adverse impacts from land acquisition or restrictions on land use by providing compensation at replacement cost and assisting displaced persons in their efforts to improve, or at least restore, livelihoods and living standards to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. Improve living conditions of poor or vulnerable persons who are physically displaced, through provision of adequate housing, access to services and facilities, and security of tenure. Conceive and execute resettlement activities as sustainable development programs.	Applies to permanent or temporary physical and economic displacement resulting from different types of land acquisition and restrictions on access. Does not apply to voluntary market transactions, except where these affects third parties. Provides criteria for “voluntary” land donations, sale of community land, and parties obtaining income from illegal rentals. Prohibits forced eviction (removal against the will of affected people, without legal and other protection including all applicable procedures and principles in ESS5). Requires that acquisition of land and assets is initiated only after payment of compensation and resettlement has occurred. Requires community engagement and consultation, disclosure of information and a grievance mechanism.
ESS-6 Biodiversity- Conservation and Sustainable Management of Living Natural Resources	Protect and conserve biodiversity and habitats. Apply the mitigation hierarchy and the precautionary approach in the design and implementation of projects that could have an impact on biodiversity. To promote the sustainable management of living natural resources.	Requirements for projects affecting areas that are legally protected designated for protection or regionally/internationally recognized to be of high biodiversity value. Requirements on sustainable management of living natural resources, including primary production and harvesting, distinguishing between small-scale and commercial activities. Requirements relating to primary suppliers, where a project is purchasing natural resource commodities, including food, timber and fiber.
ESS-7 Indigenous-	Ensure that the development process fosters full respect for	Applies when the Indigenous Peoples are present or have a

World Bank ESS Policy, Standards, Directive	Objectives	Requirements
Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	affected parties' human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods. Promote sustainable development benefits and opportunities in a manner that is accessible, culturally appropriate and inclusive. Improve project design and promote local support by establishing and maintaining an ongoing relationship based on meaningful consultation with affected parties. Obtain the Free, Prior, and Informed Consent (FPIC) of affected parties in three circumstances. Recognize, respect and preserve the culture, knowledge, and practices of Indigenous Peoples, and to provide them with an opportunity to adapt to changing conditions in a manner and in a timeframe acceptable to them.	collective attachment to the land, whether they are affected positively or negatively and regardless of economic, political or social vulnerability. The option to use different terminologies for groups that meet the criteria set out in the Standard. The use of national screening processes, providing these meet World Bank criteria and requirements. Coverage of forest dwellers, hunter gatherers, and pastoralists and other nomadic groups. Requirements for meaningful consultation tailored to affected parties and a grievance mechanism. Requirements for a process of free, prior and informed consent in three circumstances.
ESS-8 Cultural-Heritage	Protect cultural heritage from the adverse impacts of project activities and support its preservation. Address cultural heritage as an integral aspect of sustainable development. Promote meaningful consultation with stakeholders regarding cultural heritage. Promote the equitable sharing of benefits from the use of cultural heritage.	Requires a chance finds procedure to be established. Recognition of the need to ensure peoples' continued access to culturally important sites, as well as the need for confidentiality when revealing information about cultural heritage assets that would compromise or jeopardize their safety or integrity. Requirement for fair and equitable sharing of benefits from commercial use of cultural resources. Provisions of archaeological sites and material, built heritage, natural features with cultural significance, and moveable cultural heritage.
ESS-9 Financial-Intermediaries	Sets out how Financial Intermediaries (FI) will assess and manage environmental and social risks and impacts associated with the subprojects it finances. Promote good environmental and social management practices in the subprojects the FI finance. Promote good environmental and sound human resources management within the FI.	Financial Intermediaries (FIs) to have an Environmental and Social Management System (ESMS) - a system for identifying, assessing, managing, and monitoring the environmental and social risks and impacts of FI subprojects on an ongoing basis. FI to develop a categorization system for all subprojects; with special provisions for subprojects categorized as high or substantial risk. FI borrowers to conduct stakeholder engagement in a manner proportionate to the risks and impacts of the FI subprojects.
ESS-10 Stakeholder-	Establish a systematic approach to stakeholder engagement that helps Borrowers identify stakeholders and maintain a constructive relationship	Requires stakeholder engagement throughout the project life cycle, and preparation and implementation of a Stakeholder Engagement Plan

World Bank ESS Policy, Standards, Directive	Objectives	Requirements
Engagement-and-Information-Disclosure	with them. Assess stakeholder interest and support for the project and enable stakeholders' views to be taken into account in project design. Promote and provide means for effective and inclusive engagement with project-affected parties throughout the project life-cycle. Ensure that appropriate project information is disclosed to stakeholders in a timely, understandable, accessible and appropriate manner.	(SEP). Requires early identification of stakeholders, both project-affected parties and other interested parties, and clarification on how effective engagement takes place. Stakeholder engagement to be conducted in a manner proportionate to the nature, scale, risks and impacts of the project, and appropriate to stakeholders' interests. Specifies what is required for information disclosure and to achieve meaningful consultation.

Here is a 'Relative Comparison' between GoB and WB Laws/ Policies

Various relevant GoB and WB Policies and Laws have been studied and the following table (Table 3-2) presents a synopsis of the relevant policies and the actions need to be taken.

Table 3-2: Comparison between GoB and WB Laws/ Policies

Issues	GoB Policy	WB Policy	Actions Taken
Environmental and Social Assessment	National Environmental Policy, 1992 & Environmental Conservation Rules, 1997 requires to assess the environmental impact assessment before commencement of any development activities.	Environmental and social assessment is required as per the ESS1: Assessment and Management of Environmental and Social Risks and Impacts	The social assessment has also been conducted.
Environmental Pollution	There are several laws related to environmental pollution and specific laws of Medical Waste Management (MWM).	ESS3 Resource Efficiency and Pollution Prevention and Management requires all types of pollution and its necessity of mitigation.	The project itself considering the resource efficiency and the ESIA also addressing in its assessment.
Gender and GBV Issues	Women Development Policy 2011	ESS 2 Labor and Working Condition, ESS 4 Community Health and Safety	Adequate measures to address gender issues and GBV including GRM have been addressed in this ESIA
Stakeholders' consultation and disclosure	GOB Act (ARIPA 2017) does not recognize consultation with the people rather to preparation of LAP and payment of compensation and displacement without follow up.	World Bank 'ESS-10 Stakeholder Engagement and Information Disclosure' is to be addressed. Meaningful consultation with the stakeholders is to be held and opinion of various stakeholders is to be incorporated in	Stakeholders' engagement plan has been prepared to follow during implementation of the project.

Issues	GoB Policy	WB Policy	Actions Taken
		SEP.	

3.1.2.2 IFC Environmental, Health and Safety Guidelines

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of 'Good International Industry Practice (GIIP)'. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary.

The General EHS Guidelines are organized as follows:

- Environmental
- Occupational Health and Safety
- Community Health and Safety
- Construction and Decommissioning

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more severe. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

3.1.3 Environmental Clearance

Formal EIA guidelines in Bangladesh are set out in "Rules and Regulations under the 1995 Environmental Protection Acts" as published in the official Gazette on August 27, 1997. Any proponent planning an industrial project is currently required under Paragraph 12 of the Environmental Protection Acts, 1995 to obtain "Environmental Clearance Letter:" from the Department of Environment. According to the Gazette on 24 December 2017 under Environment Division-3 of MoEFCC, Government of the Peoples Republic of Bangladesh, the 2.517 MWp Industrial Rooftop solar system project (above 1MW) is considered as the "Orange B category".

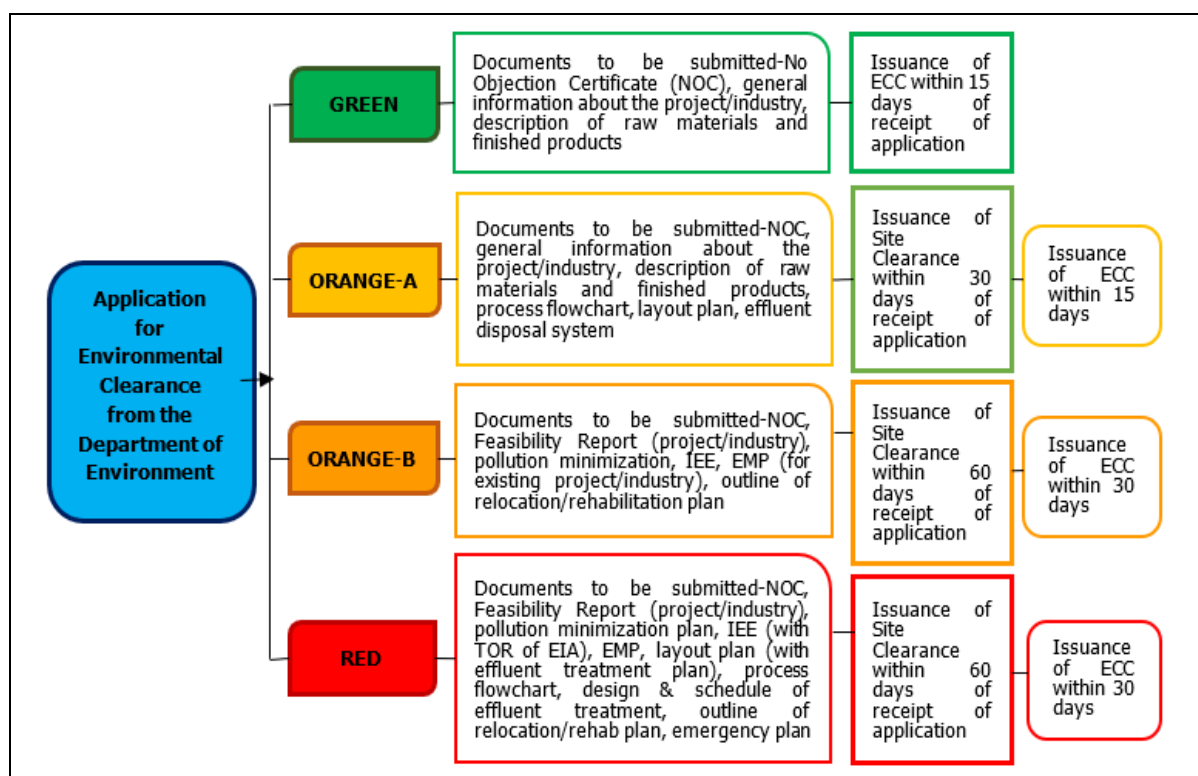


Figure 3-1: Government of Bangladesh's Environmental Clearance Process

3.1.4 Funding Agencies' Policies

3.1.4.1 Environmental and Social Management Framework (ESMF) of IDCOL

IDCOL has a mandate of financing private sector for developing medium to large-scale infrastructure and energy efficiency-renewable energy projects in Bangladesh. IDCOL recognizes the significance of environmental, health / safety and social considerations in infrastructure development and believes in sustainable development.

To achieve the above, IDCOL is committed to:

- Mainstream environmental, health/safety and social (E&S) considerations in appraising and financing infrastructure projects to avoid/minimize adverse impacts and risks to the environment and people that may be affected.
- Ensure compliance with all relevant E&S policy and legislative requirements and laws of the lands with which it engages and remain responsive to the E&S requirements of international best practices.
- Avoid/minimize land acquisition and resettlement through selection of appropriate locations and design of project.
- Where land acquisition is unavoidable, compensate replacement value of such acquired land/property will be paid before displacement or replace with land having equal value and quality together with other facilities such as housing and basic infrastructure facilities.
- Ensure protection of vulnerable groups, such as the economically and socially disadvantaged, women and children, physically handicapped and indigenous people and take appropriate measures to restore their livelihood as relevant.

The objectives of IDCOL ESSF are to:

- Assess infrastructure projects being funded by IDCOL, for their environmental and social (E&S) impacts, early in the project lifecycle or IDCOL's entry in to the project whichever applicable;
- Identify and fulfil all E&S obligations put forth by various external stakeholders (GoB institutions and Global Financial Institutions such as WB, IFC, etc.;

- Ensure E&S legal compliance of the projects;
- Influence and mandate (as relevant) clients and downstream agencies to ensure legal compliance and manage E&S risks and
- Define and outline policies, procedures, roles, and responsibilities for managing impacts, risks, and effects on environment, involuntary resettlement and tribal people of subprojects that are financed by IDCOL.

4 Technological Aspects

4.1 Proposed Process and Technology

The electrical output of a PV plant depends on the solar radiation it receives. Outside the Earth's atmosphere, on a surface normal to the solar beam, the power density is $1,365\text{W/m}^2$. As the solar radiation passes through the atmosphere, some of it is scattered and absorbed, the amount depending on the length of the atmospheric path traversed by the solar radiation and the quantity of dust, water vapor, ozone, carbon dioxide and other aerosols and gases present. About one half of the scattered energy is returned to the earth as diffused radiation from the sky. The diffused radiation plus the direct irradiance from the sun are together termed as total irradiance. The total irradiance on a horizontal surface is called the global irradiance. The diffused sunlight can vary from about 20% on a clear day to 100% in heavily overcast conditions. The peak irradiance of $1,000\text{W/m}^2$ has been taken as the standard value by which PV modules are rated. Hence, a 100 MWp PV Power plant will generate 100 MW of electricity in an irradiance of 1000W/m^2 and a cell temperature of 250°C and Air Mass 1.5. However, the total solar energy received in a day over a specific area more important than the instantaneous solar irradiance. This is called daily solar irradiance or insolation and is expressed as $\text{kWh/m}^2/\text{day}$. The solar resource is not equally available in all regions of the world. On a clear day in the tropics, when the sun is overhead, the global irradiance can exceed 1000W/m^2 but in high latitude it rarely exceeds 850W/m^2 . Similarly, daily solar insolation may be $5\text{--}7\text{ kWh/m}^2/\text{day}$ in the tropics but could be less than $0.5\text{ kWh/m}^2/\text{day}$ in high latitudes. Historically, climatological profiles of insolation and meteorology parameters calculated from ground measurements have been used for determining the viability of Renewable Energy Technology (RET) projects. These climatological profiles are used for designing systems that have low failure rates. Although ground measurement data has been used successfully in the past for implementing RETs, there are inherent problems in using them for resource assessment. Ground measurement stations are located throughout the world, but they are situated mainly in populated regions. In remote areas (where many RETs are implemented) measurement stations are limited. Also, at any particular station, data recording can be sporadic leading to incomplete climatological profiles; and, data inconsistencies can occur within a station and from one station to another. In contrast to ground measurements, the Surface meteorology and Solar Energy (SSE) data set is a continuous and consistent 22-year global climatology of insolation and meteorology data on a 1° by 1° grid system. Although the SSE data within a particular grid cell are not necessarily representative of a particular microclimate, or point, within the cell, the data are considered to be the average over the entire area of the cell. In utilizing the SSE data set, an estimate of the renewable energy resource potential can be determined for any location on the globe. That estimate is considered to be accurate enough for feasibility studies of new renewable energy projects.

4.2 Adequacy of Solar Irradiation

It has been observed that Sreepur, Gazipur, Bangladesh receives a potential amount of solar energy throughout the year with an average $4.64\text{ kWh/m}^2/\text{day}$ (Global) on horizontal surface, $4.75\text{ kWh/m}^2/\text{day}$ on 6° & 15° tilted surface and $4.86\text{ kWh/m}^2/\text{day}$. It can be seen that during February to May maximum energy can be harnessed by solar panel. Peak sunshine occurs in March which is $5.59\text{ kWh/m}^2/\text{day}$. On the other hand, during monsoon solar irradiance comparatively lower than other season and the minimum value is $4.01\text{ kWh/m}^2/\text{day}$ in the month of July. However, as the PV panel of the proposed site is planned to install toward East-West & North-South direction with an inclination angle of 6° & 15° the yearly energy yield will be more in compared to global horizontal irradiance

4.3 Plant Capacity Selection

Considering the location, roof size, roof orientation, slope of the roof, and climatic factors etc., we observed that a 2.517 MWp solar PV system can be installed based on the available

space of Fakhruddin Textile Mills Limited. Apart from this, to make the project economically feasible and maximize the return on investment, the consumption of the facility must be equal to or greater than the generated energy from the installed solar PV systems. As a result, considering both the conditions it is proposed to install a 2.517 MWp solar project in Fakhruddin Textile Mills Limited project premises.

4.4 Adequacy of Generator Size

Load & Energy Consumption Pattern of Fakhruddin Textile Mills Limited is,

- Connection type: 11 kV Line
- Sanctioned load: 3 MW
- No. & Transformer capacity: 3 Nos (6.5 MVA X 1, 4 MVA X 1 & 2.5 MVA X 1)
- Capacity of Diesel Generator: 3 Nos (1600 kW X1, 508 kW X1 & 800 kW X1)
- Capacity of Gas Generator: 3 Nos (900 kW X2 & 750 kW X1).

5 Analysis of Alternatives

An examination and evaluation of the project and potential alternatives had been analyzed. It will be taken into consideration in the ESIA. The evaluation will include:

- An analysis of the alternative means of carrying out the project, including need for the project, alternative sites, alternative projects and variations to the scope of the project (major components included and excluded) and if any of the alternatives could result in a minimization of adverse impacts. For the project components, a comparison of their environmental and technical performance potential and other relevant variables will 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 plan, 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 phase of the project.
- Examination of the 'do nothing' alternative

5.1 Do Nothing

The Do Nothing Alternative in respect to the proposed project implies that the existing state of affairs is maintained. This option is most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. However, the project activities have already been started. This option will however, involve several losses to both the project proponent and the donor organization. The property will remain under-utilized. The No Project Option is the least preferred from the socio-economic and partly environmental since if the project is not done.

- The economic benefits especially during construction i.e., provision of jobs for skilled and non-skilled workers will not be realized.
- There will be no generation of income by the developer to the Government.
- The local skills would remain under-utilized.
- No employment opportunities will be created who will work in the project area.
- Discouragement for donors to allot this level of standard and affordable developments

5.2 Alternative Energy Generation Technology

This alternative would involve the use of wind energy as an alternative development of a solar site. Similar to solar power, power from the wind is an alternative to energy production from non-renewable resources like coal and oil, or nuclear sources.

While the project area has been identified as suitable for solar projects based on the solar insolation levels (the amount of solar radiation energy) in the area, wind energy production is not well suited to the project site due to insufficient area to drive wind turbines on the rooftop.

5.3 Alternative Land Use

As the proposed project is a rooftop solar system, no alternative land use selection is possible.

5.4 Alternative Site

Relocation option to a different site is an option available for the project implementation. Looking for another rooftop to accommodate the scale and size of the project and completing official transaction on it may take a long period. In addition, it is not a guarantee that such land would be available.

The project proponent would spend another long period of time on design and approvals of the plans by the relevant government departments. The project design and planning before the stage of implantation would call for cost; already encountered in the proposed development i.e., whatever has been done and paid to date would be counted as a loss to the proponent. Assuming the project will be given a positive response (after relocation) by the relevant authorities including DoE, it (project) would have been delayed for a long period before implementation. This would also lead to a situation like No Action Alternative. In consideration of the above concerns and assessment of the current proposed site, relocation is not a viable option.

6 Description of Environment and Social Baseline

6.1 General

The baseline environmental quality is assessed through field studies within the impact zone for various components of the environment such as air, noise, water, land and socio-economic structure etc. The primary objective of identifying and describing existing environmental conditions is to provide an understanding of the baseline conditions prior to undertaking any development activities.

Data was collected from primary and secondary sources for the macro-environmental setting. Collection of primary information includes extrapolating environmental features on proposed project design, tree inventories, location and measurement of socio-cultural features adjoining proposed project area. Ambient air, noise, and water quality samples were collected in terms of environment quality to prepare a baseline database. Climate (temperature, rainfall, humidity and wind speed), physiography, geology etc. information was collected from secondary sources. Updated information has been collected to record the micro-environmental features within and adjacent to the project area. Consultation was another source of information to understand local environmental conditions, impacts, and suggestions etc.

6.1.1 Overview of the Project Location

An overview of the project area is provided in the following figure (Figure 6-1). The figure shows topographical features and landforms nearby the project site and provide a general view of the existing surroundings of the project area.



Figure 6-1: Satellite View of the Project Area

The project site is located at Gargaria, Master Bari under Sreepur Upazila within the Gazipur district under Dhaka Division. Sreepur is located in between 24° 11' 56" North Latitudes and 90° 28' 41.5" East Longitudes. The project site is located nearby Dhaka-Mymensingh highway which is 50.2 km far from Dhaka city. There are 8 unions under Sreepur Upazila. It has total area of 465.24 km², also there are 338.34 km² land area, 121.44 km² forest area and 3.16 km² riverine area. It is bounded by Bhaluka and Gaffargaon Upazilas on the north, Gazipur sadar and Kaliganj Upazilas on the south, Kapasia Upazila on the east, Kaliakair

and Sakhipur Upazillas on the west. It has 122872 households, among them 67163 are males, 59089 are females and the population density are about 1064/km² (according to Population and Housing Census 2011). This is a semi-urban area where most of the population is engaged with industrial and commercial activities. The area is economically very active. The project area is mostly consisting of people of the middle and lower-middle class.

6.1.2 Project Influence Area

The Area of Influence (AOI) of the project comprises of the project site and the surrounding area, where influence of the project activities is anticipated. According to DoE, the AOI shall be acknowledged as 1km and 5km. The areas likely to be affected by the project and its associated activities may include:

- impacts on biodiversity or ecosystem services that are vital to the livelihoods of impacted communities;
- Associated facilities, that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.
- Impacts from unintended but predictable project-related developments that may occur later at the related location, such as an increase in traffic.

In this study, considering all the above-mentioned criteria, 1 km buffer area was selected as the AOI, in which, all the baseline information was collected.

The following section describes the baseline environment into three broad categories:

- Physical Environment- factors such geology, climate and hydrology;
- Ecological Environment- factors related to life such as flora, fauna and ecosystem;
- Social Environment- anthropological factors like demography, income, public health, land use and infrastructure.

6.2 Physical Environment

6.2.1 Climate

Like other parts of the country, the project area is heavily influenced by the Asiatic monsoon, and it has these three distinct seasons:

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

High temperatures and thunderstorms characterize the pre-monsoon hot season. April is the hottest month in the country with mean temperatures ranging from 27°C in the east and south, to 31°C in the west-central part of the country. After April, increasing cloud-cover reduces the temperature. Wind direction is variable during this season, especially during the early part. Rainfall, mostly caused by thunderstorms, at this time can account for 10 to 25 percent of the annual total.

The rainy monsoon season is characterized by southerly or south-westerly winds, very high humidity, heavy rainfall and long periods of consecutive days of rainfall. The monsoon rain is caused by a tropical depression that enters the country from the Bay of Bengal. About 80% of the annual precipitation occurs during the five-month monsoon season from May to September.

The cool dry season is characterized by low temperatures, cool air blowing from the west or northwest, clear skies and meager rainfall. The average temperature in January varies from 17°C in the northwest and north-eastern parts of the country to 20°C to 21°C in the coastal areas. Minimum temperatures in the extreme northwest in late December and early January reach between 3°C to 4°C.

Although less than half of Bangladesh lies within the tropics, the presence of the Himalaya Mountain range has created a tropical macroclimate across most of the east Bengal land mass. Bangladesh can be divided into seven climatic zones (Rashid 1991). According to the Figure 6-2, the project site falls in the South-Central Region Climate Zone.

South-Central Zone: In this zone, rainfall is abundant, being above 1,900 mm. The range of temperature is, as can be expected, much less than to the west, but somewhat more than in Southeastern zone. This is a transitory zone between the Southeastern, Northwestern and Southwestern zones and most of the severe hailstorms, nor are westers and tornadoes recorded in this area.

Temperature: The project area is situated in Sreepur Upazilla. As there are no meteorological stations, so we studied the data collected from the nearby station which is Mymensingh station. The monsoon starts in April or May and continues till September to October. During the monsoon, the temperature varies between 35.59°C and 34.82°C. The temperature falls below 18°C in winter, which is spread over December and January and may well include November and February. The highest temperature is felt during May when the temperature may be as high as 35.91°C. These values of temperature are derived from the temperature data from 1989 to 2019 of Bangladesh Agricultural Research Council. The figure shows the maximum temperature of Mymensingh station, which can represent the temperature of the study area.

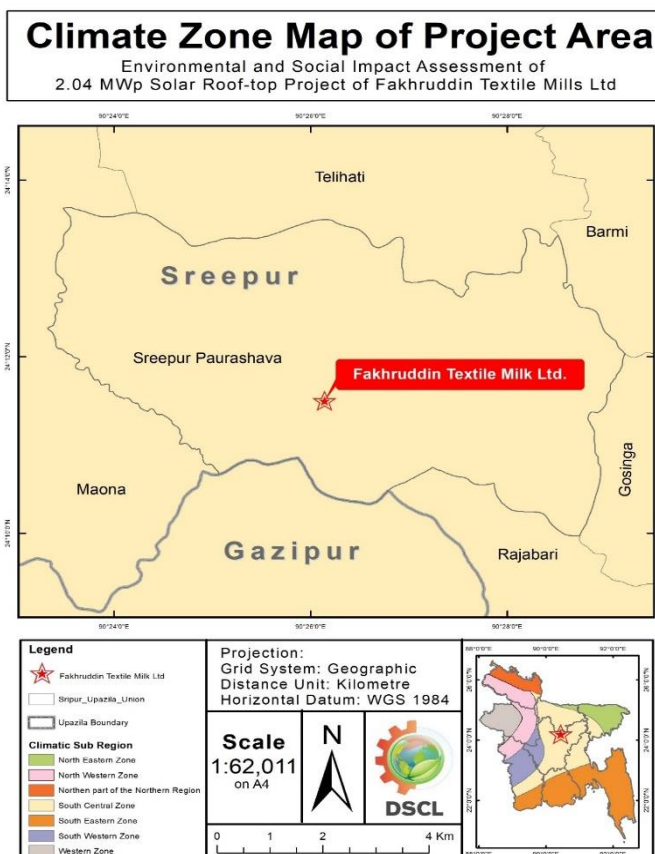


Figure 6-2: Climate Zone Map of the Project area

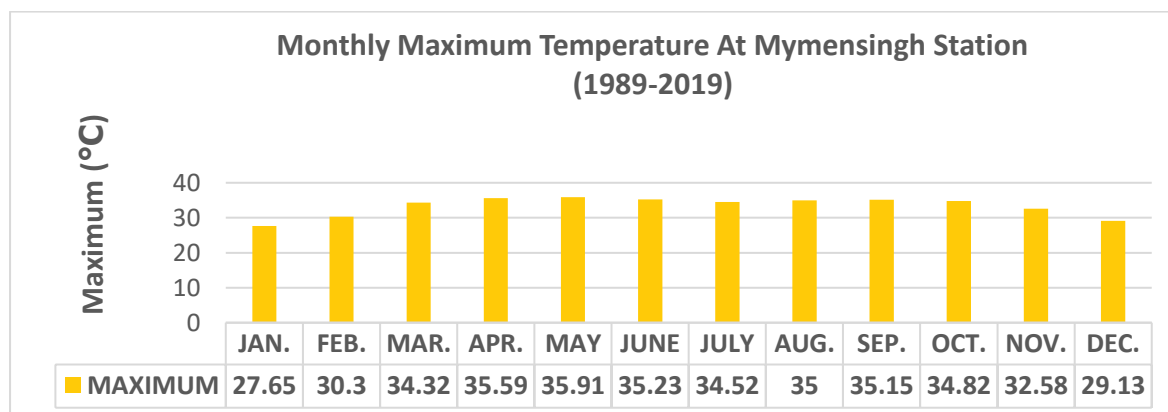


Figure 6-3: Variation of Monthly Surface Air Temperature of Mymensingh Station

Precipitation: The figure represents the monthly accumulated rainfall at Mymensingh station. The monsoon starts in May and continues till August to September in the station. The maximum monthly rainfall during May to September varies from 308.75 mm to 310.78 mm in Mymensingh station.

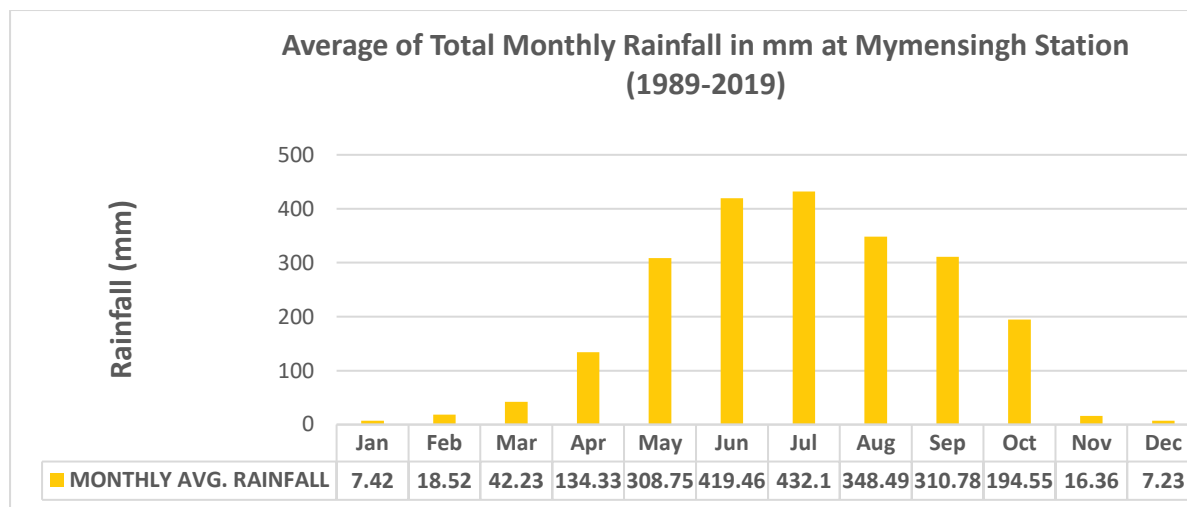


Figure 6-4: Average Monthly Accumulated Rainfall at Mymensingh Station

Wind Speed: The figure shows the average wind speed from 1989 to 2019 at Mymensingh station. Wind speed in the study area represents seasonal variation between the dry season (October to January) and the monsoon season (April to August) in the station. During the month of October to January the wind speed shows lower value. In this season it shows 2.68 to 2.31 ms^{-1} wind speed in Mymensingh station.

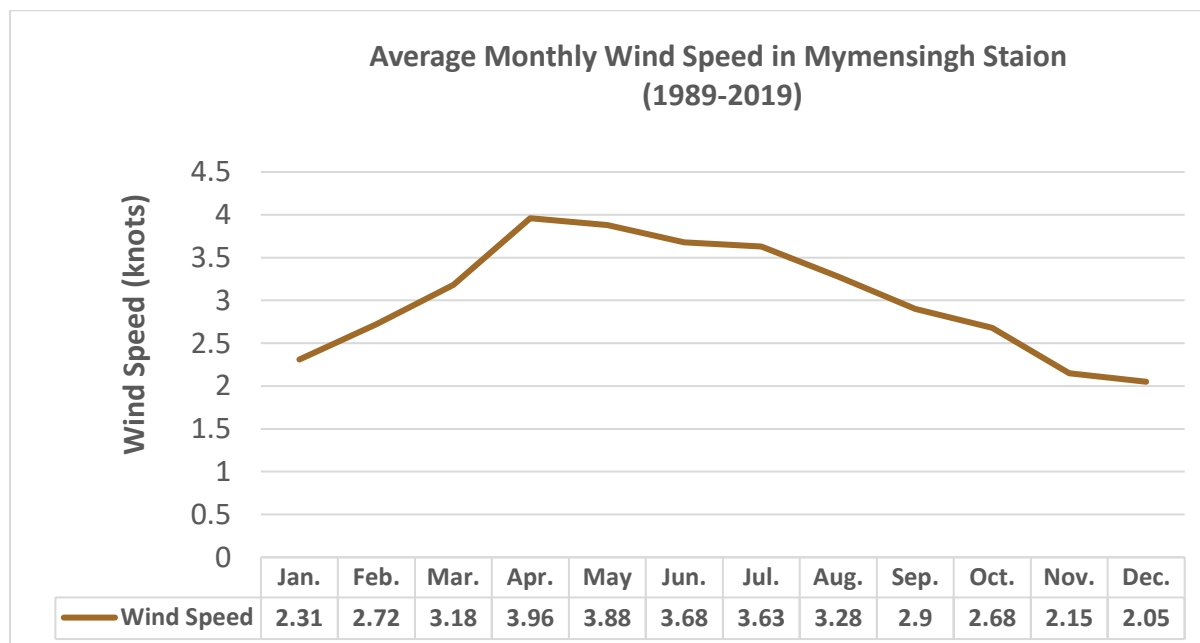


Figure 6-5: Average Monthly Wind Speed at Mymensingh Station

Humidity: Humidity remains high in summer and comparatively low in winter season. The statistical data of humidity from 1989 to 2019 in Mymensingh station indicates that humidity maximized in May to September in the year. In Mymensingh station it ranges from 80.91% to 85.94%. On the other hand, humidity falls 72.88% in March in Mymensingh station.

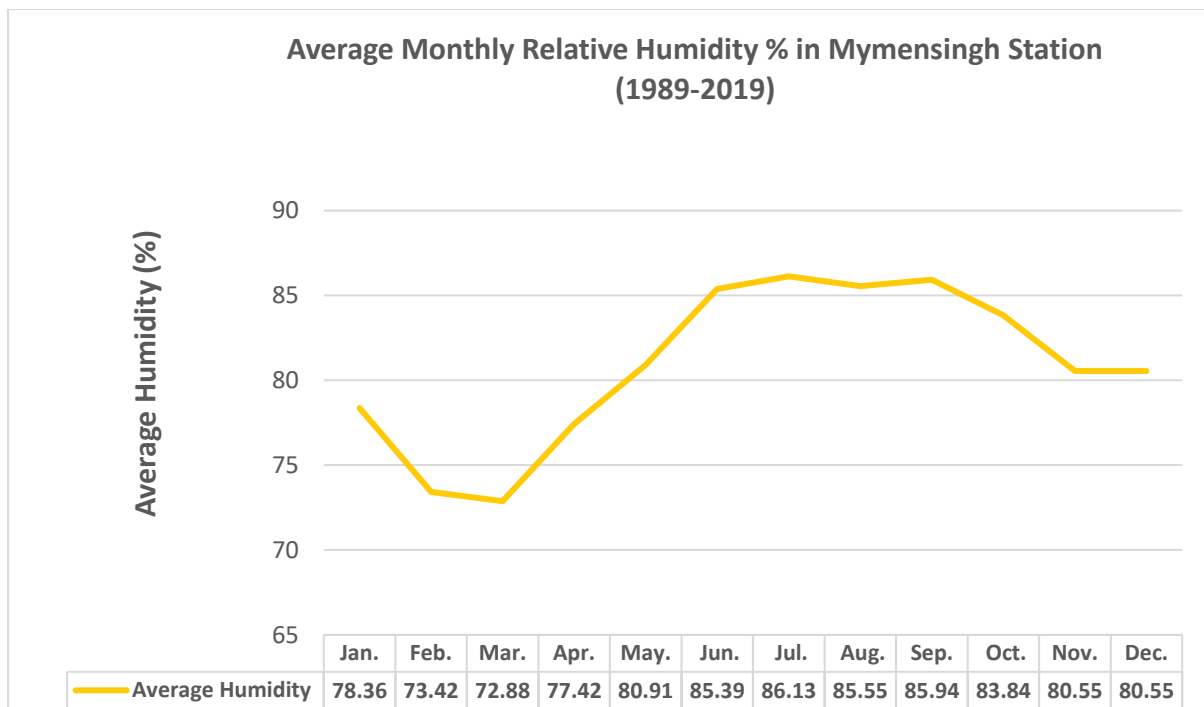


Figure 6-6: Average Monthly Relative Humidity in Mymensingh Station

6.2.2 Ambient Air Quality

The background air quality levels in a region are characterized by concentrations of various contaminants in the atmosphere and are referred to as ambient air quality. The presence of air pollutants and their concentrations is influenced by the type of polluting sources as well as other factors that affect their flow and dispersion.

Associated with the physical observations made during field visits, the project area's ambient air quality is comparatively acceptable, with the exception of some industrial emissions of dust movement and pollutants from automobiles. The proposed project location is directly adjacent to the Dhaka-Mymensingh highway. The main air pollutants in Bangladesh are nitrogen oxides (NO_x), Sulphur dioxide (SO₂), PM_{2.5} (particulate matter with diameter of 2.5 microns or smaller) and PM₁₀ (particulate matter with diameter of 10 microns or smaller), carbon monoxide (CO). Around the 1 km buffer zone, there are no additional brickfields, plastic industries etc. which are the sources of air pollution. Air quality test has been conducted on 28 October 2021 (figure: 6-7) at the proposed project site and the test was analyzed by DSCL Environmental Laboratory. Results of the air quality monitored at the two of the project locations have been showed in Table 6-1.



Figure 6-7: Ambient Air Quality Monitoring in Project Location

Table 6-1: Ambient Air Quality Test Result

Parameter	Unit	FTML_AAQ_01	FTML_AAQ_02	Bangladesh Standard**	Duration (hours)	Weather Condition	Method of Analysis
		28.10.21	28.10.21				
		Fakhruddin Textiles Mills (Unit-1) Sreepur, Gazipur	Fakhruddin Textiles Mills (Unit-2) Sreepur, Gazipur				
		23.19126°N 90.43490°E	24.19387°N 90.43511°E				
PM _{2.5}	µg/m ³	52.40	53.61	65	24	Sunny	Arequal Series 500 PM Monitor
PM ₁₀	µg/m ³	102.64	98.32	150	24		Arequal Series 500 SOx, NOx Monitor
SOx	µg/m ³	28.32	21.27	365	24		
NOx	µg/m ³	31.08	22.73	100	Annual		
CO*	ppm	<1	<1	9	8		CO Meter

Note: ** The Bangladesh National Ambient Air Quality Standards have been taken from the Environment Conservation Rules, 1997 which was amended on 19 July 2005 vide S.R.O. No. 220-Law/2005. NYS: Not Yet Standardized

The measurement results showed achievement of all air quality standards. Based on the ambient air quality standard of DoE. Particulate matter PM_{2.5} value was 52.40 µg/m³ and 53.61 µg/m³ for AAQ_01 and AAQ_02. For both of the sampling locations PM₁₀ value was 102.64 µg/m³ and 98.32 µg/m³ which are in between the DoE standard. SOx, NOx and CO values are also within the standard. The air quality in the project site can be stated as in good condition. The Laboratory Test result given in Appendix A of the report.

6.2.3 Water Resources and Hydrology

Bangladesh is located over a subsiding basin of tectonic origin overlain with a great thickness of sedimentary strata. This sedimentary stratum is an unconsolidated alluvial deposit of recent age overlaying marine sediments. The recent delta and alluvial plains of the Ganges, Brahmaputra and the Meghna Rivers constitute the upper formation. The near surface Quaternary alluvium contains good aquifer characteristics (transmission and storage coefficients). The groundwater (GW) storage reservoir has three divisions: upper clay and silt layer, a middle composite aquifer (fine to very fine sand) and a main aquifer consisting of medium to coarse sand. Drinking water is generally taken from deep tube wells with strainers set between depths of 200 meters to around 400 meters (DPHE, 2011). The Ground water level is at or very close to the surface during the monsoon; whereas, it is at maximum depth during the months of April and May (Banglapedia, 2014).

- **Surface Water:** The nearby river named 'Shaldaha River' which is 15.8 km far from the project location. Besides, another waterbody inside 'Bhowal Resort Mymensingh' which is 7.6 km far from the project area. There is a pond within 1 km of the survey area named Kewapurbo Govt. Primary School Pond. People mainly use the water for their day-to-day activities. During rainy season they utilize the water from that pond for irrigation also.

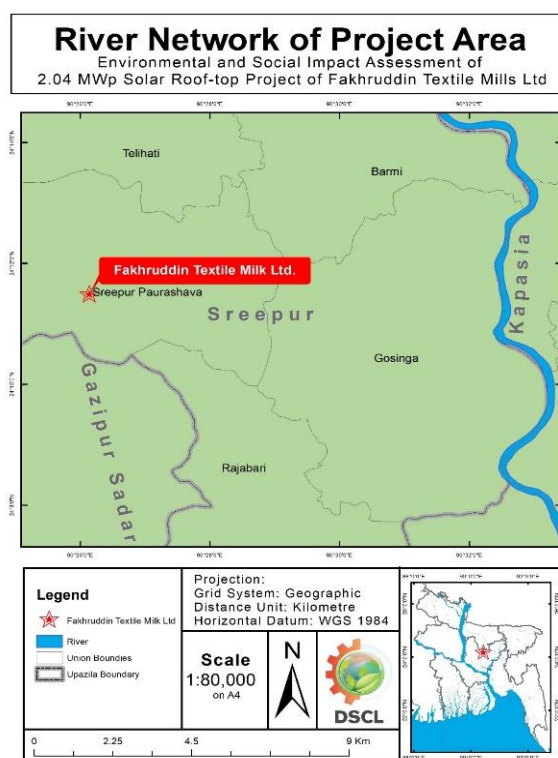


Figure 6-8: River Network of the Project Area

- **Groundwater:** The project area has a large pump to full fill the groundwater demand. The area has three pumps inside their factory. The pumps can be used as a backup if one is not capable of service. The average pipe length of those pumps are more than 350 feet.

6.2.4 Water Quality

Surface Water: Surface water samples were collected from a pond inside the project location on 28 October 2021. The locations along with GPS coordinates are summarized with results in Table 6-2. The sample were collected with Kemmerer Bottle and then transferred in 1-liter plastic sampling bottles. The sampling bottles were then kept in an ice cooler. Life jacket including Vest and helmets were used during the collection of water sample.



Figure 6-9: Surface Water Sample Collection from Project Area

Table 6-2: Surface Water Quality Test Result

Parameters	Unit	FTML_SW_01	Standards for Inland Surface Water**	Method of Analysis
		28.10.2021		
		Kewa Purbo Khondo Primary School Pond, Bhangnahati Rd, Sreepur, Gazipur		
		24.19928°N 90.43948°E		
Temperature	°C	31.5	NYS	Multimeter
pH	-	8.3	6.5-8.5	Multimeter
Dissolved Oxygen (DO)	mg/L	6.2	5 or more	DO Meter
Total Suspended Solids (TSS)	mg/L	6	NYS	Gravimetric Method
Biological Oxygen Demand (BOD ₅)	mg/L	1	6 or less	5 Days Incubation
Chemical Oxygen Demand (COD)	mg/L	4	NYS	CRM
Manganese (Mn)	mg/L	0.03	NYS	AAS
Turbidity	NTU	11.4	NYS	Turbidity Meter
Ammonia	mg/L	0.14	NYS	UVS

*Standards for Inland Surface Water is followed Environment Conservation Rule (ECR)*97
NYS = Not Yet Standardized

The test result shows that all of the parameters are within the national standard according to ECR, 97. The laboratory test result is given in Appendix B of the report.

Groundwater: Groundwater sample was collected from a pump inside the project location on 28 October 2021. The area has 3 pumps inside their factory. The pumps can be used as a backup if one is not capable of service. The sample were collected with 1-liter plastic sampling bottle. The sampling bottle was then kept in an ice cooler. Hand gloves and helmets were used during the collection of water sample. The locations along with GPS coordinates are summarized with results in Table 6-3.

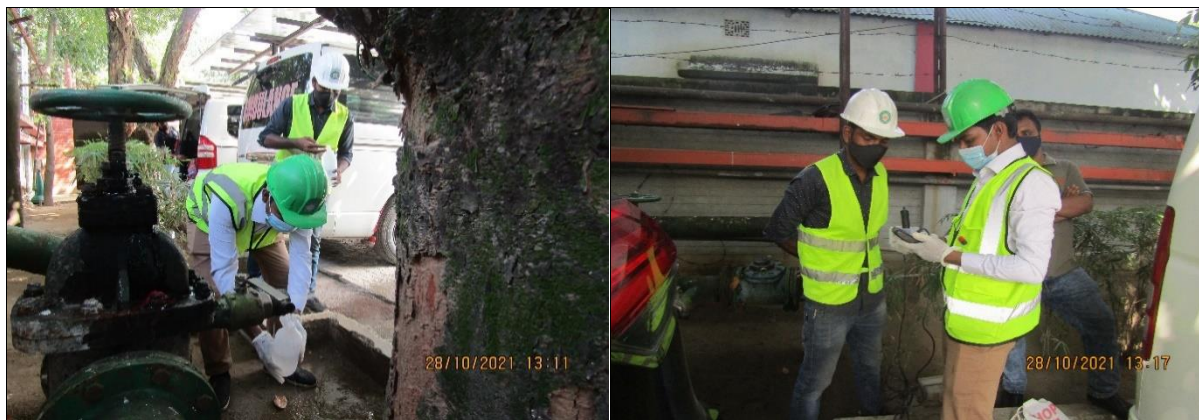


Figure 6-10: Groundwater Sample Collection from Project Area

Table 6-3: Groundwater Quality Test Result

Parameters	Unit	FTML_GW_01	Standards for Potable Water**	Method of Analysis
		28.10.21		
		Fakhruddin Textile Mills Water Pump (near pump room)		
		24.19143°N 90.43498°E		
Temperature*	°C	28.5	20-30	Multimeter
pH*	-	6.5	6.5-8.5	Multimeter
Dissolved Oxygen (DO)*	mg/L	6.2	5 or more	DO Meter
Total Suspended Solids (TSS)	mg/L	1	10	Gravimetric Method
Biological Oxygen Demand (BOD ₅)	mg/L	1	0.2	5 Days Incubation
Chemical Oxygen Demand (COD)	mg/L	4	4.0	CRM
Iron (Fe)	mg/L	0.05	0.3-1.0	AAS
Manganese (Mn)	mg/L	0.03	0.1	AAS
Turbidity	NTU	0.41	10	Turbidity Meter
Ammonia	mg/L	0.10	0.5	UVS
Arsenic (As)	mg/L	0.001	0.05	AAS

NYS = Not Yet Standardized

*On site Test

** Standards for Potable Water According to ECR, 97

The test result shows that all of the parameters are within the national standard according to ECR, 97 except BOD₅. The greater the BOD₅, the more rapidly oxygen is depleted in the stream. This means less oxygen is available to higher forms of aquatic life. Though the sample is groundwater, so there will a less effect for BOD₅ increasing. The laboratory test result is given in Appendix C of the report.

6.2.5 Noise Measurement

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

The proposed project was in RMG factory's location. Noise is generating from these industries and manufacturing factories in the project area. There are some commercial or refreshment areas where always significant number of people gather and makes chaos continuously. This is another source of noise pollution along the road. The factory has washing and dyeing department which also cause noise enhancement.

Noise Level Measurement was analyzed at project site during day time on 28 October 2021 (figure 6-11). Noise level data were taken inside the project site. Noise level data were summarized in the table 6-4.



Figure 6-11: Noise Level Monitoring from Project Location

Table 6-4: Noise Level Monitoring Test Result

Location	Sample ID	GPS Location	Date	Land Use Category	Time		Noise Level (dBA) LAeq	Bangladesh Standard
					Start	End		
Beside Admin Building	NM_01	24.19110°N 90.43485°E	28.10.21	Industrial Area	11.25 am	11.55 am	69.03	75
Beside Dyeing Room	NM_02	24.19125°N 90.43429°E			11.58 pm	12.28 pm	73.22	
Unit-2 Building	NM_03	24.19098°N 90.43319°E			12.30 pm	1.00 pm	75.87	
Near Washing Plant	NM_04	24.19385°N 90.43482°E			2.40 pm	3.10 pm	61.16	

Location	Sample ID	GPS Location	Date	Land Use Category	Time		Noise Level (dBA) LAeq	Bangladesh Standard
					Day			
					Start	End		

Notes:

- Land use category is based on the classification provided in the Noise Pollution Control Rules (2006)
- Noise level standards for industrial area is 75 dBA for day Time.
- Noise Level is the average noise recorded over the duration of the monitoring period.

The result shows that time weighted average value of the sound monitored inside the project site are within the standard set for industrial area except the location of Unit-2 building (NM_03). The reason could be for building construction inside the factory. Construction machineries and vehicle movement were observed also. The details analysis of the result is given in Appendix D of this report.

6.2.6 Soil Quality

Deep Red Brown Terrace Soil:

This type of soil occurs extensively in the northeastern Barind Tract, on the Madhupur Tract and on the Akhaura Terrace. These soils are well to moderately well drained, reddish brown to yellow-brown, strongly to extremely acidic, friable clay soils over deeply weathered, red-mottled, Madhupur Clay. They are mainly Ferric Alisols (Banglapedia, 2015).

6.2.7 Physiography

In the context of physiography, Bangladesh can be divided into three broad categories based on topography, physical features, and geological history (Brammer; 1996)

1. Floodplains
2. Terraces
3. Hills

Within these 3 broad categories, a number of authors have further divided the land surface into a series of Physiographic Units based on a combination of topographical/landscape features, underlying geology and surface soils (Brammer; 1996, Rashid; 1991, Morgan and McIntyre; 1959). The most recent study was undertaken by the Soil Resource Development Institute (SRDI) who further refined the previous classifications into 26 Physiographic Units (20 primary units and 6 sub-units) based on an assessment of more recent and detailed data

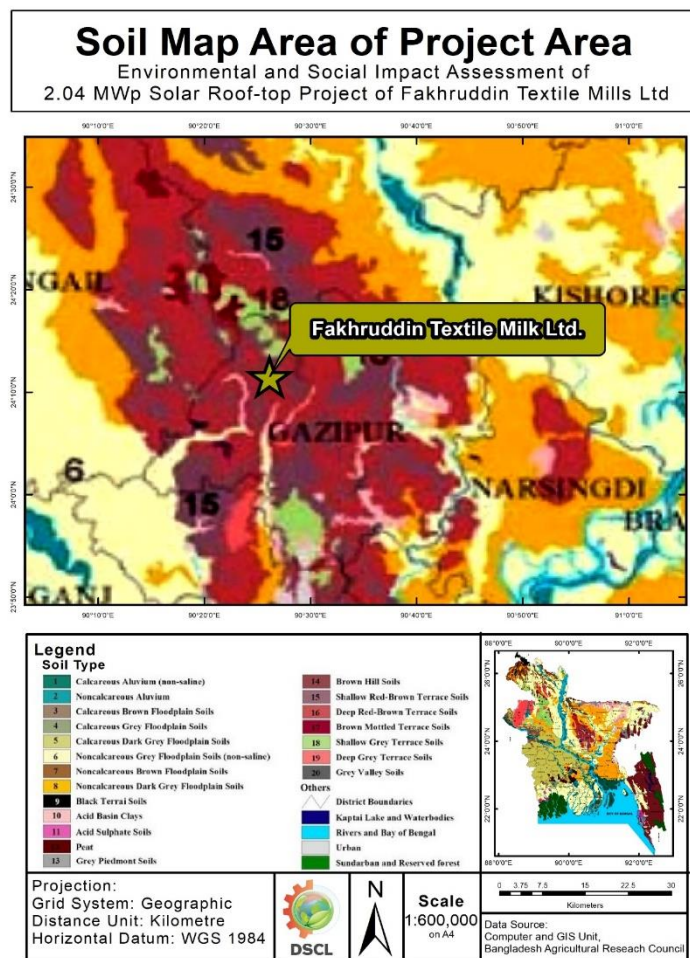
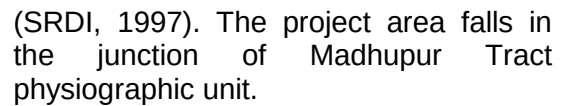


Figure 6-12: Soil Type Map of the Project Area



- **Madhupur Tract:** Another Pleistocene upland block in the Bengal Basin is located in the central part of Bangladesh comprising greater Dhaka and Mymensingh districts, between the courses of the Old Brahmaputra and the Jamuna Rivers. The south; this physiographic sub-region extends to as far as Towards Dhaka, the capital of the country. Madhupur Tract measures about 4,105 sq km. Comparable to the Barind Tract, the area belongs to a Pleistocene terrace consisting mainly of red colored and mottled clays. It is characterized by plateau-like hillocks varying in height from 9 to 18.5m, and a dendritic drainage pattern, typical of all Pleistocene terraces in Bangladesh. The valleys, mostly flat, are cultivated. The Madhupur jungle contains Shal trees (*Shorea Robusta*), the hardwood which is second to teak in value.

6.2.8 Topography

- (i) A broad alluvial plain subject to frequent flooding,
- (ii) A slightly elevated relatively older plain, and
- (iii) A small hill region drained by flashy rivers.

The general topography of the project area is relatively flat. The topography of the specific project location is 11.27 m to 18.59 m a.m.s. Topographically the cluster of the project location is almost flat, with many depressions and borrow pit.



basin clays are the major ones. Soils in the valleys are dark grey heavy clays. They are strongly acidic in reaction with low status of organic matter, low moisture holding capacity and low fertility level (Banglapedia, 2014).

6.2.11 Seismicity

Bangladesh is situated in one of the most tectonically active regions in the world. Here is where three major plates meet (the Indian Plate, the Tibet Sub-Plate, and the Burmese Sub-Plate). The project area is located over the Indian Plate, which is moving north. However due to the location of relevant plates, fault lines and hinge zones, Bangladesh itself is divided into four seismic zones (Table 6.5), based on the ranges of the seismic coefficient (note: the seismic coefficient is a measure of how strong an earthquake has the potential to be based on a combination of the mass of the plate and the seismic forces acting on it, as well as how frequently these quakes are likely to occur). As per the seismic zone map (Figure 6-16), project area falls in the zone-3 comprising the central part of Bangladesh represents the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur Tracts, and the western extension of the folded belt. It means the project area is prone to possible severe seismic intensity. Though there is no evidence of major earthquakes in the project areas in the recent past.

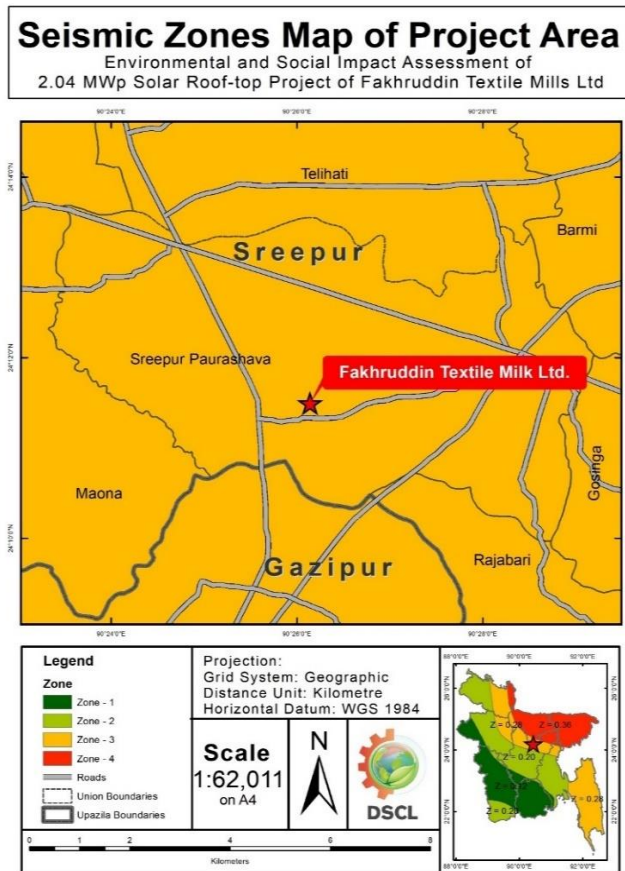


Figure 6-16: Seismic Zones Map of the Project Area

Table 6-5: Seismic Co-efficient

Zones	Bask Seismic Coefficient
Zone-1	0.12
Zone-2	0.20
Zone-3	0.28
Zone-4	0.36

6.2.12 Climate Change and Natural Hazards

Climate change is a global issue. The world's climate is changing and will continue to change in the coming century. Climate Change is basically the change in climate over a time period that ranges from decades to centuries. It is a normal part of the Earth's natural variability, which is related to interactions among the atmosphere, ocean, and land, as well as changes in the amount of solar radiation reaching the earth. However, the term "climate change" is defined by the United Nations Framework Convention on Climate Change (UNFCCC) as "A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (IPCC, 2007). The risks

associated with these changes are real but highly uncertain. Societal vulnerability to the risks associated with climate change may exacerbate ongoing social and economic challenges, particularly for those parts of societies in developing countries dependent on resources that are sensitive to changes in climate.

Building large solar power plants requires significant long-term investment so understanding impacts from climate change will aid financial planning, technology selection, and energy output projections. Climate change and its associated impacts will be experienced through changing temperatures and precipitation, rising sea levels, changes in the frequency and severity of climate extremes and in the dynamics of hazardous conditions (IPCC, 2007). Developing countries are considered to be particularly susceptible to climate change because of their exposures and sensitivities to climate-related extremes, and especially because of their limited adaptive capabilities to deal with the effects of hazardous events. Given this limited capacity to adapt, they are considered to be particularly vulnerable to damages associated with climate, just as they are particularly vulnerable to other stresses.

Photovoltaic (PV) electricity generation depends on solar irradiance, named surface-down welling shortwave (that is, wavelength interval 0.2–4.0 μm) radiation by climate models, and other atmospheric variables affecting panel efficiency, namely surface air temperature and surface wind velocity. Climate change may therefore affect PV power generation and its temporal stability for a given panel fleet.

6.2.13 Environmental and Social Sensitive Features

Environmentally sensitive features mean, according to the State Development and Redevelopment plan, the natural and cultural resources, the disturbance of which tends to impair the physical, biological, social or aesthetic quality of the resource. It is a fundamental and basic trait found in many things and is crucial because it enables an individual to adapt to different environmental conditions. Levels of Environmental Sensitivity often vary considerably from individual to individual, with some being more and others less sensitive to the same conditions. If the solar panel located in the rooftop there will be no harmful effect on the environmental and social sensitive features.

6.3 Ecological Environment

The countries of South and Southeast Asia are recognized by International Union for Conservation of Nature (IUCN) to be regions of high species diversity. A large number of native plants, including 3,000-4,000 species of woody flora, have been recorded from Bangladesh. The country lies at the meeting point of several floristic provinces, including the Manipur-Khasia, Bengal and North Burman provinces within the Indo-Malayan realm (IUCN, 2002).

Bangladesh was once well forested, but most of the native forests have disappeared in recent decades due to mounting pressure from human populations. Only scattered patches of native trees, wetlands and associated fauna habitat remain in isolated locations within the terrestrial environment (IUCN, 2002). In many parts of the country, the abundance of plantations and groves of trees around villages creates an aspect of discontinuous forest (Wahab, 2008).

The floodplains of Bangladesh have long been subject to cultivation, the most dominant land use within the project area, with only scattered patches of native trees, wetlands and associated fauna habitat remaining in isolated locations within the terrestrial environment (IUCN, 2002).

6.3.1 Bio-Ecological Zones

This section deals with the methodology for biodiversity assessment of Flora (tree, shrubs and herbs) and Fauna (birds, reptiles, amphibians, mammals) as well as the surrounding ecosystems. Most of the field work within the project study area addressed these groups although each group was dealt with different approaches and requirements. A 5 km radial zone around the project site has been taken into consideration to establish the representative baseline in the study area.

Within a relatively small geographic boundary, Bangladesh enjoys a diverse array of ecosystems. Being a low-lying deltaic country, seasonal variation in water availability is the major factor, which generates different ecological scenarios of Bangladesh. Temperature, rainfall, physiographic variations in soil and different hydrological conditions play vital roles in the country's diverse ecosystems. The ecosystems of Bangladesh could be categorized into two major groups, i.e. (i) land based and (ii) aquatic. The land-based ecosystems include forest and hill ecosystems, Agro-ecosystems and homestead ecosystems; while seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and chars, and marine ecosystems fall into the aquatic category.

Each of the ecosystems has many sub-units with distinct characteristics as well. IUCN Bangladesh in 2002 classified the country into twenty-five bio-ecological zones (Figure 6-17). The project area falls below the bio-ecological zone,

Madhupur Sal Tract: The Madhupur Sal tract extends across the district of Gazipur, Tangail and Mymensingh. The boundary between this ecosystem and its surroundings are generally sharp and well defined. Undulating Sal Forest is the main ecological feature of this zone. This region is enriched with high floral diversity, but unfortunately, over 70% of the Sal Forest area is either already degraded or encroached. The Madhupur Sal tract is prominent by the presence of Sal (*Shorea Robusta*) tree. Records show that the Bengal tiger and One-horned rhinoceros, both of which have become extinct from this zone now, had healthy population in the past. However, due to continuous habitat destruction most of the wildlife of this region are either extinct or in vulnerable condition (Biodiversity National Assessment and Program of Action 2020)

The status of terrestrial floras and faunas at the project site were assessed from visual observations, review of literature, and information documented by other agencies. The project area consists of several ecological subsystems e.g., open agricultural land, homesteads. The open agriculture land ecosystem dominates the area providing widespread habitat types for various species of flora and fauna under flooded and non-flooded conditions. The vegetation covers of agricultural lands are different crop species, weeds and other herbaceous plants species. The faunal species in the agriculture land and roadside



Figure 6-17: Bio-ecological Zones of Bangladesh Map

bush ecosystems include birds, amphibians, fishes, snakes and few mammals. The homestead ecosystem provides the main tree covered areas within rural Bangladesh including the project site. Fruit, timber, fuel wood, medicinal plants and various multipurpose tree species cover the homesteads. The wildlife species in homestead ecosystem include the birds, amphibians, reptiles, rodents and mammals like mongoose, jackal, cats, monkey, etc. Many of the species including mammals are vulnerable or/and endangered in Bangladesh due to habitat loss, over exploitation, natural calamities and lacking of management. The project command area is not the specific habitat for any particular species of flora and fauna hence none such species will be specifically affected due to project implementation.

6.3.1.1 Flora Survey

The project influence area (PIA) has a large number of trees. There are many trees inside the factory area of Fakhruddin Textile Mills Ltd. Besides some fruit trees were also observed. The data collected from the field survey suggests that the predominant species are those of cultivated vegetables and trees. A detailed list of terrestrial floral species found in the project area is shown in Table 6-6.

Within Gazipur district, there are little natural terrestrial habitats, because in most cases vegetation was cleared many years ago to provide land for development, and for agriculture in the suburbs. The project area is similar to the character to many areas of alluvial delta in Bangladesh with mixed crop vegetation. Rice, other grains and seasonal vegetables are the main crops in this area. Terrestrial plants are now mainly limited to trees, shrubs and flowers grown alongside roads, in parks and gardens, also inside the factory itself. The crops and fruit trees planted in agricultural areas. The composition of plant community includes low growing grasses and herbaceous vegetation as well as other flora.

Table 6-6: List of Flora in the Project Influenced Area

Species Name	Local Name	Family
<i>Albizia saman</i>	Rain Tree	Fabaceae
<i>Abroma augusta</i>	Ulat kambal	Malvaceae
<i>Acacia moniliformes</i>	Akashmoni	Leguminosae
<i>Areca catechu</i>	Supari	Palmae
<i>Azadirachta indica</i>	Neem	Meliaceae
<i>Borassus flabellifer</i>	Taal	Arecaceae
<i>Cocos nucifera</i>	Narikel	Palmae
<i>Artocarpus heterophyllus</i>	Kanthal	Moraceae
<i>Bambusa vulgaris</i>	Bansh	Poaceae
<i>Ficus benghalensis</i>	Bot	Moraceae
<i>Carica papaya</i>	Pepe	Caricaceae
<i>Ficus religiosa</i>	Oshwoth	Moraceae
<i>Mangifera indica</i>	Aam	Anacardiaceae
<i>Shorea robusta</i>	Shal	Dipteocarpaceae
<i>Salvadora mangle</i>	Shimul	Malvaceae
<i>Phoenix sylvestris</i>	Khejur	Palmae
<i>Streblus asper</i>	Shewra	Moraceae
<i>Swietenia macrophylla</i>	Mahogany	Meliaceae
<i>Tamarindus indica</i>	Tentul	Leguminosae
<i>Terminalia arjuna</i>	Arjun	Combretaceae
<i>Tectonia grandis</i>	Shegun	Lamiaceae
<i>Psidium guajava</i>	Peyara	Myrtaceae
<i>Albizia lebbek</i>	Koroi	Fabaceae

In figure 6-18, there are some figures of floras inside the project area.



Figure 6-18: Identification of some Flora of the Study Area

6.3.1.2 Fauna Survey

Terrestrial fauna survey studies help to understand the wellbeing of a nature and functioning of ecosystems. It helps to monitor biological heritage quality, habitat change and quantifying threatening species.

The project area's diverse habitat and ecosystem support a wide range of animal species, as shown in Table 6-7. Primary and secondary mode was adopted for identification of fauna. Most of the birds are identified through direct observation rather than from people. Most of the amphibians, reptiles and mammals were identified by using books and description of the local people during the field survey.

Table 6-7: List of Fauna in the Project Influenced Area

Species Name	English Name	Local Name
Class: Amphibian		
<i>Rana tigrina</i>	Indian bull frog	Kula bang
<i>Bufo melanostictus</i>	Common toad	Kuno bang
<i>Rhacophorus leucomystax</i>	Tree frog	Gecho bang
Class: Mammalia		
<i>Mus musculus</i>	Mouse	Nengtiindur
<i>Capra aegagrus hircus</i>	Goat	Chagol
<i>Canis lupus familiaris</i>	Dog	Kukur
<i>Ovis aries</i>	Sheep	Bhera
<i>Bos taurus</i>	Cow	Goru
<i>Bubalus bubalis</i>	Wild buffalo	Mohish
<i>Herpestes dardoussi</i>	Mongoose	Beji
<i>Sciurus carolinensis</i>	Grey Squirrel	Kath birali
<i>Canis aureus</i>	Jackal	Sheyal
<i>Macaca fascicularis</i>	Monkey	Banor
<i>Rattus rattus</i>	Rat	Indur
<i>Viverra zibetha</i>	Large Indian Civet	Khatash
<i>Felis chaus</i>	Jungle cat	Bon biral
Class: Aves		
<i>Spilopelia chinensis</i>	Spotted dove	Tilaghughu
<i>Passer domesticus</i>	House sparrow	Charui
<i>Milvus migrans</i>	Black kite	Cheel
<i>Amaurornis phoenicurus</i>	Water fowl	Dahuk
<i>Anatidae anatidae</i>	Duck	Hash
<i>Picononotus barbatus</i>	Common bulbul	Bulbuli
<i>Acridothera tristis</i>	Common myna	Shalik
<i>Copsychus saularis</i>	Magpie robin	Doyel
<i>Eudynamis scolopacea</i>	Asian cuckoo	Kokil
<i>Egretta garzetta</i>	Little egret	Bok
<i>Corvus splendens</i>	Crow	Kaak
<i>Tyto alba</i>	Barn owl	Pecha
<i>Gallus gallus</i>	Wild cock	Murgi
<i>Melopsittacus undulatus</i>	Budgerigar	Tia pakhi
<i>Orthotomus sutorius</i>	Common tailorbird	Tuntuni

In figure 6-19, there are some figures of faunas inside the project area.

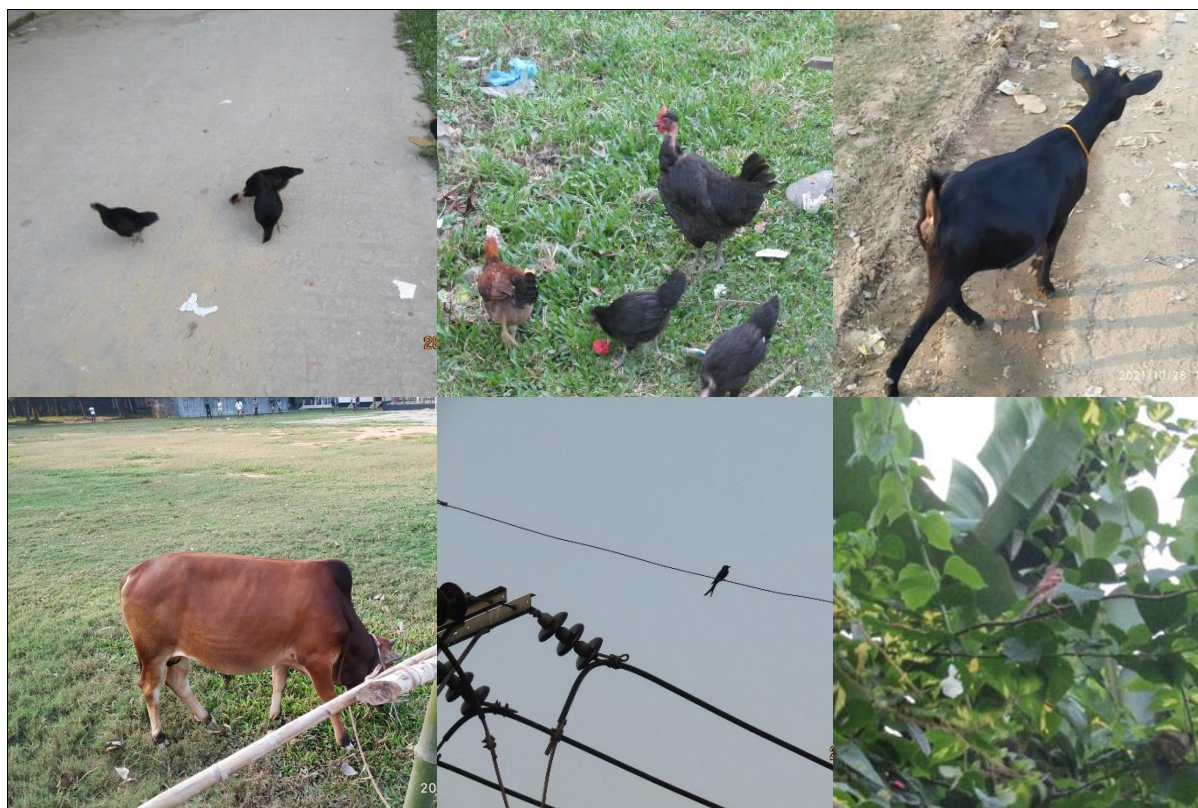


Figure 6-19: Identification of some Fauna of the Study Area

6.3.2 Aquatic Flora and Fauna

Aquatic Faunas are therefore a common component of wetlands. An aquatic fauna is an animal, either vertebrate or invertebrate, which lives in water for most or all of its life. Many insects such as mosquitoes, mayflies, dragonflies and caddisflies have aquatic larvae, with winged adults. Aquatic faunas may breathe air or extract oxygen from that dissolved in water through specialized organs called gills, or directly through the skin. Different types of aquatic fauna species were recorded in the project area. The flora species commonly found are Kochuripana, DholKalmi, Sheola, Malanchi, Kalmi, Helencha etc.

The species of fish found in the area are Mrigel, Rui, Katla, Grass Carp, Silver Carp, Mirror Carp, Big Head, Koi, Tengra, Taki, Singh, Chingri, etc.

It is observed from the stakeholder consultations that no endangered fish species were identified. No anticipated impact on aquatic species as well as fish species due to the project activities. In figure 6-20, here are some aquatic faunas which were captured inside the project location.



Figure 6-20: Identification of some Aquatic Fauna of the Study Area

6.3.3 Protected Area and Red Book Species

Many wildlife species are in stress in Bangladesh, many more are endangered/threatened and a large number already faced extinction. The status of faunal species in Bangladesh has been published by IUCN (2000). According to the IUCN findings this country has lost 10% of its mammalian fauna, 3% avifauna and 4% reptiles over the last 100 years. More than 50 species are presently critically endangered in Bangladesh of which 23 species are already declared as endangered in the Red Data Book of IUCN. In addition, 83 species are commercially threatened and are included in the appendices of Convention on International Trade in Endangered Species (CITES). Among the most endangered species are: elephant, tiger, wild Cat, Leopard or wild goat, dolphin, birds: white-winged duck, comb duck, stork, carne, partridge, and crocodile, python, monitor, lizard, tiger terrapin, roofed turtle, soft turtle, and marine turtles.

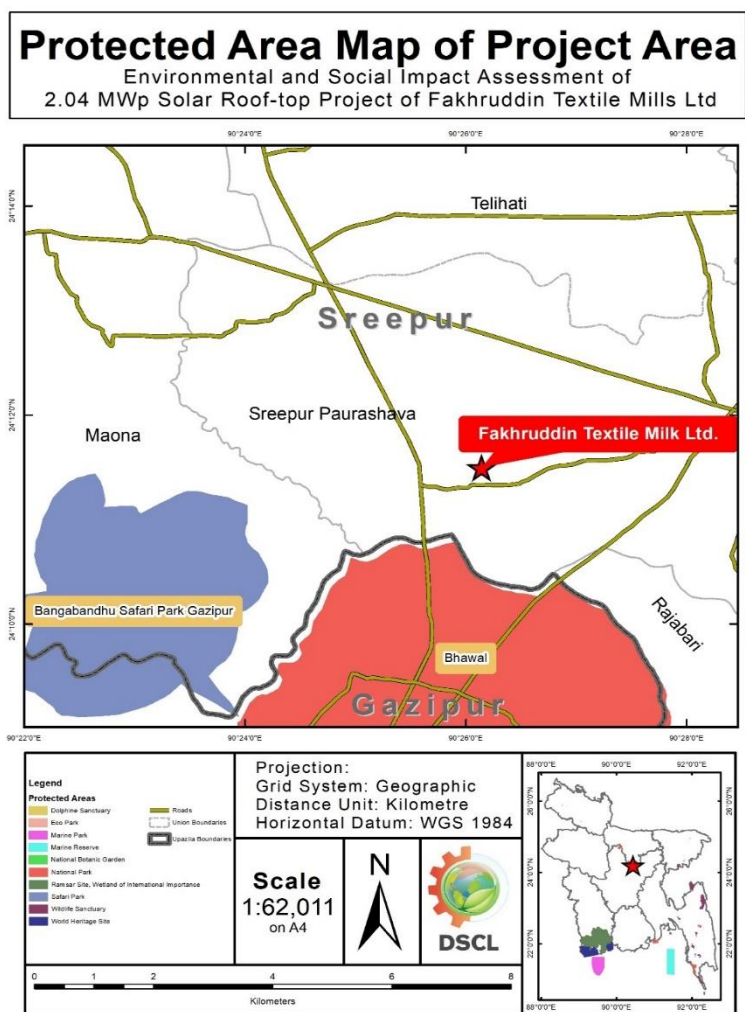


Figure 6-21: Protected Area Map of the Project Area

In and around the project no environmentally protected areas were found. Construction impacts on the rate of deforestation, loss of habitat, habitat fragmentation and interruption of wildlife migration patterns are not anticipated. Figure 6-21 shows that no environmental sensitive area is present around the project region.

6.4 Social Environment

This section provides a profile and analysis of the socio-economic characteristics and practices that currently exist within the project Area. Socio-economic baseline data has been collected in order to achieve a number of outcomes, namely to:

- Assess potential impacts that may arise as a result of the project;
- Provide a basis for the effective monitoring of the project during construction and operation; and
- Allow for the evaluation of any social, economic and demographic changes in the project Area that could be attributable to the project.

Understanding the social, human, and economic elements of the major stakeholders, i.e., those living in and around the project site, is critical for every development project, large or small. Extensive literature review and field survey were used to collect the relevant data/information on the social and economic aspects of affected people.

In addition, data obtained from secondary sources were compared with the primary information gathered during the study. Data on population, age, sex composition, household patterns, and sources of drinking water, sanitation facility, and ownership of agricultural land were enumerated from the latest community series census published by the Bangladesh Bureau of Statistics (BBS).

There is one local bazar within 1 km of the proposed project site, which is opposite of the main entrance of the project area. There are also schools and mosques near the proposed location. The range of profession includes business, farmer, service etc.



Figure 6-22: Schools and Madrasha inside 1 km buffer zone of the project area

6.4.1 Demographic and Administrative Information

Demography is the scientific study of the number of populations, especially with reference of their size, structure, sex distribution, population density, literacy rate etc.

Sreepur Upazilla which is located in Gazipur District in the division of Dhaka. About 126,249 people live here which makes this city the 36th largest city in Bangladesh. Sreepur is located in between 24° 11' 56" North Latitudes and 90° 28' 41.5" East Longitudes. The project site is located nearby Dhaka-Mymensingh highway which is 50.2 km far from Dhaka city. There are 8 unions under Sreepur Upazila. It has total area of 465.24 km², also there are 338.34 km² land area, 121.44 km² forest area and 3.16 km² riverine area. Sreepur Upazila is divided into Sreepur Municipality and eight union parishads: Barmi, Gazipur, Gosinga, Kaoraid, Maona, Prahladpur, Rajabari, and Telihati. The union parishads are subdivided into 81 mauzas and 172 villages. Sreepur Municipality is subdivided into 9 wards and 20 mahallas.

According to Census 2011, the total population of Sreepur Upazila is 122872. Among them male population is 67163 and female population is 59089.

Table 6-8: Population of the Sreepur Upazilla

Total Population	Number of Males	Number of Females
122872	67163	59089

District Statistics 2011

Population by Religion: According to Census 2011, BBS data shows that in Sreepur, Muslims form 95998 of total population. Other major religions in the city are Hinduism 25449; Buddhism 52; Christianity, 488 and others 915 of total population.

Table 6-9: Population Distribution by Religion

Total Population	Muslim	Hindu	Buddhist	Christian	Others
122872	95998	25449	52	488	915

District Statistics 2011

6.4.2 Land use

In Sreepur Upazila the amount of total land area is 465.2 km². The major part 59.91% of the Sreepur area is being used for agricultural purposes. Residential use is the second highest

land use containing 28.46% of land. A large part 1.47% of the land is occupied by the water bodies including one river. Commercial and Processing & Manufacturing use occupied 0.75% and 3.80% of land respectively. The circular network and mixed use occupied 3.09% and 0.13% of land respectively. While 0.22% of land is available for community services and 0.35% of land is used for educational facilities. (Source: Master Plan 2011-2031 of Sreepur).

6.4.3 Utility Services

- **Water Supply Situation:** The people of the area mostly collect drinking water from tube-well. According to the Population and Household Census 2011, the most of the people (79.8%) collect drinking water from tube-well while 17.9% of the people collect drinking water from tap and 2.3% of the people from other sources.
- **Drainage Condition:** There are three khals named Labolang Sagar, Maricha Khal and Chokkar Khal. The Labolang Sagar flows from west to south direction along the west and south boundary. Other two khals flow inside the Municipality towards south direction. These two khals meet Labolang Sagar and finally it routes to Turag River. These khals are very important for the drainage. (Source: Drainage, Sanitation and SWM: Volume 4 of 4 of Final Report of Sreepur, DPHE, February 2014).

The Upazila area has only 17.75 km long drain amongst which 4 km, 3 km and 10.75 km are primary, secondary and tertiary drains respectively. Most of the drain is narrow. These existing drains are not enough to carry storm and domestic waste water. (Source: Municipality Data, 2018)

6.4.4 Livelihoods

Livelihood means a supporting of one's existence, especially in terms of financial support. It encompasses people's capability, assets, income, etc. Main sources of income are commerce, employment, rent and remittance, transport and communication, industry, agricultural and non-agricultural labor, construction and others. The percentage of the different livelihood sources of Sreepur Upazila are presented in below in Table 6-10.

Table 6-10: Livelihood Sources of Sreepur

Income Source	Rate (%)
Agriculture	54.62%
Non-agricultural Laborer	3.67%
Commerce	15.63%
Transport & Communication	4.98%
Industry	0.79%
Service	8.52%
Construction	1.52%
Religious Service	0.19%
Rent and Remittance	2.02%
Others	7.71%

Source: Banglapedia, 2014

6.4.5 Transport and Communications

Sreepur Upazila is a part of Gazipur Region. And its development is guided by the special plans prepared by RAJUK. No Master Plan exists for the city on its own. The road network of the city is developed and maintained by RHD as it is in between the Dhaka-Mymensingh highway, City Corporation and LGED, but little coordination is made among these agencies. This is partly contributing to an unorganized and narrow urban road network with pervasive traffic congestion in the city.

The main modes of public transport in the city are rickshaws and intercity buses. Cycle rickshaws are widely used for short trips. In recent years the auto rickshaw has also become very popular. Traffic management is almost nonexistent. Safety signs and road markings are also inadequate.

The main bus terminal is Sreepur Bus Terminal and one truck terminal is in Cheragali (Tongi). There are no formal parking facilities for rickshaws, auto-rickshaw and trucks, which usually occupy significant road space in the city area, again reducing the efficiency of the network and adding to road safety issues.

6.4.6 Health

The health service delivery system of the Upazila is constituted by a 50-bedded Upazila Health Complex, 12 private clinics, 10 diagnostic centers, 26 EPI centers run by and NGOs from which the inhabitants of Municipality and surrounding areas are getting their necessary health supports and services (Source: Municipality Data, 2018).

Drainage, sewerage and latrine facilities are very much important facilities for any urban areas. The population and Housing Census 2011 reveals that the most of the people of the area use sanitary latrine but most of them are without water seal which is not environmentally hygienic. The Figure 6-24 shows that 38.30% households don't have toilet in well condition. 48.10 % households have semi-good condition, 10.90 % households have non-sanitary latrine and 2.70% households have no latrine themselves. There is no hanging latrine in the municipality areas. In addition, the municipality has been providing sanitation facilities for mass citizens within municipality areas. There are ten public toilets in the Municipality. (Municipality data, 2018).

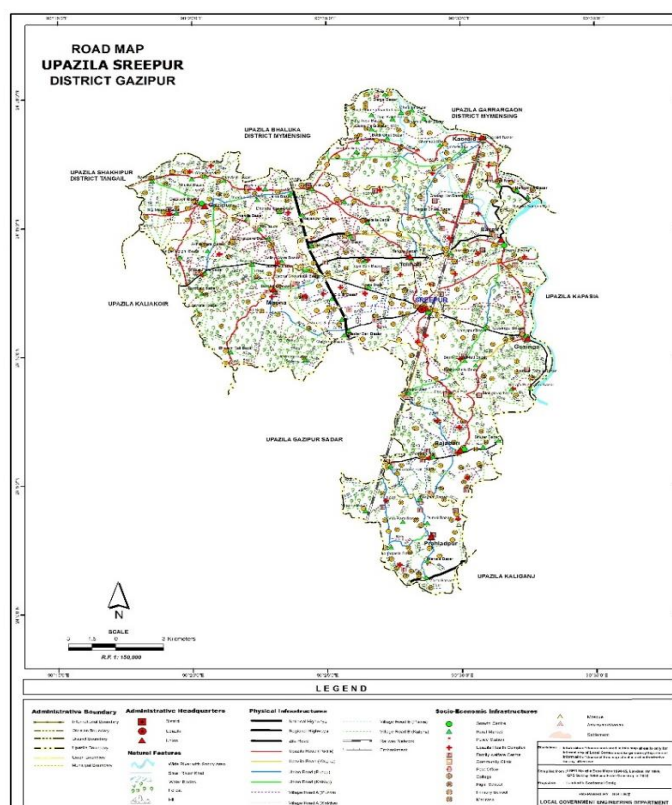


Figure 6-23 : Roadway Map of Sreepur Upazila

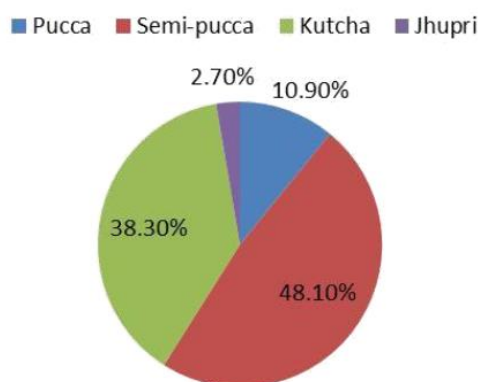


Figure 6-24: Percentage distribution of Household by type of toilet facility

6.4.7 Education

There are 15 government and non-government primary schools, 6 secondary schools, 6 higher secondary school, 3 colleges, 44 NGO operated school, 56 madrasa and 3 vocational institutes which are contributing in enhancing the educational status of the citizen living within area. Noted educational institutions are Sreepur University College (1968), Kaoraid Kali Narayan High School (1929), Sreepur Pilot High School (1942), Barmi Bazar High School (1955).

6.4.8 Recreational Activities

There are some tourist spots in the Sreepur Upazila such as, Seagirl (Maona), Banya Dighi (Karnapur), Waddah Dighi (Tengra), Jivantya Swarga (Kaoraid), Boiragir Chala (Adarsha Gram), old market and monkey grazing center at Burmese Bazar, Rabindra Bungalow and Mandir at Kaoraid and Ganga Sarabor sacred place.

6.4.9 Archaeological and Cultural Heritage

No known remarkable archeological or historically important structure and protected areas are reported in the project site. However, there is mass grave near the Sreepur Rahmat Ali University College and Sal Forest. There are 170 mosques, one temple, four shasans and three churches in the area.



Figure 6-25: Sensitive Resources in the Project Area

7 Anticipated Impacts and Mitigation Measures

7.1 General

The methodology of assessing environmental and social consequences will be based on the project's changes in the receiving environment, followed by an assessment of the overall significance of these changes in comparison to the baseline state. This section will predict and assess the project's likely positive and negative direct and indirect impacts on physical, biological, socioeconomic environment in the project's area of influence, in quantitative terms as far as possible; identify mitigation measures and any residual negative impacts that cannot be mitigated; explore opportunities for enhancement; identify and estimate the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics; and examine transboundary, and cumulative impacts as appropriate. Impacts will be quantified and illustrated using GIS mapping whenever possible. Impact evaluation will be based on expert professional opinion and informed by the outcomes of consultation if such assessment is not possible or practicable. The environmental significance will be judged in relation to applicable national/international environmental standards. The impact assessment exercise will cover all related project activities and the full project lifecycle (i.e., construction, operations, etc.). To discover integrated mitigations and establish the necessity for any additional mitigation strategies, mitigation measures will be coordinated with the Project Engineer.

7.2 Environmental and Social Considerations

A project aiming for economic and social development may nevertheless entail a risk of having negative impacts on the environment or society, such as pollution, loss of natural habitat, involuntary resettlement, and infringement of people's rights. Avoidance or minimization of such risks must be realized as an integral part of the project itself, with its cost included into the development cost.

7.3 Significant Environmental and Social Impacts

The Environmental Impact Assessment includes the six basic environmental standards on which the project's implementation is expected to have an impact. Which are listed below:

- Air Environment
- Noise Environment
- Water Environment
- Land Environment
- Biological Environment
- Socio-economic Environment

The impacts on the above parameters have been identified, analyzed and classified as adverse.

7.3.1 Pre-Construction Phase

7.3.1.1 Land Use

- **Impact**

The project site location does not conflict with any of the relevant governmental entities formal planning context. The project initiator will implement the project in their own industry rooftop. Therefore, there are no anticipated impacts during the planning phase of the project.

- **Mitigation**

The project developer is to take responsibility of minimizing environmental impact on the surroundings by following the project's environmental management plan (EMP). Since these activities are to be performed temporarily the minimum impact is expected to be acceptable.

7.3.2 Construction Phase

Environmental effects of the construction phase are expected to be temporary. Construction impacts are considered to be minimal as all the construction works will be carried out within the site boundary of the procured land and will be controlled via the mitigation measures defined in the ESMP section. Following is the brief description of impacts envisaged during the construction phase.

7.3.2.1 Visual Amenity

- **Impact**
 - The construction activities that are likely to create a visual intrusion and a disruption to aesthetics include: materials lay down, backfilling, and spoil.
 - The project site is the rooftop of the industry. There are some close communities such as some residences that would be within the visual radius of the project. Therefore, visual intrusions are anticipated to be limited to employees. Hence, the visual effects of the construction will be of low significance within the project area and largely limited to effect only employees living in the company's temporary camp facilities during construction (if any)
- **Mitigation**

The contractor must be careful while doing construction works as though the adjacent agricultural practices and close communities do not hamper.

7.3.2.2 Water Resources

- **Impact**

Rooftop PV electricity generation involves little to no water. That stands in contrast to almost all power plants that make electricity using steam. These include coal and nuclear plants, many natural gas plants, and some other renewable energy facilities, which depend on water for cooling. This dependence can cause problem when, cooling water becomes too scarce or too hot. PV systems, in contrast, require no water to make electricity. However, photovoltaic generators require water to wash dust and dirt off of the front of modules, as cell efficiency is reduced when the modules are dirty. Additionally, some amount of water is used for PV (Photovoltaic System) wash. This depends on the type of system, large-scale solar can use considerable amounts of water. These requirements can be similar or even higher than conventional fossil fuel plants. As the amount of water requirement is too little, the impact on water resources is not that significant.
- **Mitigation**

In order to minimize the adverse impact on water quality, the following mitigation measures are proposed

- The contractor will dispose of the debris material to a designated disposal site.
- All reasonable measures will be taken to prevent the wastewater produced in construction from entering into creek and stream.
- Contractor's camp will be provided with sanitary latrines that do not pollute surface waters.
- The ground water in the project area has been used for different purposes like drinking and industrial usage, hence proper mitigation measures must be ensured at construction site to avoid any spillage and leakage of oil. All the staffs at construction areas must be refrained of discharge any liquid wastes on the ground.

7.3.2.3 Air Quality

- **Impact**

As with the development of any large-scale industrial facility, the construction of rooftop solar energy power plants can pose hazards to air quality. Such threats include the release of soil-carried pathogens and results in an increase in air particulate matter which has the effect of contaminating water reservoirs.

- **Mitigation**

The following identifies the mitigation measures to be applied by the Contractor during the construction phase (to prevent impacts caused by their construction activities and which are within their control) and which include:

- If dust or pollutant emissions were found to be excessive, construction activities should be stopped until the source of such emissions have been identified and adequate control measures are implemented.
- Proper planning of dust causing activities to take place simultaneously in order to reduce the dust incidents over the construction period.
- Regular watering of all active construction areas.

7.3.2.4 Noise

- **Impact**

During construction of rooftop solar power project noise might be generated from construction work. Movement of construction materials, handling of equipment can cause significant noise which has impact on environment.

- **Mitigation**

The following identifies the mitigation measures to be applied by the Contractor during the construction phase and which include:

- Apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc.
- If noise levels were found to be excessive, construction activities should be stopped until adequate control measures are implemented etc.

7.3.2.5 Soil

- **Impact**

As the proposed project is a rooftop solar system, there will be no significant impact on the soil except for accidental spillage of the chemicals to the ground and disposal of solid wastes and wastewater.

- **Mitigation**

Assuming that spill response plans shall be in place by the contractor, it is anticipated that impacts to soil resulting from these activities will be likely, with a marginal consequence, yielding medium impact significance.

7.3.2.6 Terrestrial Ecology

- **Impact**

Installing a rooftop solar photovoltaic (PV) system requires lopping/pruning of tree branches to ensure shadow-free area. Additionally, it also needs to removing of existing rooftop vegetation/gardening if there any.

- **Mitigation**

Implement proper management measures to prevent damage to the natural vegetation of the site. This could include establishing a proper code of conduct and awareness raising of personnel and good housekeeping which include the following:

- Restrict activities to allocated construction areas only, including movement of workers and vehicles to allocated roads within the site and prohibit off roading to minimize disturbances.
- Prohibit hunting at any time and under any condition by construction workers onsite.
- Avoid unnecessary elevated noise levels at all times. In addition, apply adequate general noise suppressing measures Ensure proper storage, collection, and disposal of waste streams generated.

Before construction commences, undertake a fauna survey (through an ecological expert) to identify the presence of any key faunal species of importance (reptiles and

mammals). Should viable populations of such key species exist within the project site then it should be relocated outside of construction active areas. Also ensure that the fencing constructed for the project site allows for the natural movement of small faunal species within the area.

7.3.2.7 Waste Generation

- **Impact**

Improper management of non-hazardous and hazardous waste generated during construction may lead to impacts on soil, water, visual environment, in addition to health and safety of workers. Non-hazardous waste includes paper, wood, plastic, scrap metals, glass and mud. Hazardous waste includes absorbent material, metal drums, empty chemical containers, waste oil from machinery lubricants, etc.

- **Mitigation**

Followed the proper Waste management plan. All waste generated at construction site will be managed as per Contractor's Waste Management procedures. Domestic wastewater generated at site will be collected in septic tanks.

7.3.2.8 Employment Opportunities

- **Impact**

Positive benefits of the project may arise either from short-term job opportunities during construction, or long-term job opportunities during operation. It is important that construction and operation jobs to be targeted to the local people within Banani where feasible.

- **Recommendation**

Contractor as far as practicable will recruit construction workers from amongst the locals where possible and shall maintain gender equity while employing the locals. Additional benefits will be derived by setting aside-areas within contractor camps/labor shed for local people to sell their products or to provide additional services to the workers. Replacement on a suitable location in a better form will be done with the help and consent of the local community.

7.3.2.9 Health and Safety

- **Impact**

The construction activities include site preparation, infrastructure utilities installation, building structures. Therefore, there will be potential impacts on workers' health and safety due to exposure to risks through construction activities that lead to accidents causing injuries and death. Construction works and activities bear frequent accident and health risks for both the laborers and the public general, with varying direct and indirect consequences. Therefore, the project authority needs to make provision for specific medical services, workers insurance policies and indemnities, emergency provisions and a rescue/evacuation plans in case of major accidents.

- **Mitigation**

- The Contractor, under the supervision of developer, will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events. The contractor shall ensure all prospect risks during construction phase are assessed and all prevention and mitigation measures are in place accordingly. The contractor shall ensure all workers during construction comply with safety producers through training, awareness and supervising. Moreover, the contractor shall provide all appropriate resources (Personnel Protective Equipment) onsite to ensure providing first aid for personnel in case of occurrence emergencies.
- The project authority will be requested to prepare an approved Construction Environmental Action Plan (CEAP), which will, among others, delineate all work safety aspects he intends to apply. Focal points of the CEAP will relate to means, type and number of protective clothing, safety precautions at specific work sites, first

aid, rescue plans, work hours, and all intended measures for avoiding or proper clearance of hazardous substances, including fueling operations, transport and handling of hazardous materials and explosives, securing measures etc. The CEAP will further explain methods and volumes for using any local resource, and how to address common risks associated with public safety. The project authority will disclose the CEAP with the local stakeholders for further developments on the health and safety issue.

7.3.2.10 Traffic

- **Impact**

During the construction phase traffic is expected to increase to a certain degree due to the nature of activities that will take place such as the transport of equipment and materials to and from the site through the surrounding road network. Additional traffic load will be evident at certain times during the day, especially if there are slow moving heavy vehicles transporting material to and from the site.

The above potential traffic impacts can possibly occur during the construction, especially during working hours. However, this is considered a short-term impact. This impact is likely to happen but is not anticipated to cause any permanent effect on the receiving environment.

- **Mitigation**

Proper Traffic Management Plan (TMP) should be prepared by the contractor during starting of construction and follow it strictly. However, minimum numbers of vehicles will be used for carrying construction materials. Hence, the accidental loss is expected at the lowest. Moreover, the project authority will try to carry the construction materials during off peak hours when the traffic volume is the minimum.

7.3.2.11 Archaeology and Cultural Resources

- **Impact**

The field visits conducted at the project site and it is found that there is a college, several mosques and primary schools near the project area. But they are comparatively in long distance and therefore, the impact assessment process for this receptor has yielded the low significance.

- **Mitigation**

This impact is temporary and minor negative in nature. Mitigation measures will include:

- 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.

7.3.3 Operation Phase

There will be certain impacts on the environmental set-up in the project area as a result of increased activities and efficient operational systems, which are explored more below. Because some negative environmental impacts may result from the operation of the project facilities, it is vital to ensure the efficiency of mitigation measures even after construction in order to ensure the long-term viability of the development activities. Therefore, in order to reap the full environmental benefits of the activities and ensure environmental enhancement it would be necessary to implement the following, which are beyond the purview of this project.

7.3.3.1 PV Panel Wash

- **Impact**

Due to the upwards angle of solar panels, they are more prone to bird droppings and a build-up of general dust and dirt that does not wash off with just rain. This reduces the amount of light hitting the panel and reduces its output. As the projected energy

figures claimed by solar panel manufacturers and installers are based on the optimum performance of clean solar panels, this build-up of dirt can adversely affect the panel's ability to meet those projections. So, it is important to clean solar panels in order to protect and maintain the investment. Regular solar panel cleaning will also help to make the most of the government feed-in tariff.

- **Mitigation**

The cleaning process of a panel is below:

- To remove any trash or crud from the panels, spray them with water.
- In the buckets, combine the cleaning solution and water.
- Scrub the solar panels with a soft bristle brush after dipping it in the bucket.
- Continue with this process till effective removal all the gunk off the panel (this may take some time because bird droppings and sap are not easy to clean).
- Start to squeegee the panels until there is no water left on them.
- Put everything away and repeat the process every six months. By doing this solar panels will remain clean while producing much energy as possible.

Most solar panel operation and maintenance (O&M) processes require periodic checks for ensuring optimal performance and security. The frequency and degree of solar array monitoring and solar panel maintenance are reliant on the installation type, system configuration and location of the commercial solar power system in use. Yearly inspections are recommended by companies providing solar maintenance. Also, services provided by solar panel maintenance companies as far as solar PV systems' uptime management is concerned, the companies involved in solar panel operation and maintenance should be concerned about the following issues:

- Data interpretation and collection of data in real time;
- Monitoring of energy production on a consistent basis;
- Critical as well as non-critical repairs;
- Analysis of trends and Key performance indicators (KPIs) in order to ensure continuous improvement;
- Management of inventory, spare parts, etc.;
- The tracking of solar power generation logs and updating document service histories;
- Optimization of balance between yield, cash flows and costs of scheduled maintenance;
- Remote or on-site sensing of the various environmental conditions impacting the PV system being maintained;
- Assessment of components and inverters to ascertain whether they have to be repaired or restored and
- Identification of safety issues.

7.3.3.2 Visual Amenity

- **Impact**

The presence of a large area of PV panels is not expected to constitute a risk for glare since it is situated in the industrial rooftop, moreover, no potential visual disturbance to birds is expected given the fact, and as a result, there is no migratory birds fly way over the project area.

- **Mitigation**

It is not anticipated that visual impacts will be generated due to the PV system design, which is specifically designed to include dark, light-absorbing materials and covered with an anti-reflective coating (ARC) for glass surfaces, which reduces the reflectance from PV panels to 2.5%-2.6% while at the same time improving their efficiency.

It is essential to point out that the intensity of light reflected from a PV module surface depends on factors such as the amount of sunlight reaching the surface and will

therefore vary based on, among others, geographic location, time of year, cloud cover, and PV module orientation.

7.3.3.3 Heat Generation

- **Impact**

The presence of the PV panels will reflect heat and increase the surrounding temperature. The heat may be transferred by convection, radiation and conduction method. Theoretically, the solar thermal placement in the shell of the buildings could increase fire risk and water intrusion into the roof.

- **Mitigation**

In order to reduce the impact, air gap between the PV panels may be simulated. These air gaps will be freely connected to the outdoor air to keep the PV panels cool.

7.3.3.4 Noise

- **Impact**

The solar power as a facility is not considered to exhibit any significant noisy operations, although the facility's inverters and transformers may produce noise, but this is not considered a serious issue, since they will not generate any significant noise. In addition, there are some close by sensitive receptors such as a school and some residential dwellings within the project site.

In addition, noise generated from inverters is only heard when distance is close (i.e., within 1-2 m, however, as distance increases, noise will be greatly reduced, not to mention that they do not generate noise during night time.

- **Mitigation**

These noise impacts are not considered to significantly harm animals nor cause impacts on a population level. The increased noise levels are considered occupational noises that require occupational health and safety measures. The worker inside the project area should use earmuffs during the operation of diesel generator.

7.3.3.5 Air Quality

- **Impact**

No emissions are expected to be released during the operation phase, because solar rooftop systems do not release greenhouse gases or any toxic pollutants during their operation, as a result, no impacts on ambient air quality are anticipated during the operation phase. There will be environmental impacts of emission of greenhouse gas, Ozone depletion, photochemical smog, eutrophication and acidification and also health effects on people.

It is worth mentioning that solar power plants have very low air emissions of air pollutants such as sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, and the greenhouse gas carbon dioxide during operations compared to fossil fuel power generation facilities, since solar power plants do not involve combustion processes.

- **Mitigation**

- The project developer shall be committed to control emitted dust and gaseous pollutant from such operations through the proposed emission control procedures described in the environmental and social management plan (ESMP) included in this report.
- Photovoltaic (PV) is now a proven technology which is inherently safe as opposed to some dangerous electricity generating technologies. Photovoltaic systems make no air pollution and cause no pollution in operation. PV panel should be clean and maintenance regularly for dust free. The supplier will collect wastage PV panels for maintenance and destroy and they will be responsible for management of PV panels.

7.3.3.6 Soil

- Soil impacts during operation phase are limited to accidental spillage of lubricant, fuel and other chemicals that may potentially cause soil degradation. However, since the project area is designated for solar projects near roadside and settlements area, they do not have any agricultural significance. Another 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.
- **Mitigation**
Through implanting spill response procedures, and proper storage and handling of any chemicals on site, the impact probability will be reduced. 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.

7.3.3.7 Terrestrial Ecology

- **Impact**
The project area does not encompass any natural systems. The anticipated impacts on terrestrial ecology are considered low, however, activities such as vehicular movement, may cause disturbance to resident birds and their ground nests.
- **Mitigation**
The anticipated impacts on terrestrial ecology are considered low and hence no particular mitigation measure should be followed. However, the vehicular movement should be very limited and proper attention should be given to minimize the disturbance on surrounding ecological environment.

7.3.3.8 Waste Generation

- **Impact**
PV modules: PV modules wastes are other solid wastes generated during the operational stage. These include end-of-life solar PV modules, electrical wastes, metallic wastes and stationary wastes of office works etc.
Ground-mounted PV solar arrays are typically made up of panels of silicon solar cells covered by a thin layer of protective glass attached to an inert solid underlying substance (or “substrate”). While the vast majority of PV panels currently in use are made of silicon, certain types of solar cells may contain cadmium telluride (CdTe), copper indium di selenide (CIS), and gallium arsenide (GaAs). All solar panel materials, including the chemicals noted, are contained in a solid matrix, insoluble and non-volatile at ambient conditions, and enclosed. Therefore, releases to the ground from leaching, to the air from volatilization during use, or from panel breakage, are not a concern.
Others: Waste generation during the operation phase is considered part of daily operations, therefore, it is not considered to have any significant impacts to the environment or health of personnel present on site.
- **Mitigation**
Photovoltaic (PV) is now a proven technology which is inherently safe as opposed to some dangerous electricity generating technologies. Photovoltaic systems make no air pollution and cause no pollution in operation. PV panel should be clean and maintenance regularly for dust free. The supplier will collect wastage PV panels for maintenance and destroy and they will be responsible for management of PV panels. Cleaning of solar panels will be conducted on an overcast day, early in the morning or in the evening. If the sun is beating down on the panels, any water used can quickly evaporate and dirt will become smeared. Early morning can be a particularly good time for cleaning as dew that has settled on the panels overnight will likely have softened grime; meaning that will need to use less water and less energy to clean the solar panels. Groundwater will be used for the cleaning purpose but reuse of water will be emphasized.

7.3.3.9 Health and Safety

- **Impact**

There are many hazards associated with a solar PV power plant if sufficient precautions are not taken during the operation stages. The impact origins are in the following sectors:

- **Leaching of materials from broken or fire damaged PV modules:** The potential for chemical releases appears to be small since the chemicals are present in the sealed PV modules when completed installations of photovoltaic systems for power generation. Releases are likely to occur only due to fires or other unusual accidents. Cadmium could be a potential concern in this setting with thin-film technologies, as would arsenic and zinc to a lesser extent. Other chemicals that have inhalation toxicity factors are present only during the manufacturing process. Solar PV modules may contain heavy metals like lead, mercury, cadmium, chromium, polybrominated biphenyls (PBBs), or brominated di-phenyl ethers (PBDEs) etc. Leaching of metals from the installed modules is not likely to be a concern, as documented in a study by Steinberger (1998). Leaching from small cells used in electronic devices is also unlikely to be a concern, given the small amounts of chemicals present and the sealed nature of the devices.
- **Emergency Fire Hazard:** Since this is a power plant, the plant has always some risks of fire hazards. Electrical equipment is the main source of a potential fire hazard. In the event of fire catching a solar module, it is theoretically possible for hazardous fumes to be released and inhalation of these fumes could pose a risk to human health. However, researchers do not generally believe these risks to be substantial given the short-duration of fires and the relatively high melting point of the materials present in the solar modules. Moreover, the risk of fire at ground-mounted solar installations is remote because of the precautions taken during site preparation including the removal of fuels and the lack of burnable materials mostly glass and aluminum contained in a solar panel.
- **Electrocution of Workers:** Risk of electrocution of workers during performing duties in a power plant is always present. Faulty electrical equipment, electric short circuits, exposed electrical wires may be the chief sources of electrocution. Damaged PV modules with exposed high voltage conductor also present high risk of electrocution.
- **Electromagnetic radiation from PV modules:** The strength of electromagnetic fields produced by photovoltaic systems do not approach levels considered harmful to human health established by the International Commission on Non-Ionizing Radiation Protection. Moreover, the small electromagnetic fields produced by photovoltaic systems rapidly diminish with distance and would be indistinguishable from normal background levels within several yards.

- **Mitigation**

- The project developer shall ensure all risks from operation activities to be assessed and to establish specific work procedures for tasks during operation phase including all safety prevention and mitigation measures to avoid non-conformance events.
- The Contractor, under the supervision of developer, will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events. The contractor shall ensure all prospect risks during construction phase are assessed and all prevention and mitigation measures are in place accordingly. The contractor shall ensure all workers during construction comply with safety producers through training, awareness and supervising. Moreover, the contractor shall provide all appropriate resources (Personnel Protective Equipment) onsite to ensure providing first aid for personnel in case of occurrence emergencies.

7.3.4 Decommissioning Phase

During decommissioning, the principal mitigation and monitoring strategies to limit or mitigate environmental and social impacts are expected to be comparable to those identified during the building phase. However, some of the more significant effects are listed here.

7.3.4.1 Visual Amenity

- **Impact**
During the dismantling of the solar rooftop system, removal of ancillary facilities visual intrusions will be likely.
- **Mitigation**
Their consequence will be negligible due to fact that such impact would be temporary (over a short period). Moreover, the actual dismantling of the solar power plant will reduce or remove the visual impacts witnessed during the operation phase.

7.3.4.2 Air Quality

- **Impact**
Similar to construction, the decommissioning phase is anticipated to generate dust and exhaust emissions. Decommissioning activities will involve site preparation, dismantling and disassembling of the components of the solar power plant facility, clearance of the site, and rehabilitation if needed.
- **Mitigation**
The project developer shall be committed to control emitted dust and gaseous pollutant from such operations through the proposed emission control procedures described in the environmental and social management plan (ESMP) included in this report.

7.3.4.3 Noise

- **Impact**
The decommissioning activities of dismantling the solar power plant and removing the ancillary facilities are associated with potential increased noise levels. The receptors of the increased noise level will be only the workers of decommissioning activities
- **Mitigation**
As the only receptors will be the workers at the site and within the proposed facilities within the vicinity of the solar power plant, these increased noise levels are considered occupational noises that require occupational health and safety measures.

7.3.4.4 Soil Quality

- **Impact**
During the decommissioning phase, the decommissioning activities are anticipated to have an impact of medium significance to soil. This is due to possible accidental leakage of fuel, oil, or chemicals during demolition activities.
- **Mitigation**
Proper environmental protection measures should be followed to prevent or control the occurrence of such incidences. Take proper attention in removing the PV panels to prevent any damage as it contains chemicals and might be harmful for soil quality.

7.3.4.5 Terrestrial Ecology

- **Impact**
The activities associated with decommissioning will involve dismantling of the solar power plant and removal its facilities. This is a temporary phase that could result in some additional noise and dust disturbances. These activities are not anticipated to harm any flora elements due to absence or scarcity of vegetative cover within and around project area, provided dust suppression measures and other procedures are

followed. On the other hand, decommissioning activities may cause disturbance to bird species.

- **Mitigation**

The mitigation measures should be the same as it was considered during the construction phase since the decommissioning activities will be same as construction phase.

7.3.4.6 Waste Generation

- **Impact**

Waste generated during decommissioning limited to non-hazardous and inert wastes such as scrap metals, paper, wood, plastic, given that the contractor will adhere his waste management procedures.

Similar to the construction phase, potential generation of hazardous waste includes absorbent material, tires, metal drums, empty chemical containers, waste oil from machinery lubricants, etc.

It is not expected that hazardous wastes will be generated from dismantling the solar power plant since the project developer will opt for recycling PV panels of the facility.

PV modules and others: PV modules wastes are the other waste which include end-of-life solar PV modules, electrical wastes, metallic wastes and stationary wastes of office works etc.

Ground-mounted PV solar arrays are typically made up of panels of silicon solar cells covered by a thin layer of protective glass attached to an inert solid underlying substance (or 'substrate'). While the vast majority of PV panels currently in use are made of silicon, certain types of solar cells may contain cadmium telluride (CdTe), copper indium di-selenide (CIS), and gallium arsenide (GaAs). All solar panel materials, including the chemicals noted, are contained in a solid matrix, insoluble and non-volatile at ambient conditions, and enclosed. Therefore, releases to the ground from leaching, to the air from volatilization during use, or from panel breakage, are not a concern.

End-of-Life Solar Panels: 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 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

- **Mitigation**

The following list specifies the mitigation actions that must be implemented by all involved parties:

- Ensure that hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of hard impermeable surface, flame-proof, accessible to authorized personnel only, locked when not in use, and prevents incompatible materials from coming in contact with one another.
- Maintain a register of all hazardous materials used and accompanying Material Safety Data Sheet (MSDS) must present at all times. Spilled material should be tracked and accounted.

- Proper decommissioning and recycling of solar panels both ensures 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 industry is acting voluntarily to implement product take-back and recycling programs at the manufacturing level.

7.3.4.7 Employment Opportunities

- **Impact**

Short-term job opportunities may be arising during decommissioning; however, this can negatively impact permanent personnel at the solar power plant since the facility will cease its operations, therefore permanent staff may lose their jobs.

Although this impact is very unlikely given that fact that an upgrade is expected for the facility during its post-design life, however, the consequence is considered critical to permanent personnel if the facility underwent decommissioning, yielding a low impact significance

- **Recommendation**

Preference should be given to employing the local communities in various positions.

7.3.4.8 Health and Safety

- **Impact**

The decommissioning activities will include equipment dismantling and demolishing facilities at project site. As all project components will be recycled after decommissioning, the prospect risks from decommissioning phase will be limited to dismantling and demolishing activities including moving all recyclable components to their final destination. There will be potential impacts on workers' health and safety due to exposure to risks through decommissioning activities.

- **Mitigation**

The project developer will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events. The developer shall ensure all prospect risks during decommissioning phase are assessed and all prevention and mitigations measures are in place accordingly.

7.3.4.9 Traffic

- **Impact**

The anticipated impacts during decommissioning are similar to those for the construction phase, where the heavy machinery that transports disassembled parts of the project solar power plant facility might be of more significance than normal vehicles and pickups.

- **Mitigation**

Proper management actions with adequate mitigations can reduce significantly such anticipated impacts.

7.4 Summary of Significant Impacts

Table 7-1 Summary of Anticipated Impacts during the Planning and Construction Phase

Environmental Attribute	Likely Impact Planning and Construction Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
Landscape and Visual	Visual and landscape impacts due to presence of elements typical of a construction site such as equipment and machinery.	Short term	Local	Reversible	Likely	Medium	Mild	Moderate	Low
Geology and Hydrology	The project site is a <i>rooftop</i> and there are no significant surface water sources around. Only some possible impacts are dumping of solid waste to the nearby source during construction.	Short term	Local	Reversible	Likely	Medium	Mild	Moderate	Low
	Risk of soil contamination during the various construction activities from spillage of hazardous material, random discharge of waste and wastewater. No risk of groundwater contamination.	Short	Local	Could be irreversible	Likely	Medium	Mild	Low	High
Biodiversity	Construction activities could disturb existing habitats (flora, fauna, and avifauna) and any threatened or endangered species which might be	Long term	Local	Irreversible	Certain	Minor	Mild	Low	High

Environmental Attribute	Likely Impact Planning and Construction Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
	present within the project site. In addition, other impacts could be from improper management of the site (e.g., improper conduct and housekeeping practices).								
Air Quality	Construction activities will likely result in an increased level of dust and particulate matter emissions which in turn will directly impact ambient air quality.	Long term	Local	Reversible	Certain	Medium	Mild	Low	High
Noise	Possible noise emissions to the environment from the construction activities which will likely include the use of machinery and equipment such as generators, hammers, and compressors and other activities.	Long term	Local	Reversible	Certain	Medium	Mild	Moderate	Low
Waste Generation	Improper management and handling of hazardous and non-hazardous waste during construction.	Short term	Local	Reversible	Likely	High	Severe	Moderate	Moderate
Socioeconomic	The project is expected at a minimum to provide job opportunities for local communities. This, to some	Not applicable.							

Environmental Attribute	Likely Impact Planning and Construction Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
	extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity to local communities.								
Health and Safety	There will be some generic risks to workers health and safety from working on construction sites, as it increases the risk of injury or death due to accidents.	Short term	Local	Could be irreversible	Likely	Medium	Mild	Moderate	Low

Table 7-2: Summary of Anticipated Impacts during the Operation Phase

Environmental Attribute	Likely Impact–Operation Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
Landscape and Visual	The project is expected to be visible within the immediate vicinity and up to some long distance around the project site only and thus is likely to create visual impacts related to interaction with surrounding landscape.	Long term	Local	Reversible	Likely	Medium	Low	Low	Low
	Potential for glare caused by minimal sunlight reflected off the PV panel modules which in turn could affect nearby receptors.	Long term	Local	Reversible	Likely	Medium	Mild	Low	Low
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. There will be environmental impacts of emission of greenhouse gas, Ozone depletion, photochemical smog, eutrophication and acidification and also health effects on people.	Long term	Local	Reversible	Likely	High	Severe	Moderate	Moderate
Heat Generation	Increased heat by radiation, convection and conduction	Long term	Local	Could be irreversible	Likely	Medium	Mild	Moderate	Low
Geology and Hydrology	Risk of soil and groundwater contamination during the various operational activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater. However, most significant sources of soil and water pollution are the chemicals from PV panel's damage.	Long term	Local	Could be irreversible	Likely	Medium	Mild	Moderate	Low

Environmental Attribute	Likely Impact–Operation Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
Biodiversity	Impacts limited to improper management of the site (e.g., improper conduct and housekeeping practices).	Long term	Local	Could be irreversible	Likely	Minor	Low	Low	Moderate
Air Quality	Solar rooftop systems have very low air emissions of air pollutants such as sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, and the greenhouse gas carbon dioxide during operations.	Long term	Local	Could be irreversible	Likely	Minor	Low	Low	High
Noise	The only significant noise source from the operation activities which will likely include the use of backup generators to ensure continuous power supply.	Long term	Local	Reversible	Likely	Medium	Mild	Moderate	Low
Socio-economic	The project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity to local communities.	Not applicable.							
Occupational and Community Health and Safety	There will be some risks to workers health and safety during the operation and maintenance activities of the project.	Long term	Local	Could be irreversible	Likely	Medium	Mild	Low	Moderate
	Trespassing of unauthorized personnel into the project site could result in potential risks from several hazards of the various Project components (e.g., electric shock, thermal hazards, exposure to chemicals and hazardous materials, etc.). Leaching of	Long term	Local	Could be irreversible	Likely	Medium	Mild	Low	Moderate

Environmental Attribute	Likely Impact–Operation Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
	materials from broken or fire damaged PV modules. Emergency Fire Hazard. Electrocution of workers. Electromagnetic radiation from PV modules.								

Table 7-3: Summary of Anticipated Impacts during the Decommissioning Phase

Environmental Attribute	Likely Impact–Decommissioning Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
Geology and Hydrology	Risk of soil and groundwater contamination during the various decommissioning activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater.	Short term	Local	Could be irreversible	Likely	Medium	Low	Moderate	Low
Air Quality	Decommissioning activities will likely result in an increased level of dust and particulate matter emissions which in turn will directly impact ambient air quality.	Short term	Local	Reversible	Certain	Medium	Low	Moderate	Low
Noise	Possible noise emissions to the environment from the decommissioning activities which will likely include the use of machinery and equipment such as generators, hammers, and compressors and other activities.	Short term	Local	Reversible	Likely	Medium	Mild	Moderate	Low
Infrastructure and utilities	Of particular importance related to infrastructure and utilities is the final disposal of the panels at the end of their lifetime. Final disposal of panels, which may contain hazardous material, needs to ensure that existing waste facilities would be able accept such solar modules. In addition, it is also important to investigate other disposal options such as buy back and recycling programs.	Long term	Local	Reversible	Likely	High	Severe	Moderate	Low
Health and Safety	There will be some generic risks to workers health and safety from working on decommissioning sites, as it increases the risk of injury or death due to accidents.	Short term	Local	Could be irreversible	Likely	Medium	Mild	Moderate	Low

8 Information Disclosure and Public Consultation

8.1 Background

This section deals with the information disclosure to the public and consultation sessions held with the different stakeholder groups that are likely to be affected by the implementation of the proposed project.

This consultation process had the following objectives:

- Share information with stakeholders on proposed improvement works and expected impacts on the physical, biological and socio-economic environment of the project corridor;
- Understand stakeholders' concerns regarding various aspects of the project, including the existing condition of the project, upgrading requirements, and the likely impact of construction related activities and operation of the project;
- Provide an opportunity to the public to influence project design in a positive manner;
- Obtain local and traditional knowledge, before decision making;
- Increase public confidence about the proponent, reviewers and decision makers;
- Reduce conflict through the early identification of controversial issues, and work through them to find acceptable solutions;
- Create a sense of ownership of the proposal in the mind of the stakeholders and
- Develop the proposal which is truly sustainable.

8.2 Objectives

The objective of stakeholder consultation is to ensure that a participatory approach takes place, which in turn documents concerns of all stakeholder groups and makes sure that such concerns are considered, responded to, and incorporated into the decision-making process of the development. Stakeholder consultation needs to be a two-way communication process that imparts information to stakeholders, but also obtains additional and on-the-ground information from them. Stakeholder consultation and engagement must take place at the inception phase of the ESA process and implemented all through the study period.

The specific objectives of this chapter are to:

- Summarize Developer, national and international legal & policy requirements for stakeholder engagement;
- Describe and identify the stakeholders affected and/or with an interest in the project;
- Summarize stakeholder engagement and consultation conducted to date;
- Describe how the views and issues raised have informed and influenced the development of the project and
- Outline the future plans and approach to stakeholder engagement.

8.3 Identification of Stakeholder

During the field survey, significant efforts were made to identify the possible categories of stakeholders and their stakes. During the field survey different stakeholders identified were the villagers, local residents, government officials, shop owners, public representative and general public. All those stakeholders had different types of stakes according to their professions.

8.4 Consultation with Various Stakeholder

A stakeholder is defined as any individual or group who is potentially affected by the proposed project or can they affect the proposed project directly or indirectly. Stakeholder consultation is an inclusive process for sharing information that enables stakeholders to

understand the risks, impacts, and opportunities of a development or project, allowing them to express their views and articulate their perceptions towards it.

Through the project preparation stage extensive consultations/FGDs have been arranged during the conduct of the ESIA surveys. The details of FGDs are given in the following Table 8.1. The findings of these of these FGDs are summarized in Table 8.2 and the details of these FGDs are given in Appendix E.

Table 8-1: Details of Focus Group Discussion

FGD No.	Type of Participants	No. of Participants
1	Employee of Fakhruddin Textile Mills Ltd.	13
2	Local People (Farmer, Business, Service Holder etc.)	10
Total		23



Figure 8-1: Photos of Focus Group Discussions (FGD)

Table 8-2: Summary of the FGDs

Questions	Opinion, comments and suggestions
Are you aware about the activities of the Industrial Rooftop Solar System Project? If yes, how do you?	Yes, the project proponent has shared this information with us. The owner will establish Industrial Rooftop Solar System Project.
How The project will impact on surrounding environment? Please mention both positive and negative sides.	Construction of this proposed project, surrounding environment may impact but temporary. Air pollution and noise pollution will influence on surrounding environment. The project proponent should take proper attention regarding to reduce these impacts. The waste materials should be maintained properly and it should not be kept at open place.
Any air pollution in the area due to the project during construction and operation? If yes, how to mitigate?	The air quality will not anticipate significantly because of construction activities. Through more traffic will run to carry construction materials which will increase dust around the roadside but this would not be harmful to local people. Construction of building for workers shed and other facilities will decrease the local air quality temporarily. The proponent needs to take some attention to reduce this

Questions	Opinion, comments and suggestions
	impact.
Any noise impact of the project during construction and operation at the locality? If yes how to mitigate?	The noise level will increase because of running construction machineries and movement of workers. The effect will be temporary. After the construction is finished, the noise level will come back to the previous limit. Still, there should be proper noise barrier or boundary wall at the noise source.
Any impact on ground/ drinking water quality due to the project? If yes, how to mitigate?	There is no problem with the groundwater quality because of the Solar Power Plant construction. However, the project proponent should confirm that no accidental spillage or washout of hazardous/waste material to surrounding water bodies during construction; particularly in the monsoon.
Any impact on the surface water body (river, pond, khal, canal etc.)? If yes, how to mitigate?	There is no problem with the surface water quality because of the Solar Power Plant construction. However, the project proponent should confirm that no accidental spillage or washout of hazardous/waste material to surrounding water bodies during construction; particularly in the monsoon.
Is the proposed area inundated during flood? If yes, how much?	No.
Do you have any recommendation before the implementation of this project?	Project proponent should involve local people for the rooftop solar system.
Are you in favor of this project? Why?	Yes, we appreciate the initiative. This will influence the other people to take initiative of such kind project. In the long run it will help to develop the economic and social condition in this area.

9 Environmental and Social Management Plan (ESMP)

9.1 General

The Environmental and Social Management Plan (ESMP) focuses on ensuring that all actions carried out during the development and operation of the proposed project are in line with the Bangladesh's environmental and social safety standards. 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.

9.2 Objective

This Environmental and Social Management Plan (ESMP) focuses on ensuring that the mitigation and monitoring procedures required to mitigate and manage the various environmental and social impacts connected with the proposed project's implementation are implemented.

The key objectives of the ESMP are summarized below:

- Conducting all project activities in accordance with relevant Bangladesh Legislation and applicable World Bank guidelines;
- Minimizing any adverse environmental, social and health impacts resulting from the project activities;
- Implementation of on-going environmental monitoring programs;
- Ensure that all stakeholder concerns are addressed and
- Periodic review of the Environmental Management programs to allow for iterative improvement.

Generally, the objective of this ESMP is to ensure that the mitigation and monitoring measures required to prevent and manage the various environmental and social impacts connected with the proposed project's execution are implemented.

9.3 Environmental and Social Management Plan (ESMP)

An ESMP has been developed based on the assessment of environmental impacts and recommended mitigation measures related to project operations, which will be followed during the pre-construction, construction, operation, and decommissioning stages. Medium and large consequences are considered when preparing the ESMP, and possible mitigation strategies are suggested. A mitigation measure will be considered as successful when it complies with the Environmental Quality Standards (EQS), policies, legal requirements set by IDCOL Guidelines for Environmental and Social Considerations/World Bank Safeguard Policies, and DoE environmental guidelines & other relevant GoB legal requirements. In absence of DoE's own EQS, other relevant international or other recognized organization's quality standard will be applied.

Table 9-1: Environmental and Social Management Plan (ESMP)-Mitigation Measures

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Pre-construction Phase						
Land Use	The proposed project is a rooftop system, so there are no anticipated impacts.	-	-	-	-	-
Construction Phase						
Visual Amenity	Visual impacts from construction activities such as materials lay down, infrastructure development, etc.	The contractor shall ensure general cleanliness and good housekeeping practice at the project site at all times.	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
Water Resources	As the amount of water requirement is too little, the impact on water resources is not that significant. Again, there is no surface water body around the project area.	- The contractor will dispose of the debris material to a designated disposal site. - All reasonable measures will be taken to prevent the wastewater produced in construction from entering into creek and stream. - Contractor's camp will be provided with sanitary latrines that do not pollute surface waters. - The ground water in the project area has been used for different purposes like drinking and irrigation, hence proper mitigation measures must be ensured at construction site to avoid any spillage and leakage of oil. All the staffs at construction areas must be refrained of discharge any liquid wastes on the ground.	Daily	Compliance with DoE and National guideline limits for Environmental noise at sensitive receptors.	Contractor	Environmental Pollution Control Ordinance, 1977
Noise	Increased noise levels during to construction & machinery	The contractor shall use heavy equipment, machinery, and fuels in compliance with national regulations. The contractor shall perform regular maintenance on all	Every week and after receiving any complaints from worker	Compliance with DoE and National guideline limits for Environmental noise at sensitive	Contractor	- Environmental Pollution Control Ordinance, 1977 - Noise Pollution Control Rules

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		equipment, vehicle and machinery to prevent noise emissions. ▪ The contractor shall limit idling of engines when not in use to reduce its contribution to noise emissions.	or third parties.	receptors.		(2006)
Air Quality	▪ Dust generation 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. ▪ Unnecessary handling of dusty materials will be avoided such as minimizing drop heights when loaders dump soils into trucks. ▪ Train workers to handle construction materials and debris during construction to reduce fugitive emissions. ▪ Ensure adequate maintenance and inspection of vehicles to minimize exhaust emissions. Not running engines for longer than is necessary.	Daily	▪ No visible dust plumes originating From construction sites. ▪ Regular machineries maintenance records.	Contractor	▪ Environmental Pollution Control Ordinance, 1977 ▪ Environment Conservation Rules (ECR), 1997 ▪ Environment Court Act, 2000 ▪ Bangladesh Climate Change Strategy and Action Plan (2008)
Soil Pollution	Soil disturbance due accidental spillage	▪ A spill prevention and response plan shall be prepared by the contractor in order to control any inadvertent leakage or spillage. Spill response measures shall be implemented (as necessary) to contain and clean up any contaminated soil. ▪ Construction of bunds around relevant work and storage areas. Bunds in areas of hazardous chemical storage (including temporary storage) should be lined to contain accidental spillage and minimize the potential for migration to the underlying soil. ▪ Any spilled chemical shall be immediately collected and disposed of in accordance with Spill	Weekly	▪ Number of spills or incidents to be recorded during onsite audits. ▪ Training records of Personnel trained in spill response procedures must be filed	Contractor	▪ Environmental Pollution Control Ordinance, 1977 ▪ The Environment (Pollution Control) Act, 1995

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		Prevention and Response Plan and MSDS. Contractor shall ensure that a spill kit and adequate PPE is available at the site for emergency cleanup activities in case of chemical/oil spillage.				
Terrestrial Ecology	Potential disturbance to birds	- Minimize human and vehicular contact with fauna, including their burrows and feeding grounds. - Waste shall be stored on site within closed container, especially food remnants to avoid attracting birds on site.	Daily	N/A	Contractor	- Bangladesh Wildlife Preservation Order 1973 and Revision 2008 - 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)
Waste Generation	Improper management and handling of hazardous and non-hazardous waste during construction.	- The contractor shall segregate storage for different types of wastes, such as hazardous, non-hazardous recyclable construction material, plastic, paper, etc. to facilitate proper disposal. - The contractor shall provide a separate storage area for hazardous materials. The hazardous materials/products must be labeled with proper identification of its hazardous properties.	Daily	- Compliance with 8Waste management procedures. - Current and Complete records of regular waste pickup and disposal.	Contractor	- Environmental Pollution Control Ordinance, 1977 - The Environment (Pollution Control) Act, 1995 - Environment Conservation Rules (ECR), 2018

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		- 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 contractor's waste management procedures. - The sanitary and organic wastes shall be collected in a septic tank to be installed on site and disposed of regularly.				
Health and Safety risks	- Potential of 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 the 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. - Provide walkways that are clearly designated as a walkway; all walkways shall be provided with good conditions underfoot; signposted and with adequate lighting. - Signpost any slippery areas, ensure proper footwear with a good grip is worn for personnel working within slippery areas. - Avoid work at height where it reasonably practicable to do so, e.g., by assembly at ground level. - Prevent any person falling a distance liable to cause personal injury e.g., by using a scaffold platform with double guard-rail and toe boards;	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 Law, 2006

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		▪ Arrest a fall with equipment to minimize the distance and consequences of a fall, e.g., safety nets, where work at height cannot be avoided or the fall prevented. ▪ Carry out fire risk assessment for the construction areas, identify sources of fuel and 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 also communicate emergency response plan (ERP) 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 procedure, in addition to training for personnel and drills to test the plan ▪ Ensure all plant machines and vehicles are regularly inspected, serviced and maintained; ensure all staff assigned is trained and competent to operate plant machines and vehicles. ▪ Ensure clear signage's are in place, such as Warning of speed limits, obstructions, allowable widths/ heights...etc.				

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		▪ Electrical equipment must be safe and properly maintained; works shall not be carried out on live systems. ▪ Only competent authorized persons shall carry out maintenance on electrical equipment, adequate Personal Protective Equipment (PPE) for electrical works must be provided to all personnel involved in the tasks. ▪ Lock-Out / Tag-Out (LOTO) system shall be implemented during any electrical works. ▪ Adequate number of staff and first aiders shall be on site in accordance with Bangladesh Labor 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. ▪ Emergency evacuation response shall be prepared by the contractor and relevant staff shall be trained through mock-up drills. ▪ Ensure all equipment is suitable for jobs (safety, size, power, efficiency, ergonomics, cost, user acceptability etc.), provide the lowest vibration tools that are suitable and can do the works. ▪ Ensure all tools and other work equipment are serviced and maintained in accordance with maintenance schedules and manufacturer's instructions. ▪ Regular noise exposure assessments and noise level surveys of noisy areas, processes				

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		and equipment shall be carried out in order to form basis for remedial actions when necessary. ▪ As far as reasonably practical, all steps to reduce noise exposure levels of employees by means other than that of personal protective equipment shall be taken, such as reducing exposure times, enclosures, silencers, machine covers, etc. ▪ Awareness training sessions should be established and provided to all personnel involved during the construction phase in order to highlight the heat related illnesses of working in hot conditions such as heat cramps, heat exhaustion, heat stroke, dehydration. ▪ Ensure adequate quantities of drinking water are available at different locations within the site, ▪ Provision of sun shades at different locations within the site. ▪ Eliminate the risk of exposure whenever possible, provide proper PPE wherever necessary and to ensure that there are satisfactory washing and changing facilities. ▪ Ensure that all workers exposed to a risk are aware of the possible dangers. They should be given thorough training in how to protect themselves and there should be effective supervision to ensure that the correct methods are being used.				
Traffic	Additional traffic load due to transport of equipment and materials to and from the site through the surrounding road network	▪ The contractor to ensure that all trucks and vehicles accessing the facility are operated by licensed operators.	Continuously	▪ No complains or concerns from traditional	Contractor	

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		▪ Pedestrians Safety: All project vehicles and trucks shall comply with the proposed speed limits ▪ Ensure adequate maintenance and inspection of vehicles ▪ Presence of flagman at the entrance and exit of the project site in order to control vehicles and truck movement.		users of the area's roads routes are received during the construction activities. ▪ No incidents or accidents (collisions) are recorded		
Operation Phase						
Visual Amenity	Reflection from the solar panel will create visual intrusion.	The used technology has Anti-Reflective coating (ARC) that significantly reduces the reflectance of the Panels (from 2.5% to 2.6% only).	N/A	N/A	Project Developer	▪ 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. ▪ Noise barrier should also be given around the generator room. ▪ The worker inside the project area should use earmuffs during the operation of diesel generator.	Every week and after receiving any complaints from worker or third parties.	Compliance with DoE and National guideline limits for Environmental noise at sensitive receptors.	Project Developer	▪ Environmental Pollution Control Ordinance, 1977 ▪ 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 source of air pollutants. ▪ Replace the damaged and expired tools and equipment.	Daily	▪ No visible dust plumes originating from project site. ▪ Regular machineries maintenance records.	Project Developer	▪ Environmental Pollution Control Ordinance, 1977 ▪ Environment Conservation Rules (ECR), 2018 ▪ Environment Court Act, 2000

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
						Bangladesh Climate Change Strategy and Action Plan (2008)
Heat Generation	- Potential glare from PV panels and Reflected Heat. - Theoretically the solar thermal placement in the shell of the buildings could increase fire risk and water intrusion into the roof.	- This can be easily avoided, since only four holes per panel on the roof will be integral part of the roof. - Air gaps will be provided to keep the system cool.	N/A	No heat generation and complains from the worker.	Project Developer	Environmental Pollution Control Ordinance, 1977
Soil Pollution	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 rainfall Event - Weekly	Maintain readily available records of all workers training on spill response procedures.	Project Developer	Environmental Pollution Control Ordinance, 1977; 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. - Waste shall be stored on site within closed container, especially food remnants to avoid attracting birds on site.	Weekly	No reported harm to birds.	Project Developer	- 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

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
						Strategy and Action Plan, 2004
Waste Generation	▪ Solid wastes from PV modules which contains toxic metals. ▪ Wasted PV modules few other solid wastes generated during the operational stage. These include end-of-life solar PV modules, electrical wastes, metallic wastes and stationary wastes of office works etc.	▪ Collect the domestic waste in septic tanks to treat according to the approved procedure.	Continuously	▪ Compliance with Waste management procedures. ▪ Current and Complete records of regular waste pickup and disposal.	Project Developer	▪ Environmental Pollution Control Ordinance, 1977 ▪ 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. There will be environmental impacts of emission of greenhouse gas, Ozone depletion, photochemical smog, eutrophication and acidification and also health effects on people. Wasted PV modules few other solid wastes generated during the operational stage. These include end-of-life solar PV modules, electrical wastes, metallic wastes and stationary wastes of office works etc.	Photovoltaic (PV) is now a proven technology which is inherently safe as opposed to some dangerous electricity generating technologies. Photovoltaic systems make no air pollution and cause no pollution in operation. PV panel should be clean and maintenance regularly for dust free. The supplier will collect wastage 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.	Continuously	Compliance with DoE Regular machineries maintenance records.	Project Developer	▪ Environmental Pollution Control Ordinance, 1977 ▪ Environment Conservation Rules (ECR), 2018 ▪ Environment Court Act, 2000
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 ▪ Lead can enter body in two ways: by breathing or by swallowing it. Lead	▪ 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.	Continuously	▪ Total Recordable Incidence Rate (TRIR) ▪ Lost Time Incidence Frequency ▪ Number of safeties Training	Project Developer	▪ Bangladesh Labor Law, 2006

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	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.	- Signpost any slippery areas, provide proper footwear during working within slippery areas. - Carry out fire risk assessment during operation to identify sources of fuel and 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 procedure, in addition to training for personnel. - Adequate first aiders shall be on site in accordance with Bangladesh Labor 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.		performed Number of nonconformance events.		
Decommissioning Phase						
- The solar power plant facility is considered a large-scale long-term investment that will contribute to economic benefits to the country through provision of power supply, designed in accordance with best practice, taking into account all relevant national and internal codes and legislation. - As can be noted from the impact assessment chapter 7, 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 will be dismantled and sent for recycling or disposal.						

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
▪ 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 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 encapsulates (~7.5%) and 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. Proper decommissioning and recycling of solar panels both ensures 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 industry is acting voluntarily to implement product take-back and recycling programs at the manufacturing level.						

10 Environmental and Social Monitoring Plan (ESMoP)

10.1 General

During the building and operation phases of the project, an Environmental and Social Monitoring Plan will be developed to offer recommendations for environmental and social management. 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 9.1.

10.2 Objective

Environmental monitoring during the building and operation phases has the goal of comparing monitored data to a baseline condition gathered during the study period in order to assess the efficiency of mitigation measures and environmental protection based on national requirements. The main objectives of the pre-construction, construction and operation phase monitoring plans will be to:

- Monitor the project's actual impact on physical, biological, and socioeconomic receptors within the project area to determine if the ESIA is appropriate;
- Propose mitigating steps in the event of an unexpected impact or if the impact level exceeds the ESIA's expectations;
- 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 and
- Evaluate the effectiveness of the mitigation measures proposed in the ESMP.

Table 10-1: Environmental and Social Monitoring Plan

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility	
				Implementation	Supervision
Pre-Construction Stage					
Air Quality	SO2, NOx, CO, PM2.5, PM10	Air quality standard by DoE, Bangladesh	Once	Contractor	FTML
Noise Level	dBA	Noise Pollution Control Rules (2006)	Once	Contractor	FTML
Water Quality	Surface water: Temperature, pH, EC, DO, TDS, ORP, Nitrite,.Ammonia, Manganese, Iron, Chlorine	Surface water quality standard by DoE, Bangladesh	Once	Contractor	FTML
	Ground water: Temperature, pH, EC, DO, Salinity, TDS, ORP, Ca, Mn.	Ground water quality standard by DoE, Bangladesh	Once	Contractor	FTML
Construction Stage					
Air Quality	SO2, NOx, CO, PM2.5, PM10	Air quality standard by DoE, Bangladesh	Once	Contractor	FTML
Dust	Dust control	Air quality standard by DoE, Bangladesh	Once	Contractor	FTML
Noise Level	dBA	Noise Pollution Control Rules (2006)	Once	Contractor	FTML
Water Quality	Surface water: Temperature, pH, EC, DO, TDS, ORP, Nitrite, Ammonia, Manganese, Iron, Chlorine	Water quality standard by MoEFCC, Bangladesh	Once	Contractor	FTML
	Ground water: Temperature, pH, EC, DO, Salinity, TDS, ORP, Ca, Mn.	Water quality standard by MoEFCC, Bangladesh	Once	Contractor	FTML
Waste	▪ Check storage, transportation, disposal, handling of hazarders waste ▪ Waste and effluents to be collected and disposed safely from camp. ▪ Wastes and garbage from construction sites to be disposed safely	Monitoring	Weekly	Contractor	FTML

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility	
				Implementation	Supervision
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; - First Aid Box with required tools and medicines; - Check of personal protective equipment (PPE) for worker at the sites	Monitoring	Regularly	Contractor	FTML
Operation Stage					
Air Quality	SO ₂ , NO _x , CO, PM _{2.5} , PM ₁₀	Air quality standard by DOE, Bangladesh	1/year (5 year)	FTML	DOE/IDCOL
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	1/year (5 year)	FTML	DOE/IDCOL
Water Quality	Surface water: Temperature, pH, EC, DO, TDS, ORP, Nitrite, Turbidity.	Water quality standard by DOE, Bangladesh	1/year (5 year)	FTML	DOE/IDCOL
	Ground water: Temperature, pH, EC, DO, Salinity, TDS, ORP, Mn, Turbidity, Iron.	Water quality standard by DOE, Bangladesh	1/year (5 year)	FTML	DOE/IDCOL
Accident and Public Safety	Record of accidents, different level of disabilities/fatalities.	None Specific	-----	FTML	DOE/IDCOL
PV panels	Chemicals		1/year (5 year)	FTML	DOE/IDCOL
Decommissioning Stage					
Air Quality	SO ₂ , NO _x , CO, PM _{2.5} , PM ₁₀	Air quality standard by DOE, Bangladesh	Once	Contractor	FTML/IDCOL
Dust	Dust control	Air quality standard by DOE, Bangladesh	Once	Contractor	FTML/IDCOL
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	Once	Contractor	FTML/IDCOL

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility	
				Implementation	Supervision
Water Quality	Surface water: Temperature, pH, EC, DO, TSS, ORP, Nitrite, Turbidity	Water quality standard by MoEFCC, Bangladesh	Once	Contractor	FTML/IDCOL
	Ground water: Temperature, pH, EC, DO, Salinity, TSS, ORP, Nitrate Mn, Turbidity, Iron.	Water quality standard by MoEFCC, Bangladesh	Once	Contractor	FTML/IDCOL
Waste	- Check storage, transportation, disposal, handling of hazardous waste - Careful and proper handling of PV panels. - Waste and effluents to be collected and disposed safely from camp. - Wastes and garbage from worker sites to be disposed safely	Monitoring	Weekly	Contractor	FTML/IDCOL
Health and Safety	- Check quality of food and accommodation at worker camp; - Check safe water supply, hygienic toilet at camps, construction of drain at camp sites; - Check toilets are close to construction site; - First Aid Box with required tools and medicines; - Check of personal protective equipment (PPE) for worker at the sites	Monitoring	Regularly	Contractor	FTML/IDCOL

10.3 Environmental and Social Budget

The estimated budget for the implementation of environmental and social monitoring plan proposed in ESMoP. The total cost will comprise the following:

- Environmental monitoring through sample collection and analysis;
- Any remedial measures necessary to reduce or avoid environmental damage;
- Designing and implementing all mitigating and enhancement measures.

The total budget is estimated as BDT. 383,900. This budget does not include the decommissioning stage since the minimum operation period is 5 years and the rate will vary largely from the present

Table 10-2: Environmental and Social Budget

Component	Item	Unit	Quantity	Rate (in BDT)	Amount (BDT)
PRE-CONSTRUCTION STAGE					
Air Quality	Measuring air quality	No.	1	20,000	20,000
Noise	Measuring ambient noise level	No.	4	5,000	20,000
Water Quality	Surface water quality measurement	No.	1	6,000	12,000
	Groundwater quality measurement	No.	1	6,000	
SUB TOTAL (PRE-CONSTRUCTION STAGE)					42,000
CONSTRUCTION STAGE					
Air Quality	Measuring air quality	No.	2	20,000	40,000
Noise	Measuring ambient noise level	No.	4	5,000	20,000
Water Quality	Surface water quality measurement	No.	1	6,000	12,000
	Groundwater quality measurement	No.	1	6,000	
Waste disposal and management	Disposal and management of construction waste and solar panels of individual households	Lump sum			15,000
Construction Safety	General Safety (provision of PPE like ear muffs, gloves etc.)	Lump sum			5,000
Health	Health check-up camps for construction workers	Camp	-	5,000	5,000
SUB TOTAL (CONSTRUCTION STAGE)					97,000
OPERATION STAGE (5 years)					
Air Quality	Monitoring air quality	No.	1 (per/year)	20,000	1,00,000
Noise	Monitoring ambient noise level	No.	1 (per/year)	5,000	25,000
Water	Monitoring surface water quality	No.	1 (per/year)	6,000	60,000
	Monitoring Groundwater quality	No.		6,000	
SUB TOTAL (OPERATION STAGE)					1,85,000
ESTABLISHMENT and TRAINING					
Training	Environmental training and awareness, Management Information System	Lump sum	As per training details	15,000	15,000
SUB TOTAL (ESTABLISHMENT and TRAINING)					15,000
GRAND TOTAL (Pre-construction, Construction, Operation, establishment and training)					3,49,000
CONTINGENCIES @ 10 % on total Environmental Costs					34,900
Grand Total (in BDT)					3,83,900

11 Disaster Impact Assessment

11.1 Overview

Disaster Impact Assessment (DIA) is a methodology to assess development projects from the viewpoint of disaster risk reduction by identifying improvement points of the project. Based on the findings, revisions of the project shall be incorporated for reduction of disaster risks and mitigation of potential effects happened to and from the project activities. Disaster can create considerable damages and losses related to an ongoing project activity. Because it is an unexpected event due to sudden failure of the system, external threats, internal disturbances, earthquakes cyclonic storms, heatwave, fire and accidents.

The first step is to identify the causes, which develop unexpected danger to the structural integrity of the project. Therefore, disaster-monitoring team should take immediate and intermediate action of the project to avoid any potential damage or loss from the project implementation and operation.

Usually, disasters are classified into two types, where natural disasters in our country are earthquake, flood, landslide, drought, cyclone, massive storm. In addition, there are disasters caused by either development actions in the surrounding or development actions itself. The impacts of disasters can be long term, complex, and intangible. Collectively, we are only now beginning to understand indirect, flow on and cumulative effects of disasters. We do know that disasters can trigger long-term challenges across a range of areas, including reduced education and workforce participation, increased crime, and physical and mental health and wellbeing. Vulnerable or susceptible groups make us these impacts disproportionately.

11.1.1 Flood Hazards

Flood is a natural seasonal disaster that occurs most often during monsoon. The frequency and magnitude depend upon many factors like the amount and duration of rainfall, flooding in the upstream, drainage congestion etc. It has also a linkage with the tidal effect from the coast. Bangladesh is one of the first line victims of ongoing and upcoming threats of climate change due to its geographical location, poverty and higher dependence on climate sensitive sectors like agriculture. The merciless face of climate change and sea level rise reflects in the form of intense and frequent cyclone with tidal surge, subsequent flooding, salinity regression, extreme temperature and precipitation along with local problems like river erosion, water logging and weak institutional framework poses the highest vulnerability in Bangladesh. Flooding is caused downstream from dams when reservoirs, which normally help to prevent downstream areas of rivers from flooding, are opened due to unusually high levels of precipitation to prevent the reservoir from overflowing the dam.

Bangladesh, a developing country in Southeast Asia is ranked as the world's ninth-most disaster-prone country by the World Risk Report, 2018 because of its high exposure to multiple hazards and less coping and adaptive capacities. The country is recurrently hit by flood hazard almost every year. Being a densely populated country with the fragile economic condition, Bangladesh urgently needs to focus on future flood-risk reduction with more effective measures in order to sustain the development milestone achieved till now. Flood hazard mapping, an initial phase of risk understanding is often considered to be an indispensable component of flood-risk reduction strategies.

Sreepur Upazila situated in the central part of our country. The north side of our country is the main victim of flood during every year. Being located in the middle of Bangladesh in Gazipur district, Sreepur Upazila is in less risk of flood every year. But it has also become an increasingly concerning issue in such areas like Gazipur districts due to poor waste management. Waterlogging can be particularly problematic at the end of the monsoon period (August-September).

11.1.2 Earthquakes

According to The Bangladesh National Building Code (BNBC) which has divided our country into four seismic zones. Our project location was in Sreepur Upazilla and filed up in Zone-3 (with basic seismic zone coefficient of 0.28 and peak ground acceleration 2.75 m/s^2). This zone within an active earthquake zone classified as severe risk. No major earthquake has been reported in the project area in recent years. It is understood that seismic risk at the project area has the potential to cause structural damages to the solar plant and the transmission lines, the probability is severe.

11.2 Mitigation Measures

The following mitigation measures should be taken by the project proponent to reduce damage, loss, and casualties of any disaster event in the proposed project:

Flood Hazards

- Property owners may fit their project area to stop water entering by blocking entry point and waterproofing important areas and sandbagging the edges of the project site.
- Improving rainwater infiltration through the use of permeable paving materials and grading away from structures, and inclusion of berms, wetlands or swales in the landscape.

Earthquakes

- It is understood that seismic risk at the project area has the potential to cause structural damages to the solar plant and the transmission lines, the probability is severe. However, during, designing of the solar plant structure for the proposed project, Bangladesh national building code (BNBC) and all other relevant codes should be strictly followed.
- The proposed project operating personnel and other key personnel shall be trained to manage emergency situations during an earthquake.
- The high-risk electrical area should be clearly marked with warnings to avoid dangerous practices in the vicinity so that there would be less chance of accidents from those installations.
- Isolate electrical supply where ever it is possible.
- Emergency transport vehicle shall be parked in open so that it is free from any falling object. Identify critical and weak areas of the project site and organize to support them adequately to prevent collapse.

12 Institutional Arrangements

12.1 Proposed Institutional Arrangement

Institutional arrangement is essential to implement the suggested mitigation measures and to execute monitoring plan at different project phases illustrated in chapter 9 under Environmental and Social Management Plan (ESMP). The implementation of the ESMP also requires capacity building of the ESMP implementation agency through training needs and plan. The structured institutional settings facilitate proper implementation of the environment safeguard requirements for the project.

The project will require the implementation of multi-year mitigative and monitoring actions, as defined in the Environmental and Social Impact Assessment. FTML and IDCOL will be responsible for ensuring the construction and operation period mitigative and monitoring tasks defined the ESIA's ESMP are completed on time and in a technically sound manner. During construction and operation periods, a consultant will assist. Monitoring of ESMP will require field surveys, analyses and technical reporting to DoE as well as to IDCOL. Further, throughout the project, the project authority will be receiving environmental reports from the contractor as well as the supervision consultant, and will need to evaluate and comment on the technical content, etc. The project proponent is agreed to set up an environmental and social development cell within Project Implementation Unit (PIU) of the project.

PIU Staffing: The PIU within the project proponent will include environmental and social expertise, who will oversee and ensure all agreed environmental and social management measures are fully implemented through all project civil works activities, as well as guide and oversee the various studies, planning efforts and technical assistance components of the project with potential social and environmental implications. Given the complexity of the project from an environmental and social perspective, the various management tasks which will fall to IDCOL specialist staff for each, as outlined in Figure 12.1 below. The senior (officer) individuals will preferably be permanent staff deputed by the agency for the life of the project. Supporting specialists would be hired as consultants to provide necessary expertise and additional capacity.

Independent monitoring/ supervision consultants: In addition, the independent monitoring consultant for the grid tied solar plant contractor, as well as the Construction Supervision Consultant for the contractors developing the transmission line, will also include requisite environmental and social expertise to monitor implementation of agreed ESMPs for each activity. These independent consultants will report to PIU and provide “eyes and ears on the ground” on implementation of safeguards measures. The consultants’ role in safeguards management of the project is also shown in Figure 12.1 below.

Contractors: Contractors for all civil works activities, including the installation. Contractor, will be required to maintain adequate environmental, health and safety, and social expertise to ensure effective implementation of agreed ESMP requirements, as specified in their contracts.

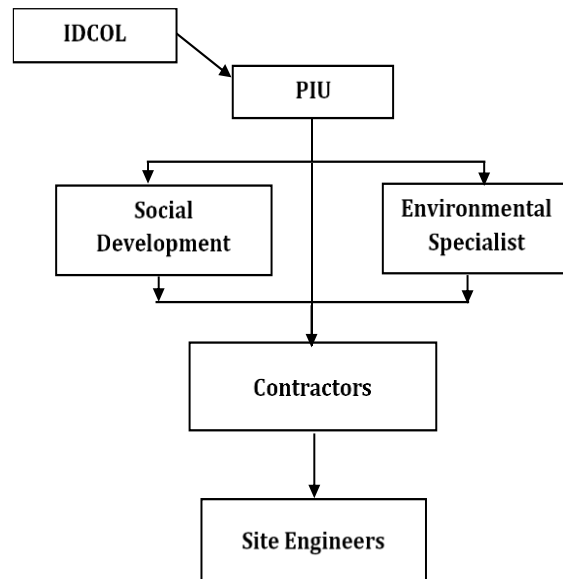


Figure 12-1: Proposed Institutional Arrangement for the Project

12.2 Project Management Organization

During the construction period, the management content includes design, construction, installation, equipment transport, debugging, connection to the grid and completion. According to the composition of work objects, linear function of the organizational structure of management organization is recommended.

One project manager will be in charge of the entire project and daily management. The other four persons are in finance department, purchasing department, project administration department and Integrated Management department, who are responsible for expense payment and settlement, equipment transportation and field storage, construction design and quality, internal management and coordination task, respectively

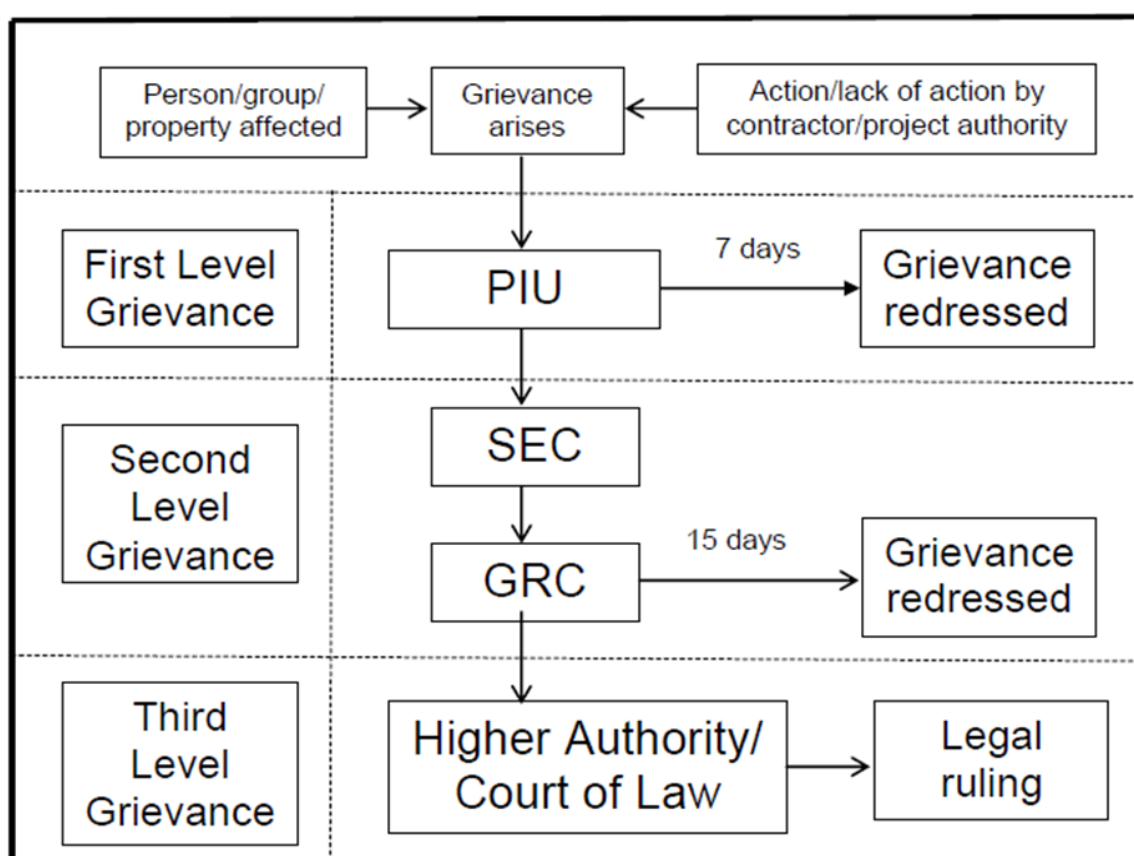
12.3 Training Schedule

In order to ensure the correct operation, the necessary training for plant management and technical personnel is required. Theory and practical training are adopted. Theory subject training is planned for 10 days, and the actual site operation training is planned for 8 days.

12.4 Grievance Redress Mechanism (GRM)

The grievances from local/affected people may come up related to inappropriate implementation of various components of ESMP or the overall activities of the subproject itself. These issues will be addressed through acknowledgement, evaluation and corrective action and response approach. A Grievance Redress Mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected people's concerns, complaints, and grievances about the social and environmental performance of the project. The GRM aims to provide a trusted way to voice and resolve concerns linked to the project and to be an effective way to address affected people's concerns.

The project proponent will make the public aware of the GRM through public awareness campaigns. The project information brochure will include information on the GRM and shall be widely disseminated through the project area by the Environmental Specialist/Engineer, with support from the NGOs and communication firm. Grievances can be filed in writing or by phone with any member of the responsible team. Figure 12.2 represents how GRM will be implemented for the project.



PIU= Project Implementation Unit
 SEC= Social Environmental Circle
 GRC= Grievance Redress Committee

Figure 12-2: Proposed GRM for the Project

First Tier of GRM: The Project Manager (PM) shall be the designated person as the key specialist for grievance redress (1st tier). Resolution of complaints will be done within 7 working days. Investigation of grievances will involve site visits and consultations with relevant parties (e.g., affected persons, contractors, etc.) Grievances will be documented and personal details (name, address, date of complaint, etc.) will be included, unless anonymity is requested. A tracking number shall be assigned for each grievance, including the following elements:

- Initial grievance sheet (including the description of the grievance), with an acknowledgement of receipt handed back to the complainant when the complaint is registered;
- Grievance monitoring sheet, mentioning actions taken (investigation, corrective measures); and
- Closure sheet, one copy of which will be handed to the complainant after he/she has agreed to the resolution and signed off.

The updated register of grievances and complaints will be available to the public at the main office, construction site, and other key public offices along the project area. If the grievance remains unresolved, it will be elevated to the second tier.

Second Tier of GRM: IDCOL will activate the second tier of GRM by referring the unresolved issue (with written documentation). The Grievance Redress Committee (GRC) shall be established by the responsible team of the project proponent before commencement of site works. The GRC will consist of the following persons: (i) project director; (ii) representative of city ward; (iii) representative of the affected persons; (iv) representative of the local Upazila Parishad's office; and (v) representative of the Department of Environment (DoE) for environmental related grievances. A hearing will be called with the GRC, if

necessary, where the affected person can present his or her concerns and issues. The process will facilitate resolution through mediation. The local GRC will meet as necessary when there are grievances to be addressed. The local GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 working days. The contractor will have observer status on the committee. If unsatisfied with the decision, the existence of the GRC shall not impede the complainant's access to the government's judicial or administrative remedies.

Third Tier of GRM: In the event that a grievance cannot be resolved directly by the PIU (first tier) or GRC (second tier), the affected person can seek alternative redress through the city ward committees or in appropriate courts. The PIU or GRC will be kept informed by the city corporation authority. The grievance redress mechanism and procedure are depicted in Figure 12.2. The monitoring reports of the ESMP shall include the following aspects pertaining to progress on grievances:

- Number of cases registered with the GRC, level of jurisdiction (first, second, and third tiers), number of hearings held, decisions made, and the status of pending cases;
- Lists of cases in process and already decided upon, which may be prepared with details such as name, identification (I.D.) with unique serial number, date of notice, date of application, date of hearing, decisions, remarks, actions taken to resolve issues and status of grievance (i.e., open, closed, or pending).

12.5 Construction Workers Grievance

At the construction sites, work camps and on-the-job, laborer and other unskilled hired employees of the contractor have little recourse when either their living conditions are badly degraded, they are not paid according to agreement, or basics, such as potable water, are not supplied. Under this contract, as part of the written agreement with each hire, the contract or letter of assignment with the work will include the name and contact information for the worker to contact. The letter of agreement will contain a second statement indicating that the contractor will not penalize the worker for reporting a complaint and if that occurs, the contract will be levied a fine equal to the employee's contract duration from the time of the incident to the end of the contract period. That amount will be paid to the complainant. The contractor will provide a compliant box, sealed by the Civil Service Commission (CSC) and collected by the CSC, thus allowing the construction worker to file complaints by going directly to the CSC.

13 Environmental and Social Benefit

13.1 Introduction

Renewable energy is highlighted as an important contributor to climate, nature, and environmental protection, as well as a wide number of environmental, economic, and social benefits that will help to ensure long-term global sustainability.

Increased renewable energy supply would allow carbon-intensive energy sources to be replaced, resulting in considerable reductions in global warming emissions. The use of renewable energy to generate power has numerous public health benefits. Coal and natural gas plant pollution has been related to respiratory difficulties, neurological impairment, heart attacks, and cancer.

Solar rooftop 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 requires essentially no water to operate and thus do not pollute water resources or strain supply by competing with agriculture, drinking water systems, or other important water needs.

13.2 Energy and Climate Concern

The severe environmental consequences of generating energy at thermal power plants using traditional fossil fuels are widely documented. This includes air pollutant emissions including ozone, sulfur-dioxide (SO₂), nitrogen-dioxide (NO₂), particulate matters and other gases, which are the source of major environmental issues like smog, acid rain, and health consequences, among others.

Additionally, the combustion of fossil fuels produces carbon dioxide, a primary greenhouse gas generated by human activity that contributes to global warming. The combustion of fossil fuels for energy generation and transportation is the primary source of CO₂. At the same time, global climate change has been a source of concern, and lowering greenhouse gas emissions has emerged as one of the most important concerns to solve as the world seeks 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-years lifetime.

13.3 Energy and Livelihood Concern

The idea that supplying power from renewable sources can result in desired socio-economic improvements (e.g., expanded economic opportunities, better 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 a 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 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.

13.4 Energy and Economy Concern

Bangladesh is struggling with severe issues such as energy scarcity, persistent poverty, and environmental deterioration. Only 180 kW-h of energy is used per capita (Energylopedia-2014). Only 59.60 percent of Bangladeshis have access to power, while the national system has only been able to service 42 percent of the country's 161 million people. The modern industrial economy is built on the foundation of energy. Energy is required for nearly all human activities, including cooking, water heating, lighting, health, food production and storage, education, mineral extraction, industrial output, 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. 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.

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.

PV remains the most rapidly growing energy technology by a wide margin. Indeed, global PV installations for 2014 should reach at least 40,000 megawatts, expanding world PV capacity by another 30 percent. As concerns about climate change grow, solar PV has firmly established itself as an integral player in the transition from fossil fuels.

14 Conclusions and Recommendations

14.1 Conclusions

According to the above analysis, we can conclude that, if the recommended mitigation measures and environmental management processes are adopted properly, the project will be environmentally sound and sustainable.

During the construction stage, there will be some negative impacts of the project. There are no significant cumulative adverse impacts during operation that are identifiable at this stage. The construction impacts should be very predictable and manageable, and with appropriate mitigation, few residual impacts are likely. Additional human and financial resources will be required to improve environmental capability, and to progress and achieve necessary compliance and environmental clearance certification for the project or associated activities that also require environmental assessment and environmental permits under the environmental laws of Bangladesh.

The project is expected to have a small 'environmental footprint'. No endangered or protected species of flora or fauna are reported at the project site. The proposed project activities have no significant adverse environmental impact so far as a time bound execution program with application of advanced construction technology is ensured. The mitigation measures are well within such codes and practices of construction and operation of the proposed project.

14.2 Recommendations

Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures. The potential cumulative and residual impacts of the project classify as not a highly sensitive or complex.

The ESMP, its mitigation and monitoring programs, contained herewith shall be included within the bidding documents for project works. The bid documents state that, the contractor shall be responsible for the implementation of the requirements of the ESMP through his own Site-Specific Environmental Management Plan, which will adopt all of the conditions of the ESMP. This ensures that all potential bidders are aware of the environmental requirements of the project and its associated environmental costs.

The ESMP and all its requirements shall then be added to the contractor's contract, thereby making implementation of the ESMP a legal requirement according to the contract. To ensure compliance with the ESMP the contractor should employ an environmental specialist to monitor and report project activities throughout the whole project life cycle.

Appendix

Appendix A: Analysis of Air Quality Analysis



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Name of the Project	Environmental and Social Impact Assessment of 2.04 MWp Roof-top Solar Project of Fakhruddin Textile Mills Ltd.
Description of Sample	Ambient Air Quality
Sample Collector	Collected by DSCL Personnel
Sampling Date	28 October 2021

On-site Test Result of Ambient Air Quality Analysis

Parameter	Unit	FTML_AAQ_01	FTML_AAQ_02	Bangladesh Standard**	Duration (hours)	Weather Condition	Method of Analysis
		28.10.21	28.10.21				
		Fakhruddin Textiles Mills (Unit-1) Sreepur, Gazipur	Fakhruddin Textiles Mills (Unit-2) Sreepur, Gazipur				
		23.19126°N 90.43490°E	24.19387°N 90.43511°E				
PM _{2.5}	µg/m ³	52.40	53.61	65	24	Sunny	Areal Series 500 PM Monitor
PM ₁₀	µg/m ³	102.64	98.32	150	24		Areal Series 500 SOx, NOx Monitor
SOx	µg/m ³	28.32	21.27	365	24		
NOx	µg/m ³	31.08	22.73	100	Annual		CO Meter
CO*	ppm	<1	<1	9	8		

Description of the Surrounding Environment

Sample Location and ID	Sample Site Description
Fakhruddin Textiles Mills (Unit-1) Sreepur, Gazipur FTML_AAQ_01	➤ The weather was sunny during the monitoring period. ➤ Dust particles were moderate. ➤ Vehicle movement was low. ➤ People movement high. ➤ Vegetation moderate.
Fakhruddin Textiles Mills (Unit-2) Sreepur, Gazipur FTML_AAQ_02	➤ The weather was sunny during the monitoring period. ➤ Visual dust particle was low. ➤ Vehicle movement was low. ➤ People movement low. ➤ Animal movement low.


 Test Performed By:
SK. Ekram Hossain Riyad
 Jr. Environmental Specialist




 Checked By:
Saiful Islam Imran
 Deputy Manager

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Appendix B: Test Results of Surface Water Quality Analysis



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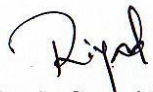
Name of the Project	Environmental and Social Impact Assessment of 2.04 MWp Roof-top Solar Project of Fakhruddin Textile Mills Ltd.
Description of Sample	Surface water Quality
Sample Collector	Collected by DSCL Personnel
Sampling Date	28 October 2021

On-site Test Result of Surface water Quality Analysis

Parameters	Unit	FTML_SW_01	Standards for Inland Surface water **	Method of Analysis
		28.10.2021		
		Kewa Purbo Khondo Primary School Pond, Bhangnahati Rd, Sreepur, Gazipur		
		24.19928°N 90.43948°E		
Temperature	°C	31.5	NYS	Multimeter
pH	-	8.3	6.5-8.5	Multimeter
Dissolved Oxygen (DO)	mg/L	6.2	5 or more	DO Meter

Description of the Surrounding Environment

Sample Location and ID	Sample Site Description
Kewa Purbo Khondo Primary School Pond, Bhangnahati Rd, Sreepur, Gazipur (FTML_SW_01)	➤ The pond is used for bathing. ➤ Enough vegetation around the area. ➤ Beside a battery factory.


 Test Performed By:
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 Checked By:
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Lab Memo: 380/ CC, DPHE, CL, Dhaka

Date: 21-11-2021

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2021110133	Sample Receiving date: 02-11-2021
Ref. Memo No: DSCL/2021/Nill & Dated: 02-11-2021	Sample Source: Surface Water
Sent by: SK. Ekram Hossain Riyad, Asst. Manager, DSCL, Mirpur DOHS, Dhaka.	Dist: Gazipur, Upa: Sreepur
Care Taker: DSCL (sample ID : SW-01)	Union:, Vill.: Kewapurbo Govt. School Pond
Sample Collection date:	Date of Testing: 02/11/2021-18/11/2021

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.14	mg/L	UVS	0.10
2	Biochemical Oxygen Demand (BOD)	0.2	1	mg/L	5 days Incubation	0.1
3	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
4	Manganese (Mn)	0.1	0.03	mg/L	AAS	0.03
5	Total Suspended Solid (TSS)	10	6	mg/L	Gravimetric Method	-
6	Turbidity	10	11.4	NTU	Turbidity Meter	-

Comments: Sample was collected & supplied by client.

N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, 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		1.) Name: Mita Sarker Designation: Senior Chemist	 21.11.2021
2.) Name: Taslima Akhter Designation: Sample Analyzer	 21.11.21	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 21/11/2021 Md. Biplab Hossain Chief Chemist

Department of Public Health Engineering
 Central Laboratory Mohakhali, Dhaka

Appendix C: Test Results of Groundwater Quality Analysis



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Name of the Project	Environmental and Social Impact Assessment of 2.04 MWp Roof-top Solar Project of Fakhruddin Textile Mills Ltd.
Description of Sample	Groundwater Quality
Sample Collector	Collected by DSCCL Personnel
Sampling Date	28 October 2021

On-site Test Result of Groundwater Quality Analysis

Parameters	Unit	FTML_GW_01	Standards for Groundwater**	Method of Analysis
		28.10.21		
		Fakhruddin Textile Mills Water Pump (near pump room)		
		24.19143°N 90.43498°E		
Temperature	°C	28.5	NYS	Multimeter
pH	-	6.5	6.5-8.5	Multimeter
Dissolved Oxygen (DO)	mg/L	6.2	5 or more	DO Meter

Description of the Surrounding Environment

Sample Location and ID	Sample Site Description
Fakhruddin Textile Mills Water Pump (near pump room) FTML_GW_01	- The pump was placed 6 years ago. - It was installed in 2016. - Pipe length is more than 350 feet.

Test Performed By:
SK. Ekram Hossain Riyad
Jr. Environmental Specialist



Checked By:
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Deputy Manager

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Lab Memo: 380/ CC, DPHE, CL, Dhaka

Date: 21-11-2021

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2021110132	Sample Receiving date: 02-11-2021
Ref. Memo No: DSCL/2021/Nill & Dated: 02-11-2021	Sample Source: Ground Water
Sent by: SK. Ekram Hossain Riyad, Asst. Manager, DSCL, Mirpur DOHS, Dhaka.	Dist: Gazipur, Upa: Sreepur
Care Taker: DSCL (sample ID : GW-01)	Union:, Vill.: Fakhruddin Textile Mill
Sample Collection date:	Date of Testing: 02/11/2021-18/11/2021

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.10	mg/L	UVS	0.10
2	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
3	Biochemical Oxygen Demand (BOD)	0.2	1	mg/L	5 days Incubation	0.1
4	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
5	Iron (Fe)	0.3-1	0.05	mg/L	AAS	0.05
6	Manganese (Mn)	0.1	0.03	mg/L	AAS	0.03
7	Total Suspended Solid (TSS)	10	1	mg/L	Gravimetric Method	-
8	Turbidity	10	0.41	NTU	Turbidity Meter	-

Comments: Sample was collected & supplied by client.

N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, 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		1.) Name: Mita Sarker Designation: Senior Chemist	 21.11.2021
2.) Name: Taslima Akhter Designation: Sample Analyzer	 21.11.21	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 21/11/2021 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

Appendix D: Noise Level Measurement Results



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Multidisciplinary Development Consultants

Name of the Project	Environmental and Social Impact Assessment (ESIA) of 2.04 MWp Solar Roof-top Project of Fakhruddin Textile Mills Ltd.
Description of Sample	Noise Level Measurement
Sample Collector	Collected by DSCCL Personnel
Sampling Date	28 October 2021

Noise Level Analysis

Location	Sample ID	GPS Location	Land Use Category	Time		Noise Level (dBA) LAeq	Bangladesh Standard
				Day			
				Start	End		
Beside Admin Building	NM_01	24.19110°N 90.43485°E	Industrial Area	11.25 am	11.55 am	69.03	75
Beside Dyeing Room	NM_02	24.19125°N 90.43429°E		11.58 pm	12.28 pm	73.22	
Unit-2 Building	NM_03	24.19098°N 90.43319°E		12.30 pm	1.00 pm	75.87	
Near Washing Plant	NM_04	24.19385°N 90.43482°E		2.40 pm	3.10 pm	61.16	
Notes: - Land use category is based on the classification provided in the Noise Pollution Control Rules (2006) - Noise level standards for industrial area is 75 dBA for day Time. - Noise Level is the average noise recorded over the duration of the monitoring period.							

Description of the Surrounding Environment

Sample Location and ID	Sample Site Description
Beside Admin Building (NM_01)	➤ Beside generator. ➤ Industrial area. ➤ Vehicle movement low.
Beside Dyeing Room (NM_02)	➤ Continuous loading-unloading ongoing. ➤ People movement high. ➤ Vehicle movement moderate.
Unit-2 Building (NM_03)	➤ Beside a construction area. ➤ Vehicle low. ➤ Beside a brick crushing machine.
Near Washing Plant (NM_04)	➤ Beside a printing shed. ➤ People low. ➤ No construction ongoing.

Test Performed By
SK. Ekram Hossain Riyad
Jr. Environmental Specialist



Checked By
Saiful Islam Imran
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Appendix E: Attendance Lists of Focus Group Discussions (FGDs)

Environmental and Social Impact Assessment (ESIA) of 2.04 MWp Solar Roof-top Project of Fakhruddin Textile Mills Ltd.

List of Participants in Public Consultation/FGD

Address: FTML Assembly point (FGD-01)
 GPS: 24.19159° N 90.43323° E
 Date: 28.10.21 Time: 12.35 pm

SL No.	Participant's Name	Age	Occupation	Mobile No.	Signature
01	MAMUN AR Rashid	39	Asst-Manager (Electrical)		M.A.S.
	Farhad Hossain	32	Electrician		Farhad
	Mahmodul Hasan	25	Executive electrician		Hasan
	Ghannim	24	Electrician		Ghannim
	Mahadeb Shavema	26	Jr. Electrician		Mahadeb
	Rakib uddin	29	Electrician		Rakib
	Md. Abdur Rahman	28	Electrician		Abdur Rahman
	Mr. Joy Pasa	38	Electrician		Joy
	Md. Ridoy Mia	24	Electrician		Ridoy
	Alomgir Hossain	20	Jr. Electric		Alomgir
	Mahabubul Alam	42	SR Electrician		Mahabubul
	Md. Shahadat	26	Executive Electrician		Shahadat
	Jisan Ahmed	27	Jr. Electric		Jisan

Facilitated By Sk. Ikram Hossain Riyad

Signature Riyad

Environmental and Social Impact Assessment (ESIA) of 2.04 MWp Solar Roof-top Project of Fakhruddin Textile Mills Ltd.

List of Participants in Public Consultation/FGD

Address: ETML Washing main gate (FGD-02)
 GPS: 24.19414°N 90.43545°E
 Date: 28.10.21 Time: 3.00 pm

SL No.	Participant's Name	Age	Occupation	Mobile No.	Signature
০১	সফিকুল হোসেন	৪০	কাজ		
০২	মাহবুবুল হক	৪০	চাকরি		
০৩	মোঃ আমানুল হক	৩৬	কাজ		
০৪	মোঃ আনিসুল	৪০	কাজ		
০৫	মোঃ জাহাঙ্গীর হোসেন	৪৫	কাজ		
০৬	মোঃ জাহাঙ্গীর হোসেন	৪০	কাজ		
০৭	মোঃ রাফিক	২০	কাজ		
০৮	মোঃ রাফিক	২০	কাজ		
০৯	অমিত সাহা	৪১	চাকরি		
১০	মোঃ বনিফ	২০	চাকরি		

Facilitated By SK EKRAM HOSSAIN RIYAD

Signature Riyad

