Initial Environmental Examination Report

July 2019

Bangladesh: Dhaka and Western Zone Transmission Grid Expansion Project

Prepared by Power Grid Company of Bangladesh, Ministry of Power, Energy and Mineral Resources, Government of Bangladesh for the Asian Development Bank.

CURRENCY EQUIVALENTS
(as of 20 May 2019)

Currency unit	–	taka (Tk)
Tk1.00	=	$0.012
$1.00	=	Tk.83.85

ABBREVIATIONS

ADB	–	Asian Development Bank
AIS	–	air-insulated switchgear
AP	–	affected persons
ASl	–	above sea level
BMD	–	Bangladesh Meteorological Department
CAP	–	corrective action plan
CHT	–	Chattogram Hill Tracts
DoE	–	Department of Environment
DPP	–	development project proposal
DPs	–	displaced persons
DSC	–	design and supervision consultants
DWZTGEP	–	Dhaka and Western Zone Transmission Grid Expansion Project
EIA	–	environmental impact assessment
EMF	–	electromagnetic field
EMoP	–	environmental monitoring plan
EMP	–	environmental management plan
EQS	–	environment quality standards
ESMS	–	environmental and social management system
FGD	–	focus group discussion
GIS	–	gas insulated switchgear
GoB	–	Government of Bangladesh
GRC	–	grievance redress committee
GRM	–	grievance redress mechanism
GSS	–	grid substation
HES	–	health environment and safety
IEC	–	important environmental component
IEE	–	initial environmental examination
ISC	–	important social component
IUCN	–	International Union for Conservation for Nature
LGI	–	local government institutions
LGRC	–	local grievance redress committee
LILO	–	line-in line-out
MoEF	–	Ministry of Environment and Forest
NGO	–	non-governmental organization
PAI	–	project’s area of influence
PAP	–	project affected persons
PCB	–	polychlorinated biphenyl
PCRs	–	physical cultural resources
PDB	–	Power Development Board
PGCB	–	Power Grid Company of Bangladesh

PMU	–	project management unit
PPE	–	personal protective equipment
PSMP	–	power system master plan
RCC	–	reinforced cement concrete
RMA	–	Resource Management Associates (Pvt) Ltd.
RoW	–	right of way
RP	–	resettlement plan
SF_6	–	sulfur hexafluoride
SPS	–	safeguard policy statement
SWTGEP	–	Southwest Transmission Grid Expansion Project
UPI	–	Union Parishad Institutions

WEIGHTS AND MEASURES

cm	–	centimetre
ha	–	hectare
km	–	kilometer (1,000 meters)
kV	–	kilovolt (1,000 volts)
kW	–	kilowatt (1,000 watts)
m	–	meter
mm	–	millimeter
MVA	–	mega-volt ampere
MW	–	megawatt

NOTE

In this report, "$" refers to United States dollars.

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EXECUTIVE SUMMARY

i. The development policy framework of the Government of Bangladesh envisages moving towards a middle-income threshold by year 2021 through sustainable development. The per capita income is rising steadily, from $1,110 in 2014 to $1,675 in 2018.[1] The GDP growth rate in 2016 was 7.2% while in 2018, it further increased to 7.9%. Electricity consumption is growing rapidly at an annual rate of over 6%, largely due to the growth in per capita income, increasing industrialization and the expansion of the agriculture and commercial sectors. Energy demand is expected to increase threefold by 2035, needs 33,708 MW to meet the desired service quality and quantity projected under future growth.

ii. The Power System Master Plan envisages that by 2022, all the key generating facilities would be operational. The peak load flow toward Dhaka from the southwestern generating facilities is estimated to be about 1,800 to 2,000 MW by 2025. Transmission system studies carried out by the Power Grid Company of Bangladesh (PGCB) for Dhaka service area, considering the demand forecast prepared by Dhaka Electric Supply Company Limited (DESCO), has identified considerable improvements required in the transmission network. Accordingly, new 400/230 kV and 230/132 kV grid substations with interconnecting transmission lines are required to enhance the reliability of electricity supply in the Dhaka service area.

iii. The proposed Dhaka and Western Zone Transmission Grid Expansion Project (DWZGEP) of a total investment of $750.0 million will ensure that the capacity of electricity supply in Dhaka and western zone of Bangladesh is upgraded, with improvements in the technical efficiency of the transmission system. The proposed project is expected to provide support for the construction of new substations and transmission lines and support the improvements of existing transmission network of PGCB.

iv. The DWZTGEP will also strengthen the power transmission system in southwest and northwest Bangladesh to enhance its reliability and efficiency. The project area comprises agricultural land, where, due to inadequate surface water supply, cultivation mostly depends on groundwater. Hence electricity demand is at its peak during the irrigation season. Furthermore, the electricity demand in the southwest is expected to rise in the near future with large scale industrialization expected after completion of construction of the Padma Bridge[2].

v. The subprojects of DWZTGEP are situated in five administrative divisions and twenty districts of Bangladesh, comprising construction of 15 new substations, ten overhead transmission lines and ten Line-In Line-Out (LILO) connections of a total length of 394 km overhead lines, 14 km underground lines in Dhaka, and bay extensions in 9 existing grid substations. Also, the project will strengthen the institutional capacity of PGCB by (i) supporting installation and operation of an Enterprise Resource Planning (ERP) System and (ii) establishing a Drone Inspection Center within the Operation and Maintenance Department of PGCB.

vi. All the subprojects are located in agricultural lands and in settlement areas. Asp per IBAT, no ecologically sensitive habitats or national protected areas are found in the project area. According to the Environment Conservation Act 1995 and Environment Conservation Rules 1997 (amended in 2017) of Bangladesh, transmission lines and grid substations are categorized as

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1 Bangladesh Bureau of Statistics.

2 The Padma Bridge with 150 m span and 6150 m length, is a multipurpose road-rail bridge across the Padma River under construction in Bangladesh. It will connect Louhajong, Munshiganj to Shariatpur and Madaripur, linking the southwestern to northern and eastern regions.

‘Orange B category’ projects that require an Initial Environmental Examination (IEE) for site clearance and environment clearance. Therefore, to obtain ‘Site Clearance’ and ‘Environmental Clearance’ from the Department of Environment (DoE), PGCB conducted the necessary Route Surveys and environmental assessment studies with the help of consultants.

vii. The project also needs to comply with Asian Development Bank (ADB)’s safeguard requirements. This IEE document is prepared to fulfil environmental assessment requirements under ADB’s Safeguard Policy Statement (SPS) 2009. The IEE will be updated and disclosed if any unexpected impacts or design changes occur during project implementation.

viii. The IEE study has been done based on both primary and secondary data. A composite and interdisciplinary approach has been developed for this study, based on the guidelines of DoE and ADB’s SPS 2009. A scoping process was followed for identifying Important Environmental (IECs) and Social Components (ISCs), which are likely to be impacted by interventions of the project. Impacts to ecological resources will be minimal and localized in all phases of the project because there is no ecological or environmentally sensitive area.

ix. The Right of Way (RoW) of the transmission lines and the lands for the grid substations (GSS) are on low lying ground. Lands along the transmission lines are predominantly cultivated, at least in the dry season, and have homestead activities. Rice-based crops are grown mainly in the dry season along with potatoes, onions, mustard, garlic, jute and other vegetables.

x. Trees taller than 5m found inside the 12m width of the RoW with a total number of 22,790 will be removed. There will be some damage to standing crops in the field during the construction phase and a small amount of crop production will also be affected during the stringing process. Efforts will be made to avoid cutting of trees as much as possible. In areas where removal of trees is unavoidable, tree planting with a ratio of 1:3 will be undertaken. Most trees in the area are associated with homesteads, i.e. they are fruit and rapid growing timber trees and the same species will be replaced. Planting of local, native or indigenous tree species will also take place. Proper compensation for all types of damages will be paid.

xi. An area of 80.92 acres land in 15 new substations plus one existing substation and 1 acre of land tower footings, will be changed from the land type of agricultural use and fisheries. The proposed bay extensions would not require land acquisition as the required land extents are available within the existing GSS premises, except for Satkhira, which needs 3 acres for the bay extension.

xii. The RoW of proposed overhead transmission lines does not cross any protected area or environmentally/ecologically sensitive sites. Adverse impacts on flora and fauna would be marginal. Overhead transmission lines in component 1 & 2 cross 31 rivers, canals, khals, beels and ponds. Transmission tower platforms will be placed 150m away from the river bank alongside the wider rivers such as Rupsha, Katcha and Teesta with the single wire spans cross the river (no foundations required in the rivers).

xiii. There will be minor impact of noise for short periods during construction of foundations for the transmission line towers and also result in temporary increase in traffic, but work will take place during day time and residents close by will be warned of any foundation piling activity. The transmission and LILO lines will traverse some populated areas. Therefore, inspection of existing electromagnetic field (EMF) along the selected routes of existing and new transmission lines in populated areas would be important. For housing structures, clearance between the transmission line and roof tops should be 6.5m-8m and for river crossings it will be 14.6m-15.9m[3]. The estimated EMF values are within the ICNIRP public exposure limits. No houses or people will be directly affected by the EMF of transmission and LILO lines.

xiv. Labor camps required for the project will be provided with water supply and sanitation facilities. Proper procedures will be in place for storage, containment and correct disposal of building materials at all work sites during construction. The GSSs will be provided with necessary fire-fighting equipment, personal protective equipment (PPE) and access to emergency rescue items such as first aid boxes, etc.

xv. PGCB has been found to be adequately responsive on environmental safeguards during the operation of the current substations identified as related existing facilities. The substations need the yard cleanness and appropriate waste handling and disposal practices. Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and to prevent spillages. PGCB needs to carry out a time bound Corrective Action Plan (CAP) mentioned in the environmental audit of existing substations (Annex 7).

xvi. During the construction phase of the project, there will be some environmental impacts with machinery and vehicle movement for construction tower foundations, the erection of towers and stringing of conductors. Various activities will take place for towers and new GSS construction including land filling, storage of construction materials, activity of workers and movement of construction vehicles. Mitigation measures are proposed in the Environmental Management Plan (EMP) and will be included in contracts to ensure that good practices are observed as per the measures identified in the EMP. Costing for EMP and CAP will be included in construction contracts.

xvii. There were 42 consultation meetings held in September and October 2018 with local people at various locations along the transmission line routes and substation sites for which 623 people attended. Local people consider that the project would contribute significantly to national development by improving the supply of electricity and they look forward to having employment opportunities during the pre-construction and construction phases. Alternative analysis was conducted.

xviii. A Grievance Redress Mechanism (GRM) will be established at local union level and there will be recourse to a project level redress system when required. The PGCB will set up a Project Management Unit (PMU) to implement the project. The implementation of EMP and CAP will be monitored to ensure the ADB's SPS 2009 will be met.

xix. Since the project does not involve activities that have significant adverse impacts that are irreversible, diverse or unprecedented, the present IEE has been prepared to determine the impacts of the project as per ADB's SPS 2009. Accordingly, the environmental classification for the project is expected to be 'Environment Category B'.

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[3] Environmental Impact Assessment (EIA) for the Feasibility Study of Enhancement and Strengthening of Power Network in Eastern Region (ESPNER) of Bangladesh.

1. INTRODUCTION

1.1 Background

1. The development policy framework of the Government of Bangladesh envisages sustainable development and moving towards a middle-income threshold by year 2021. The per capita income is rising steadily, from $1,110 in 2014 to $1,675 in 2018.[4] The GDP growth rate in 2016 was 7.2% while in 2018, it further increased to 7.9%, meeting the national economic growth target of 7.0%. In contrast, the per capita grid electricity consumption in Bangladesh is only 336 kWh[5], which is lower than its neighbouring countries. Electricity consumption is growing rapidly at an annual rate of over 6%, largely due to the growth in per capita income, increasing industrialization and the expansion of the agriculture and commercial sectors. Energy demand is expected to increase threefold by 2035 as the government rolls out connections to rural households and Bangladesh continues on a trajectory of strong economic growth. Electricity demand would need to increase to 33,708 MW by 2035 to meet the desired service quality and quantity projected under future growth. In the endeavour to become a high-income country by 2041[6], development of energy and power infrastructure is vital for Bangladesh.

2. The government's strategy is to promote power sector and it has embarked on implementation of a master plan to add low cost, base load power generation capacity to compensate for declining domestic gas production and replacement of expensive diesel and fuel oil-based power plants. It is providing subsidies, including for life line consumption, to support the objective of increasing electricity distribution to all parts of the country[7]. For the energy sector, national targets include increased access to electricity, from 93%[8] in 2018, and reaching 100% by 2021. Increase in per capita consumption, from 170 kWh in 2010 to a target of 514 kWh by 2020 is anticipated.

3. The Power Division, under the Ministry of Power, Energy and Mineral Resources (MPEMR) leads the power sector while the Bangladesh Energy Regulatory Commission (BERC) is the regulatory agency which regulates electricity, gas, and petroleum sectors. The electricity sector is unbundled into generation, transmission, and distribution segments. Backbone transmission lines and substation network in the country are operated by the Power Grid Company of Bangladesh Limited (PGCB). As of December 2018[9], PGCB network comprised, transmission lines operated at 400 kV, 230 kV and 132 kV voltage levels with a total length of 11,396 circuit km and 125 132/33 kV substations with a cumulative capacity of 20,211 MVA. Development of transmission and distribution network in line with generation has been identified as a key element of the power sector strategy in the 'Bangladesh Seventh Five Year Plan FY2016 – FY2020'. Development of an inter-region transmission network is required due to the unbalance in concertation of generation and demand, while local network expansions are required to cater the increasing demand at new load centres. Due to the growing electricity demand, a considerable number of grid substations and transmission lines have already been overloaded. Therefore, urgent upgrades and expansions are required by PGCB to supply power to the key economic corridors in the southern and western regions including greater Dhaka area.

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4 Bangladesh Bureau of Statistics.

5 Government of Bangladesh, Bangladesh Power Development Board. 2018. *Annual Report 2017-2018*. Dhaka.

6 Policy "Vision 2041"

7 Government of Bangladesh. 2013. *The National Sustainable Development Strategy 2010–2021*. Dhaka.

8 Bangladesh's Power Sector at a Glance. www.powercell.gov.bd. Power Cell. Ministry of Power, Energy and Mineral Resources.

9 Power Grid Company of Bangladesh Ltd. PGCB at a glance.

4. The Dhaka and Western Zone Transmission Grid Expansion Project (DWZTGEP) focuses on expanding the local transmission network to deliver electricity to new and expanding load centres while meeting the network operating criteria. The People's Republic of Bangladesh applied for financing for a transaction technical assistance (TRTA) from the Asian Development Bank (ADB) to conduct assessments to prepare the investment project. The concept paper for the project was approved by ADB on 6th March 2019, comprising three main investment components namely;

Component 1: Transmission system in Greater Dhaka expanded. The project will construct and commission substations with a total capacity of 4,450 MVA and 40 km of transmission lines in Greater Dhaka.

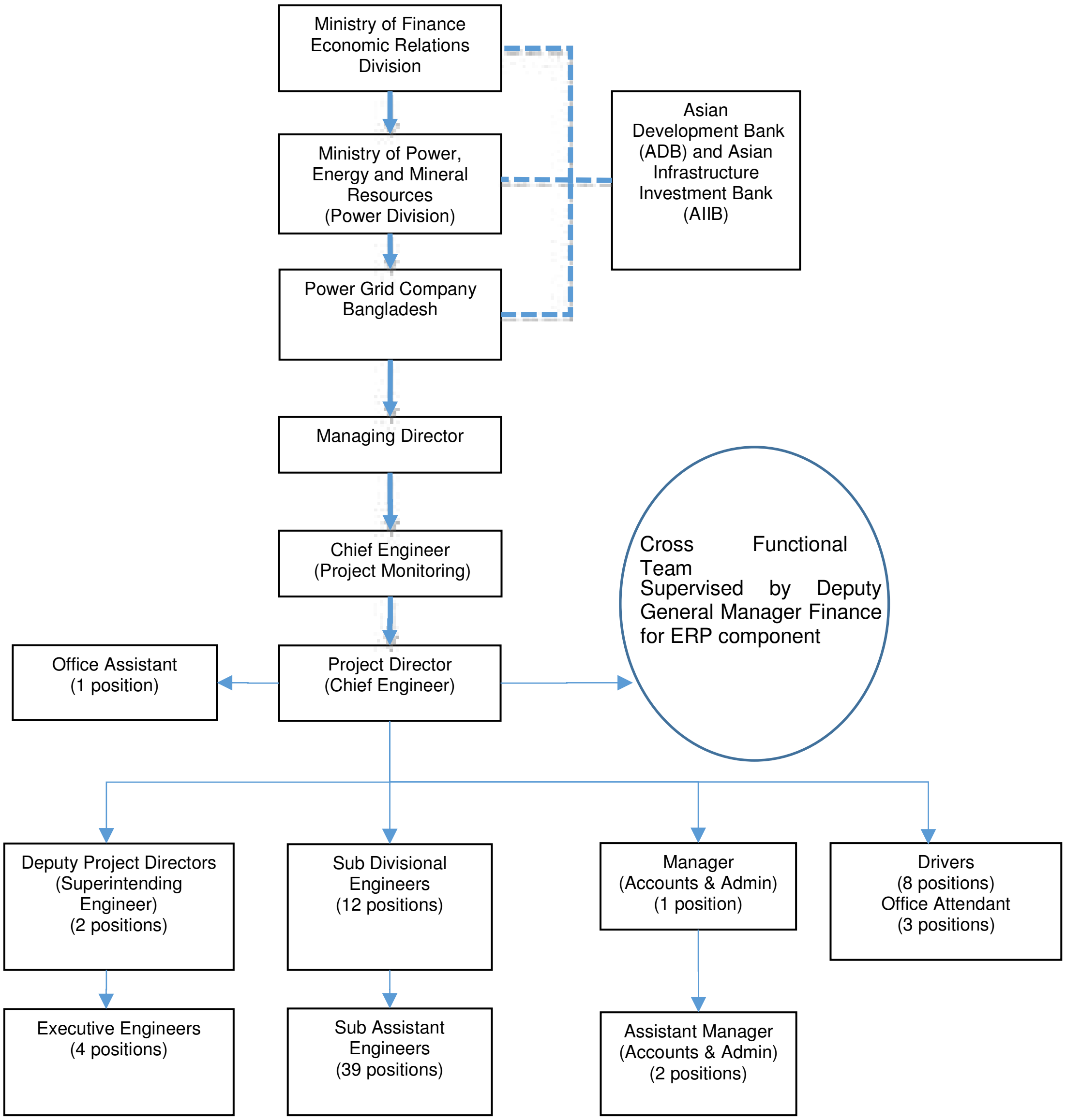
Component 2: Transmission system in Western Zone expanded. The project will construct and commission substations with a total capacity of 3,070 MVA and 368 km of transmission lines in western zone.

Component 3: Institutional Capacity of PGCB strengthened. The project will enhance capacity by (a) supporting installation and operation of an enterprise resource planning (ERP) system to assist PGCB in optimally managing its capital-intensive assets; (b) establishing a Drone Inspection Center within the operation and maintenance department of PGCB with some gender equality element.

5. On behalf of the government, overall coordination of the project will be managed by MPEMR. PGCB will be the Executing Agency (EA) for Component 1, 2 and 3. The project preparation, implementation, monitoring, and reporting to ADB and the government will be handled by the Project Management Unit (PMU) established by PGCB. EPC Contractors with separate environmental officer and Health & Safety Officer for each package will implement Environment Management Plan (EMP). Designated PMU engineers will be trained and supervised by the PGCB safeguards unit to work together with contractors for EMP implementation. Figure 1-1 shows the institutional framework for DWZTGEP.

Figure 1-1 – Institutional Framework for

Dhaka and Western Zone Transmission Grid Expansion Project



Note: ERP component implementation will be supervised by a deputy general manager (project finance) with support from PGCB's Cross Functional Team which comprises 7 members.
ADB = Asian Development Bank, AIIB = Asian Infrastructure Investment Bank, ERP = Enterprise Resources Planning, PGCB = Power Grid Company of Bangladesh Limited., P&D = planning and design.
Source: PGCB.

1.2 Objectives of the Initial Environmental Examination

6. The implementation of the project could have both negative and positive impacts on the surrounding environment, depending on environmental sensitivities and the design of responsive mitigation measures. Environmental impacts include physical, ecological and socio-economic impacts. This project is categorized as an Environmental B project, based on the rapid environmental assessment and the ADB's Safeguard Policy Statement (SPS) 2009. For Category B projects, the environmental impacts are site-specific, few if any of them are irreversible. An

Initial Environmental Examination (IEE) is required to address the anticipated impacts and to suggest appropriate mitigation measures in the Environmental Management Plan (EMP). This IEE report was prepared following the requirements of the ADB's SPS 2009. PGCB will ensure that safeguard plans in IEE/EMP are updated if any changes are identified in detailed engineering designs and changes in project scope.

1.3 Scope of Work

7. This IEE requires identification of potential environmental issues associated with the project and appropriate mitigation measures to minimize the environmental impacts. The broad scope of the IEE is:

i) To conduct field visits to collect data relevant to the study area and also collect secondary data so as to establish the baseline environmental status of the study area;
ii) To assess the impacts on environmental attributes due to the location, design, construction and operation of the proposed project;
iii) To identify critical environmental parameters required to be monitored subsequent to the implementation of the proposed project;
iv) To carry out consultation with local people to identify public perception regarding the project;
v) To prepare an EMP and an Environment Monitoring Plan (EMoP) including cost estimates for PGCB to comply with during the project implementation; and
vi) To prepare an IEE report in accordance with the ADB's SPS 2009 and the national regulations of the government.

8. The DWZTGEP subprojects are located in five administrative divisions and twenty districts of Bangladesh; one in Rajshahi division (Noagoan), six in Dhaka division (Dhaka, Narayanganj, Gopalganj, Madaripur, Gazipur and Faridpur), seven in Khulna division (Jhenaidah, Bagerhat, Kustia, Meherpur, Jessore, Satkhira, and Khulna), three in Barishal division (Bhola, Jhalokaki, and Pirojpur), and three districts in Rangpur division (Dinajpur, Lalmonirhat and Nilphamari) (Figure 1-2).

1.4 Methodology

9. The IEE is usually used to estimate the potential environmental impacts of a proposed project, based on available preliminary information and information readily acquired through rapid environmental surveys. This study has been conducted in accordance with the ADB's SPS 2009 and other relevant national/international laws and treaties applicable to the proposed project.

10. The field survey team used a combination of desk studies, field investigations, census data, structured interviews, focus group discussions (FGDs), google maps, and reports to generate the data required to describe the existing environment and assess the potential impacts due to the construction and operation of the project. Local knowledge about the ecosystem and problems associated with the project activities were carefully recorded through public consultations and used in the impact assessment and to develop the mitigation plan. Formal public consultations, as well as informal ones, involving local villagers and Affected Persons (APs) were carried out from September to December 2018.

1.4.1 Secondary Data Collection

11. The review of secondary sources and informal initial field investigations were undertaken to prepare a preliminary assessment of the physical and social environment, biodiversity, and conservation significance of the identified project area. The preliminary literature reviews also assisted in identifying data gaps which could be addressed with collection of additional primary information through field surveys.

12. Relevant data/information was collected from various government and non-governmental organizations, especially related to site aspects, climate (weather), topography, geology, waterbodies, surface/groundwater quality, ecology/biology, socioeconomics, and other aspects. Previous environmental site studies, where available, were reviewed, as well as relevant articles and web sites.

1.4.2 Primary Data Collection

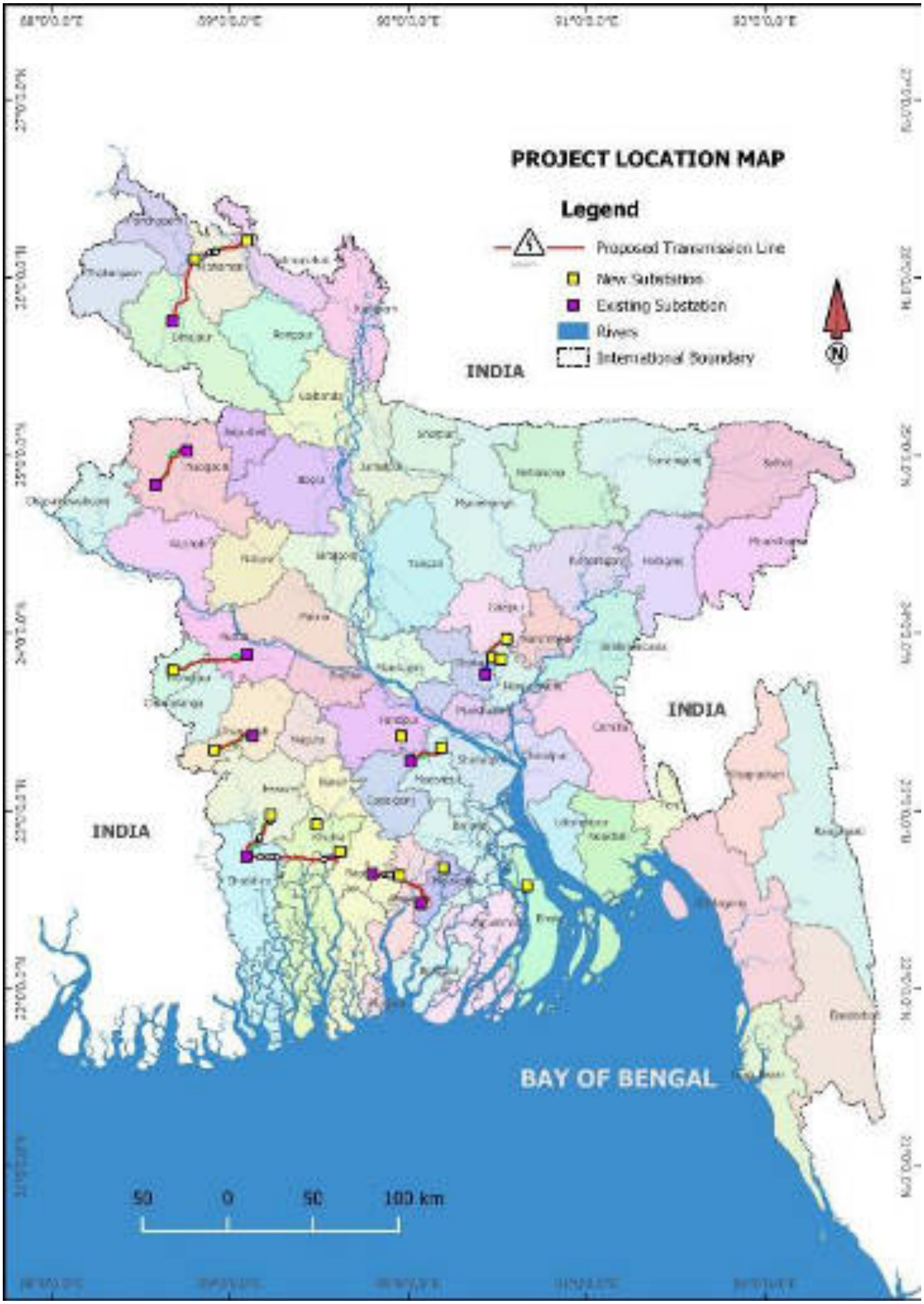
13. Primary data/information included data collected during the field surveys and observations, and discussions with stakeholders, such as community representatives and APs at key project locations and in the project influence area. The main purpose of this approach was to obtain a clear impression on the people's perceptions of the project and its environmental impacts and possible mitigation measures.

14. The primary data on environmental and socioeconomic aspects of the project area were collected from September to December 2018 by the safeguards survey team to comprehensively evaluate the existing project area environmental baseline conditions. An orientation workshop for the field survey team was conducted on 13 and 14 August 2018 before commencing the field work.

15. Status of flora and fauna within the project area was determined by reviewing the literature relevant to the area, as well as observations and surveys at the project sites. Tree counting at the project sites within the RoW was also carried out by the safeguard survey team. Identification of tree species in different habitats, such as home gardens, plantations, and agricultural lands, and assessment of stage of growth (whether mature tree or sapling) were also carried out.

16. A discussion with PGCB officials on 30 January 2018, revealed that trees or saplings below five meters in height will not be cleared within the RoW. Trees taller than five meters in height and within 12 meters from the centre of the RoW will be cleared to make space for the tower footings and conductors. Tree branches outside 12 meters of the RoW will be cut in a 45° angle to the tower. Cutting branches that grow horizontally towards the conductors and towers will be carried out every three months to prevent the in-growth. The value of the trees was determined according to the information provided by the Bangladesh Forest Department and Department of Agriculture.

Figure 1-2 - Diagrammatic Representation of the Proposed Subprojects in Dhaka and Western Zone Transmission Grid Expansion Project



1.5 Structure of the Report

17. The report has been structured in compliance with the requirements. Chapter 1: Providing introduction presenting a brief overview of the assignment along with its background, objectives, scope of work, etc. Chapter 2: Policy, Legal and Administrative Framework, Chapter 3: Description of the project describes the proposed interventions including background, project category, and the need for the project, location, size and magnitude of operations. Chapter 4: Description of Environment (Baseline Data): Chapter5: Anticipated Environmental Impacts and Mitigation Measures, Chapter 6: Analysis of Alternatives, Chapter 7: Information Disclosure, Consultation and Participation, Chapter 8: Grievance Redress Mechanism, Chapter 9: Environmental Management Plan and finally the Report is rounded up with Conclusion and Recommendations in Chapter 10.

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Overview

18. The Environment Conservation Act of 1995 establishes the requirement for an environmental assessment in Bangladesh. Any proposed "industrial unit or project" must obtain prior approval from the Department of Environment (DoE). The act has classified projects to be assessed by the DoE in four categories (Green, Amber A, Amber B, and Red). Electrical infrastructure projects involving transmission lines longer than 50 km are categorised as Orange B category[10], which triggers an automatic requirement for an IEE. The DoE issues an authorization for the project to proceed subject to a satisfactory review of the environmental assessment. The authorization consists of two parts, one is a "site clearance", which gives approval to the sites proposed for the project and the other is an "environmental clearance", which approves the content of the project.

19. PGCB, as the project proponent, is responsible for carrying out the IEE study of the proposed project. Therefore, PGCB has the responsibility to administer the environment assessment process with the consultants, review the findings, and submit the documents to the DoE for review. A key requirement of the IEE for projects classified in the Orange B category is an EMP. The function of the EMP is to enable PGCB to show the DoE how it will deliver the environmental performance assessed in the IEE (for which DoE approval is sought). The EMP should describe the management responsibilities, mitigation measures as well as the institutional arrangements, and explain how monitoring will be carried out.

20. Possession of a "clearance" from the DoE does not relieve the developer of a project from the requirement to comply with other environmental regulations. The Bangladesh National Environment Quality Standards for industrial effluents have been set and compliance with them are mandatory (Figure 2-1). There are also statutory instruments that are applicable to power development projects, which are not primarily environmental but to mitigate environmental impacts. Compliance with such statutory instruments is mandatory.

2.2 Procedure for Obtaining Site/Environmental Clearance

2.2.1 Requirement for IEE Reports

21. All industries and projects in the Orange B category must conduct IEEs, which help in understanding the potential extent of environmental changes of the project.
Figure 2-2 shows the process of obtaining the environmental clearance for Orange B category projects.

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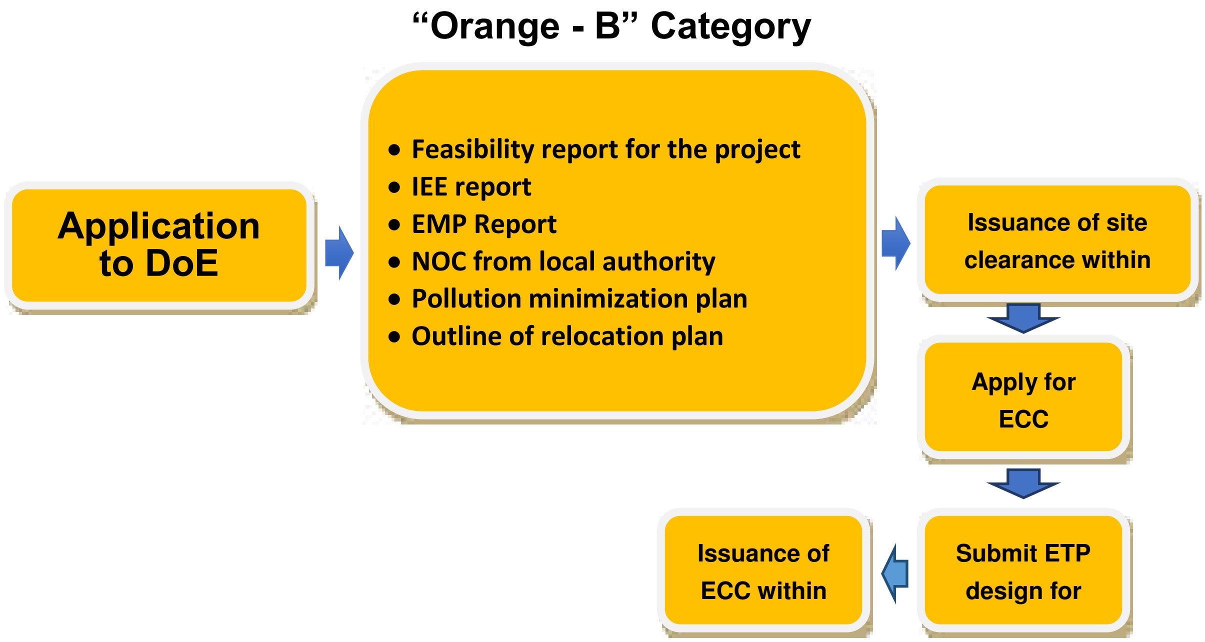
10 Bangladesh law applicable for environmental approval for this project is Environmental Conservation Rules 7(2), which was amended on 24 -12-2017. As per SRO No. 349-Law-2017 4 (ga) 71, electricity transmission lines longer than 50 km fall under 'Orange B' category. According to the provision of Orange B category, an IEE with an Environmental Management Plan (EMP) is the only requirement to obtain the site clearance and the environmental clearance certificate from Department of Environment (DoE).

Figure 2-2 - Process of Obtaining Environmental Clearance for Orange B Category



ECC- Environmental Clearance Certificate. NOC- No Objection Certificate

22. The IEE process helps in determining ways to mitigate negative impacts by considering available information, past experiences, and standard operating practices. The steps for conducting IEEs are as follows:

- Collection of baseline information with respect to a project and the environmental setting of the project and its site;
- Setting of boundaries of an IEE by identifying the significant issues;
- Impact assessment suggesting mitigation measures, development of an EMP, and discussion of alternative sites for the project or other project modifications; and
- In the event the IEE of the project or industry reveals that further investigation is required to be carried out, the sponsors will have to conduct a detailed EIA.

2.2.2 Procedure

23. The project proponent applies to the DoE in the prescribed format for site or environmental clearance after completing the IEE report. The application for environmental clearance for the project classified in the Orange B category should be accompanied by the following documents:

- Feasibility Study Report of the industry (project);
- IEE report including EMP;
- No Objection Certificate (from the local authorities concerned);
- Pollution minimization plan, including emergency plan for mitigation of adverse environmental impacts;
- Outline of relocation plans (where applicable); and
- Other information as deemed necessary.

24. The Environment Conservation Rules give the Director General of the DoE the discretion to issue environmental clearance directly without issuing any site clearance to any industry or project if the Director General finds an appropriate reason for doing so. The project will ensure that this clearance is in place prior to site works. The application is under preparation currently.

2.3 Organizations Related with Enforcement of Environmental Standards

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

2.3.1 Ministry of Environment and Forest

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

- Department of Environment;
- Forest Department; and
- Forest Industries Development Corporation.

2.3.2 Department of Environment (DoE)

27. The government adopted the Environmental Pollution Control Ordinance in 1977 to expand the scope of environmental management and to strengthen implementation powers. The ordinance established an Environmental Pollution Control Board, which formulates policies and proposes measures for their implementation. In 1982, the Board was renamed as the Department of Environmental Pollution Control. Six divisional offices were established in Dhaka, Chattogram, Khulna, Barishal, Sylhet and Rajshahi.

28. A special presidential order renamed the Department of Environmental Pollution Control as the DoE and placed it under the newly formed MoEF in 1989.

29. The DoE is a department of the MoEF and is headed by a Director General. The Director General has complete control over the DoE. The power of the Director General, as given under the Environment Conservation act, is outlined as follows:

- The Director General as the operator of DoE has the authority to stop activities considered harmful to human life or the environment. The operator has the right to appeal and procedures are in place for this. However, if the incident is considered an emergency, there is no opportunity for appeal;
- The Director General has the authority to declare an area affected by pollution as an ecologically critical area. The DoE governs the type of work or process within that area;
- Before undertaking any new development project, the project proponent must take an environmental clearance from the DoE; and

- Failure to comply with any part of the Environment Conservation Act 1995 may result in punishment by a maximum of 5 years' imprisonment or a maximum fine of Tk100,000, or both.

2.3.3 Forest Department (FD)

30. This department under the MoEF is responsible for the protection and management of all reserve forests in the country. Department personnel extend down to the union level in areas where there are reserve forests. Appropriate permission would be required to obtain from the FD in favour of cutting/felling of any plant/tree/sapling planted by any individual or government prior to such activities. The department has recently started some agroforestry programs and its officers are also responsible for the protection of wildlife in the forests.

2.3.4 Other Related Organizations

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

- Ministry of Land: Land Reform and Land Acquisition Directorate;
- Ministry of Water Resources: Bangladesh Water Development Board;
- Ministry of Fisheries and Livestock: Directorate of Fisheries;
- Ministry of Labour and Employment (Occupational Health and Safety and labour issues); and
- Ministry of Power and Energy (supply and safety guidelines).

2.4 National Legislation Relevant to Environment

2.4.1 Environmental Policies and Acts

32. National strategies, policies, acts and rules related with the environment include the following:

- Environment Pollution Control Ordinance, 1977;
- Environmental Quality Standards for Bangladesh, 1991;
- National Conservation Strategy 1992;
- Environment Policy,1992;
- National Environment Management Action Plan, 1995;
- Environment Conservation Act (ECA 1995);
- Environment Conservation Rules (ECR 1997);
- Bangladesh Labour (Amendment Act #30, 2013);
- Electricity (Amendment Act 2012).

2.4.1.1 *Bangladesh Wildlife Preservation Order (1973; amended to Act in 1974)*

33. The Bangladesh Wildlife (Preservation) Order 1973, and its amendment 1974, provides for the preservation, conservation, and management of wildlife in Bangladesh. Earlier legislation concerning wildlife preservation including the Elephant Preservation Act (1879), the Wild Bird and Animals Protection Act (1912), and the Rhinoceros Preservation Act (1932) have all been repealed and their provisions have been suitably incorporated into this law.

2.4.1.5 *The National Forest Policy (1994)*

34. The National Forest Policy of 1994 is the amended and revised version of the National Forest Policy of 1977, as part of the National Forestry Master Plan. The main purpose of the policy is to conserve existing forest areas and bring about 20% of the country's land area under the forestation program and increase reserve forest land by 10% by 2015 through coordinated efforts of government organizations, non-governmental organizations (NGOs) and active participation of the people.

2.4.1.3 *Other Environmental Related Rules and Policies*

35. In addition to the environmental policies and regulations, the following rules and regulations, listed in Table 2-1 will be checked for compliance to help maintain a sustainable environment and safe working conditions during project construction and operation.

Table 2-1 - Environmental Laws, Regulations and Standards of Bangladesh

Year	Title	Objectives and Relevance to Project
1885	The Telegraph Act (Act XIII of 1885)	Under the law sections 10-19, specifies parameters and obligations for government-built transmission lines throughout the country.
2013	Bangladesh Labour (Amendment Act # 30, 2013)	Amends and clarifies appropriate working conditions in all sectors and the rights of workers regarding safe working conditions.
1910	The Electricity Act (Act IX of 1910)	Under the law section 51, government-built transmission lines throughout the country.
2012	Electricity (Amendment) Act 2012	Among other things, specifies conditions of distribution, sale, and use of electricity, including related generation and transmission infrastructure, and obligations regarding the need for preservation of the environment, and associated protection and safety clauses
2018	Electricity (Amended) Act 2018	This act repeals the provisions of Electricity Act 1910. A chain of penal measures, intended to serve temporary demand, have been taken. Anyone involved with electricity misappropriation, pilferage, or wastage, or with interference or destruction of supply lines, may now be subjected to both fines and imprisonment
1950	East Bengal Protection and Conservation of Fish Act	Requirements and actions for protection and conservation of fish in Bangladesh.
1985	The Protection and Conservation of Fish Rules	Prevention of harm to fisheries resource and fisheries habitat in coastal and inland waters.
1953	Town Improvement Act	Improvement and development of Dhaka City.
1958	Antiquities Act	Protection and preservation of archaeological and historical artefacts, if found during project construction.
1960, 1966	Port rules, shipping operation	Control of discharges in ports; waterway rules.
1965	Factories Act	Industrial workers' health and working conditions (now better addressed by the new Labour Act).
1971	Pesticide Ordinance	Pesticide use, production, selection and importation.
1976	Antiquities (Amendment) Ordinance	Protection and prohibition of export of archaeological artefacts.
1977	Municipal Ordinance	Municipal activities in health, sanitation, water supply, drainage, etc. in the city.
1979	Factory Rules	Disposal of wastes and effluents.

Year	Title	Objectives and Relevance to Project
1980	Agricultural Pesticides (Amendment) Act	Selection, use and handling of pesticides in the agricultural sector.
1982	Municipal Act	Drainage, sewerage, water supply and sanitation.
1982	Acquisition and Requisition of Immovable Property ordinance	The Acquisition of Immovable Property Rules, 1982 (No. S.R.O. 172-U82) The government adopted these rules in exercise of the powers conferred upon by section 46 of The Acquisition and Requisition of Immovable Property Ordinance, 1982 (Ordinance No. II of 1982). Not directly relevant to this project, as no structures are to be removed except a very small bridge on the site cross-over road).
1983	Agricultural Pesticides (Amendment) Ordinance	Revised Agricultural Pesticides Ordinance.
1985	The Pesticide Rules	Pesticide selling, use and safety measures.
1990	Bangladesh standard specification for drinking water	Formulation and revision of national standards (inasmuch as the sub-station will continue to require access to safe drinking water).
1860	The Penal Code	This contains several articles related with environmental protection and pollution management (it is considered over-ridden by the latest laws and regulations in the last 20 years governing environmental management).
1996	Building Construction (Amendment) Act and Building Construction Rules	The Rules are more comprehensive for taking care of the present circumstances and issues of building, such as the new sub-station.

2.5 Policy Related with Energy Development

2.5.1 The Electricity Act (1910) and Electricity Rules (1937)

36. Under the act, any person can obtain a license to supply electricity and lay down or place electric supply lines. The licensee can open and break up the soil and pavement of any street, railway or tramway and can lay down any line or do other work near other utility services (gas, telecommunication, water, sewer, etc.), provided prior permission is taken from the respective authority, as stated in Sections 12-18 of the Act.

37. According to Section 19 (1) of this act, the licensee shall give full compensation for any damage, detriment or inconvenience caused by, or anyone employed by, that licensee.

38. Sub-section (1) of Section 51 of the Electricity Rules, 1937 advises that the licensee should take precautions in laying down electric supply lines near or where any metallic substance or line crosses to avoid electrocution.

2.5.2 The Electricity Act amended in 2018

39. The Electricity Act 2018, repeals the provisions of Electricity Act 1910. A chain of penal measures, intended to serve temporary demand, have been taken. Anyone involved with electricity misappropriation, pilferage, wastage, or with interference or destruction of supply lines, be they civilians or government officials or corporations, may now be subjected to both fines and imprisonment. The current Act does not require officials to obtain a magisterial order before entering the premises of consumers to test or terminate supply.

2.5.3 The Telegraph Act (1885)

40. Under Sections 10-19, Part III (Power to place Telegraph Lines and posts), the government can build towers on public land without giving any land compensation.

2.5.4 The Power Policy (1996)

41. As with the Petroleum Policy, this is presently an integral part of the National Energy Policy (1996). It has different policy statements on a whole range of issues including demand forecasts, long-term planning and project implementation, investment and lending terms, fuel and technology, power supply to the different zones, isolated and remote load centres, tariffs, captive and standby generation, system loss reduction, load management and conservation, reliability of supply, system stability, load dispatching, institutional issues, private sector participation, human resource development, regional/international cooperation, technology transfer and research program, and environment policy and legal issues.

42. As the proposed project is a power transmission project, all necessary requirements mentioned above will be adopted for the Project.

2.5.5 The Energy Policy (1996; updated 2004)

43. The first National Energy Policy of Bangladesh was formulated in 1996 by the Ministry of Power, Energy and Mineral Resources to ensure proper exploration, production, distribution, and the rational use of energy resources to meet growing energy demand sustainably. The policy was updated in 2004 in response to rapid global and domestic change. The updated policy includes additional objectives, namely to ensure environmentally sustainable energy development programs, to encourage public and private sector participation in the development and management of the energy sector, and to electrify the entire country. The policy highlights the importance of protecting the environment by requiring an EIA for any new energy development project, or by introducing an economically viable and environment friendly technology.

2.5.6 The Industrial Policy (1999)

44. The National Industrial Policy (1999) aims to ensure a high rate of investment by the public and private sectors, a strong productive sector, direct foreign investment, development of labour intensive industries, introduction of new appropriate technology, women's participation, development of small and cottage industries, entrepreneurship development, high growth of exports, infrastructure development, and environmentally sound industrial development. The World Trade Organization guidelines have been proposed to be followed in the Industrial Policy.

2.6 Building Construction (Amendment) Act (1990) and Rules (1996)

45. The first Building Construction Act dates back to 1952. The earlier Government Buildings Act (1899) exempted certain buildings and land that belonged to or were occupied by the government and situated within the limits of a municipality, from the municipal building laws. The 1990 Act supersedes the provision of Municipal Building Laws to regulate the creation, re-creation, construction, alteration, or maintenance of buildings within the limits of any municipality. The East Bengal Legislative Assembly promulgated the Building Construction Act (1952) on 21 March 1953 as the East Bengal Act II of 1953 in response to the need to regulate haphazard construction of buildings. The act was framed to allow streamlining of planned development and implement government beautification programs.

46. An important modification to the 1953 act was added through an ordinance titled, "the Building Construction (Amendment) Ordinance, 1986" (Ordinance. No. LXXII of 1986). Later in 1987, the ordinance was adopted for enactment as "The Building Construction (Amendment) Act, 1987" (Act No. 12 of 1987).

47. An authorized officer is empowered through this amendment so that he/she can take necessary action to prevent unauthorized construction or to remove such construction without intervention of the court.

48. The act was further amended in 1990 allowing power to issue limited sanctions to cut down or raze any hill within the area to which this act applies.

49. To support the implementation of the provisions laid down in the Building Construction Act, 1952, the government made the Building Construction Rules, 1953. The Imarat Nirman Bidhimalas (1984) superseded these rules. Later in 1996, the government framed the Imarat Nirman Bidhimala (Building Construction Rules, 1996). The rules are more comprehensive and more relevant to present circumstances and issues of building construction and other related development activities.

2.7 Compliance with International Requirements

50. Bangladesh has acceded to, ratified, or signed a number of major international treaties, conventions and protocols related to environment protection and conservation of natural resources.

2.7.1 Rio Declaration

51. The 1992 United Nations Conference on Environment and Development adopted the global action program for sustainable development called ‘The Rio Declaration’ and ‘Agenda 21’. Principle 4 of The Rio Declaration, to which Bangladesh is a signatory, states that “in order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it”[11].

2.7.2 Convention on Biological Diversity (1992)

52. The Convention on Biological Diversity, Rio de Janeiro, was adopted on 5 June 1992 and entered into force on 29 December 1993. Bangladesh ratified the Convention on 20 March 1994. This is the overarching framework for biodiversity and the signatories are required to develop a National Biodiversity Strategy and Action Plan that incorporates the articles of the Convention into national law and statutes.

53. Obligation has been placed on state parties to provide for environmental impact assessments of projects that are likely to have adverse effects on biological diversity.

2.7.3 Wetlands of International Importance as Waterfowl Habitat (1971)

54. The Convention of Wetlands of International Importance as Waterfowl Habitat (1971) is also known as the Ramsar Convention. It was adopted on 2 February 1971 and entered into force on 21 December 1975. Bangladesh ratified the Convention on 20 April 2002. The Convention provides a framework for national action and international cooperation for the conservation and

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[11] United Nations, Rio Declaration on Environment and Development, 1992.

wise use of wetlands and their resources. There are 127 parties with 1,085 wetland sites designated as 'Wetlands of International Importance.'

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

56. Bangladesh has two Ramsar sites: parts of the Sundarbans Reserved Forest (Southwest of Bangladesh) and Tanguar Haor (Northeast of Bangladesh). The proposed project will not have any effect on these two Ramsar sites.

2.7.4 United Nations Framework Convention on Climate Change (UNFCCC)

57. The Kyoto Protocol to the United Nations Framework Convention on Climate Change was adopted in 1997 and requires developed countries and economies in transition, listed in Annex B of the Protocol, to reduce their GHG emissions by an average of 5.2% below 1990 levels. Article 12 of the Kyoto Protocol provides for the Clean Development Mechanism (CDM). According to CDM, projects are eligible to earn Certified Emission Reductions (CERs) if they lead to "real, measurable, and long-term" GHG reductions, which are additional to any that would have occurred without the CDM project.

2.7.5 UN Convention on the Law of the Sea, Montego Bay (1982)

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

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

2.7.6 Others (Conventions and Agreements)

59. The following conventions and agreements include provisions which may be relevant for environmental management, nature protection, and biodiversity conservation:

- Convention relative to the Preservation of Fauna and Flora in their Natural State (1933); International Convention for the Protection of Birds, Paris (1950);
- International Plant Protection Convention, Rome (1951);
- The Convention concerning the Protection of the World Cultural and Natural Heritage, Paris (1972) has been ratified by 175 states. This defines and conserves the world's heritage by drawing up a list of natural and cultural sites whose outstanding values should be preserved for all humanity. Of the 730 total sites, there are currently 144 natural, 23 mixed, and 563 cultural sites that have been inscribed on the World Heritage List (distributed in 125 State parties);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington (Convention on International Trade in Endangered Species, 1973): This

provides a framework for addressing over-exploitation patterns which threaten plant and animal species. Under the Convention on International Trade in Endangered Species, governments agree to prohibit or regulate trade in species which are threatened by unsustainable use patterns; and

- Convention on the Conservation of Migratory Species of Wild Animals, Bonn (1979, Amended 1988): This provides a framework for agreements between countries important to the migration of species that are threatened.

2.8 Compliance with ADB Safeguard Policy Statement, 2009

60. ADB's environmental and social safeguards form the cornerstone of its support to inclusive economic growth and environmental sustainability in Asia and the Pacific. In July 2009, ADB's Board of Directors approved the new Safeguard Policy Statement (SPS) governing the environmental and social safeguards of ADB's operations. The objectives of the SPS are to avoid, or when avoidance is not possible, to minimize and mitigate adverse project impacts on the environment and affected people. Objectives also include helping borrowers strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

61. ADB's environmental safeguards emphasize development and implementation of a comprehensive EMP. Key elements of EMP are mitigation measures, monitoring programs, budgets, and institutional arrangements for implementation. In addition, the environmental assessment process emphasizes public consultation, information disclosure, and consideration of alternatives.

62. The key safeguard areas which must be addressed are (i) environmental; (ii) involuntary resettlement; and (iii) indigenous peoples.[12]

63. ADB's environmental safeguards emphasize development and implementation of a comprehensive EMP. Key elements of EMP are mitigation measures, monitoring programs, budgets, and institutional arrangements for implementation. In addition, the environmental assessment process emphasizes public consultation, information disclosure, and consideration of alternatives.

64. Further, ADB adopts a set of specific safeguard requirements that borrowers or clients are required to meet in addressing environmental and social impacts and risks associated with a specific project. ADB will not finance projects that do not comply with its safeguard policy statement, nor will it finance projects that do not comply with the host country's social and environmental laws and regulations. The safeguard policy statement applies to all ADB-financed and/or ADB-administered sovereign and non-sovereign projects, and their components, regardless of the source of financing.

2.8.1 ADB's Environmental Safeguard Requirements – Policy Principles

65. Environmental assessment incorporates the following policy principles:

- Projects are screened and assigned to one of the following categories described in Error! Reference source not found. as soon as possible.
- Conduct an environmental assessment for each proposed project. Assess potential trans-boundary and global impacts, including climate change.

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[12] In Bangladesh, this means Tribes, Minor Race, Ethnic Sects and Communities Peoples

- Examine alternatives to the project's location, design, technology, and components. Avoid, minimize, mitigate, and/or offset adverse impacts.
- Prepare an EMP.
- Carry out meaningful consultation with affected people and facilitate their informed participation.
- Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders.
- Implement the EMP and monitor its effectiveness. Document and disclose monitoring results.
- Do not implement project activities in areas of critical habitat, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area.
- Apply pollution prevention and control technologies and practices consistent with international good practices such as the World Bank Group's Environmental, Health and Safety Guidelines.
- Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease.
- Conserve physical cultural resources (PCRs) and avoid destroying or damaging them by using field-based surveys.

66. The project categorization system and the assessment required are described in Table 2-2. Most of the environmental impacts of the project are temporary and reversible. This project is categorized as an Environmental Category B project. The project will also address the World Bank/IFC EHS guidelines as they apply to transmission lines and associated infrastructure (such as the substations).

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

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

Category	Definition	Assessment Requirement

Source: ADB. Safeguard Policy Statement 2009, page19. http://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf.

2.9 Compliance with PGCB Health Environment and Safety Requirements

67. PGCB has its own policy and requirements for compliance relating to environment, health and safety issues for its operations. The company is committed to managing its operations in a safe, efficient and environmentally responsible manner. The PGCB's Health Environment and Safety (HES) manuals, guidelines, procedures, and plans are important tools indicating their commitment. HES manuals include:

- Environmental Impact Assessment Module;
- Guideline on Integrated Impact Assessment;
- Health Impact Assessment Module; and
- Social Impact Assessment Module.

68. In addition, the requirement for impact assessment is affirmed in the PGCB's Statement of General Business Principles. The PGCB is committed to:

- Pursuing the goal of no harm to people;
- Protecting the environment; and,
- Managing HES as any other critical business activity.

69. The mandatory company Operations Management System, Environmental Care Element/ Standards, issued in March 1997, refers to Environmental Assessment indicating that "EIA (including a consideration of social impacts) shall be conducted prior to all new activities and facility developments, or significant modifications of existing ones."

2.10 Comparison of Environmental Safeguard Principles between ADB and Bangladesh

70. Table 2-3 presents a summary comparing the environmental safeguard principles of ADB and the government.

Table 2-3 : Comparison of Environmental Safeguard Principles

SPS 2009			Government	Gaps (if any)
No.	**Principles**	**Delivery Process**		
1	Use of screening process to determine the appropriate environmental assessment	Uses sector-specific rapid environmental assessment checklist for screening and assigns categories based on potential impacts: • A - EIA required (irreversible, diverse or unprecedented adverse environmental impacts) • B - IEE required • C - no environmental assessment required but a review of environmental implications • FI - ESMS required	ECA 1995 and ECR 1997 (amended in 2017) set screening criteria to classify industries/projects based on potential environmental impacts as follows: Green (pollution-free), Orange-A, Orange-B and Red (causes significant environmental impacts). The screening criteria are based on project or industry type and do not consider the scale and location. The category determines	No major gaps

SPS 2009				
No.	**Principles**	**Delivery Process**	**Government**	**Gaps (if any)**
			the level of environmental assessment.	
2	Conduct an environmental assessment	• EIA and IEE - Identify potential impacts on physical, biological, PCRs, and socioeconomic aspects in the context of project's area of influence (i.e., primary project site and facilities, and associated facilities) • ESMS for FIs	• Industry/project category • Green- no environmental assessment required • Orange-A - no IEE or EIA required but must provide process flow, lay-out showing effluent treatment plant, etc. • Orange-B - IEE required • Red - both IEE and EIA are required	No major gaps
3	Examine alternatives	• Analyze alternatives to the project's location, design, and technology • Document rationale for selecting the project location, design, and technology • Consider "no project" alternative	• Regulations (i.e., ECA 1995 and ECR 1997 amended in 2017) do not require specifically the identification and analysis of alternatives	Not required by law but the TOR for EIA to be approved by the DOE now includes a discussion on analysis of alternatives.
4	Prepare an EMP	• EMP to include monitoring, budget and implementation arrangements	• EMP and procedures for monitoring included in the IEE and EIA (i.e., Orange-A, Orange-B, and Red category projects)	No major gaps
5	Carry out meaningful consultation	• Starts early and continues during implementation • Undertaken in an atmosphere free of intimidation • Gender inclusive and responsive • Tailored to the needs of vulnerable groups • Allows for the incorporation of all relevant views of stakeholders • Establish a grievance redress mechanism	• Public consultation and participation are not mandatory based on ECA 1995 and ECR 1997 (amended in 2017) • Grievance redress mechanism is not mentioned in ECA 1995 and ECR 1997 (amended in 2017) • EIA format required by DOE includes stakeholders' consultation	Approval of the TOR of EIA by DOE now includes consultation with stakeholders.
6	Timely disclosure of draft environmental assessment (including the EMP)	• Draft EIA report posted on ADB website at least 120 days prior to Board consideration (for Category A) • Draft IEE/EARF prior to appraisal • Final or updated EIA/IEE upon receipt • Environmental monitoring report submitted by borrowers upon receipt	• No requirement for public disclosure of environmental reports but DOE posts the Minutes of the Meeting on the application for environmental clearance certificate to its website, http://www.doe-bd.org/minutes.php	Still no requirement for public disclosure of environmental assessment, but the project will be posted to the DoE website and will be available in summary form at the project site.

SPS 2009			Government	Gaps (if any)
No.	**Principles**	**Delivery Process**		
7	Implement EMP and monitor effectiveness	• Prepare monitoring reports on the progress of EMP • Retain qualified and experienced external experts or NGOs to verify monitoring information for Category A projects • Prepare and implement corrective action plan if non-compliance is identified • Requires submission of quarterly, semi-annual, and annual reports to ADB for review	• Environmental clearance is subject to annual renewal based on compliance of the conditions set by DOE	No major gaps
8	Avoid areas of critical habitats (use of precautionary approach to the use, development and management of renewable natural resources)	• Provides guidance on critical habitats	• ECA 1995 and ECR 1997 (amended in 2017) identifies ecologically critical areas and the rules to protect them	No major gaps
9	Use pollution prevention and control technologies and practices consistent with international good practices	• Refers to World Bank's Environmental Health and Safety (EHS) General Guidelines 2007 (or any update) • If national regulations differ, more stringent will be followed • If less stringent levels are appropriate in view of specific project circumstances, provide full and detailed justification	• Effluent standards, ambient and emission standards included in ECA 1995 and ECR 1997 (amended in 2017) • Ambient noise levels included in Noise Pollution Control Rules 2006	No major gaps
10	Provide workers with safe and healthy working conditions and avoid risks to community health and safety	• Refers to WB EHS General Guidelines 2007 (or any update)	• Occupational health and safety standards included in the Factories Act 1965, the Bangladesh Labour Law 2006, and the Bangladesh Labour Act 2013.	No major gaps; WB/IFC EHS guidelines will still apply, as per the ADB SPS, and enforcement requirements will be noted.
11	Conserve physical cultural resources (PCRs) and avoid destroying or damaging them	• Use of field-based surveys and experts in the assessment • Consult affected communities on PCRs findings • Use chance find procedures for guidance	• Preservation and protection of cultural resources are within the Antiquities Act 1968.	No major gaps
12	Grievance Redress Mechanism	• Establish a grievance redress mechanism	• Grievance redress mechanism is not mentioned in ECA 1995	Not required by regulation in Bangladesh

SPS 2009			Government	Gaps (if any)
No.	Principles	Delivery Process		
			and ECR 1997 (amended in 2017)	

ADB = Asian Development Bank, DoE = Department of Environment, EARF = Environmental Assessment and Review Framework, ECA = Environment Conservation Act, ECR = Environment Conservation Rules, EHS = Environmental Health and Safety, EIA = Environmental Impact Assessment, EMP = Environmental Management Plan, ESMS = Environmental and Social Management System, FI = Financial Intermediary, IEE = Initial Environmental Examination, NGO = Non-governmental Organization, PCRs = Physical Cultural Resources, ToR = Terms of Reference, WB = World Bank.

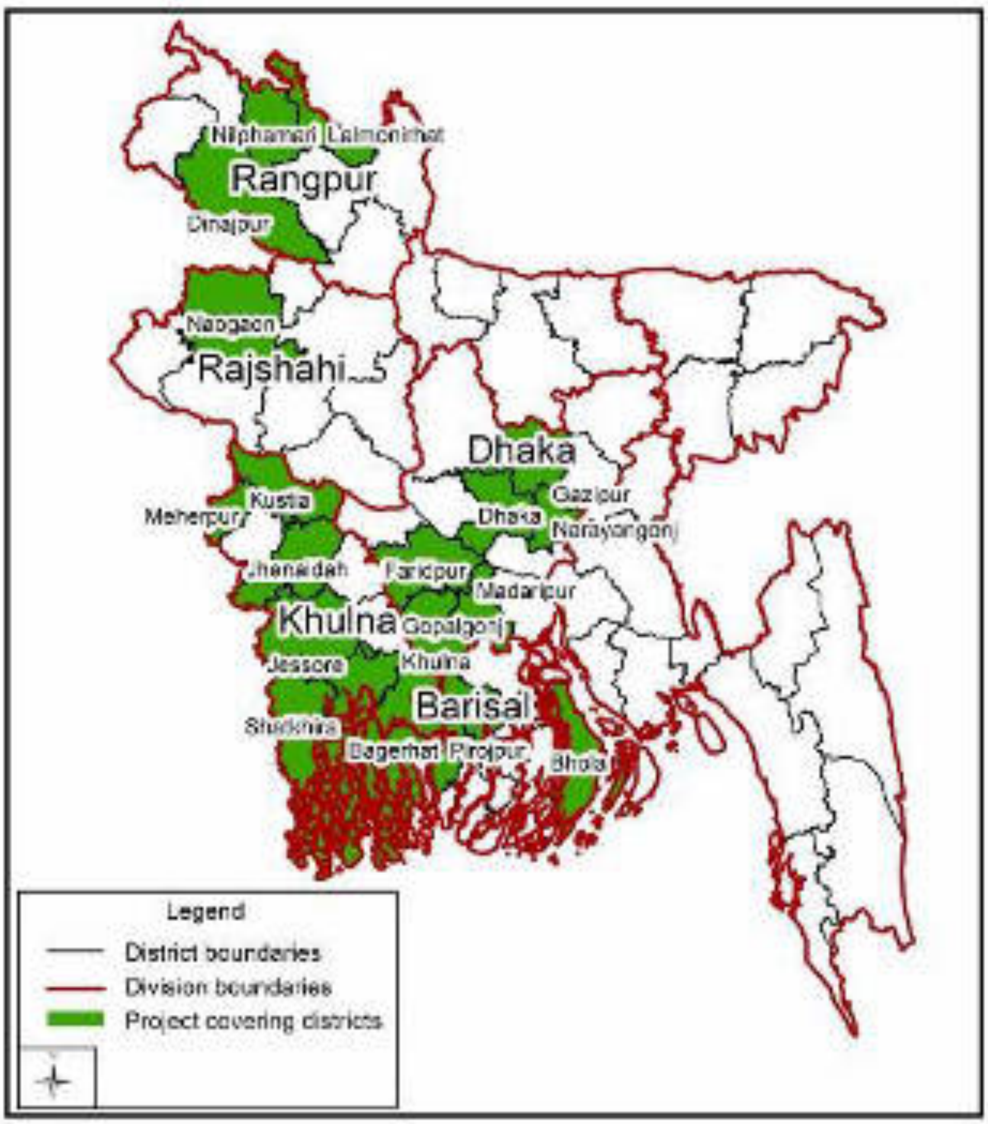
3. DESCRIPTION OF THE PROJECT

3.1 Project Location

71. The project area comprises five administrative divisions and twenty districts of Bangladesh; one in Rajshahi division (Noagoan), six in Dhaka division (Dhaka, Narayangonj, Gopalganj, Madaripur, Gazipur, and Faridpur), seven in Khulna division (Jhenaidah, Bagerhat, Kustia, Meherpur, Jessore, Satkhira, and Khulna), three in Barishal (Bhola, Jhalokaki and Pirojpur), and three districts in Rangpur division (Dinajpur, Lalmonirhat and Nilphamari).

72. Khulna and Barishal Divisions, and the Faridpur, Madaripur and Gopalganj Districts of Dhaka Division, all located south of Padma River, can be grouped as Southwest Bangladesh, while Rajshahi and Rangpur Divisions bordered by Padma and Jamuna Rivers can be grouped as Northwest Bangladesh. Merge in Southwest and Northwest Bangladesh forms the Western Zone.

Figure 3-1: Administrative Divisions and Districts of Project Area



3.2 Project Components

73. The Dhaka and Western Zone Transmission Grid Expansion Project (DWZTGEP) contains three (3) main components as listed below.

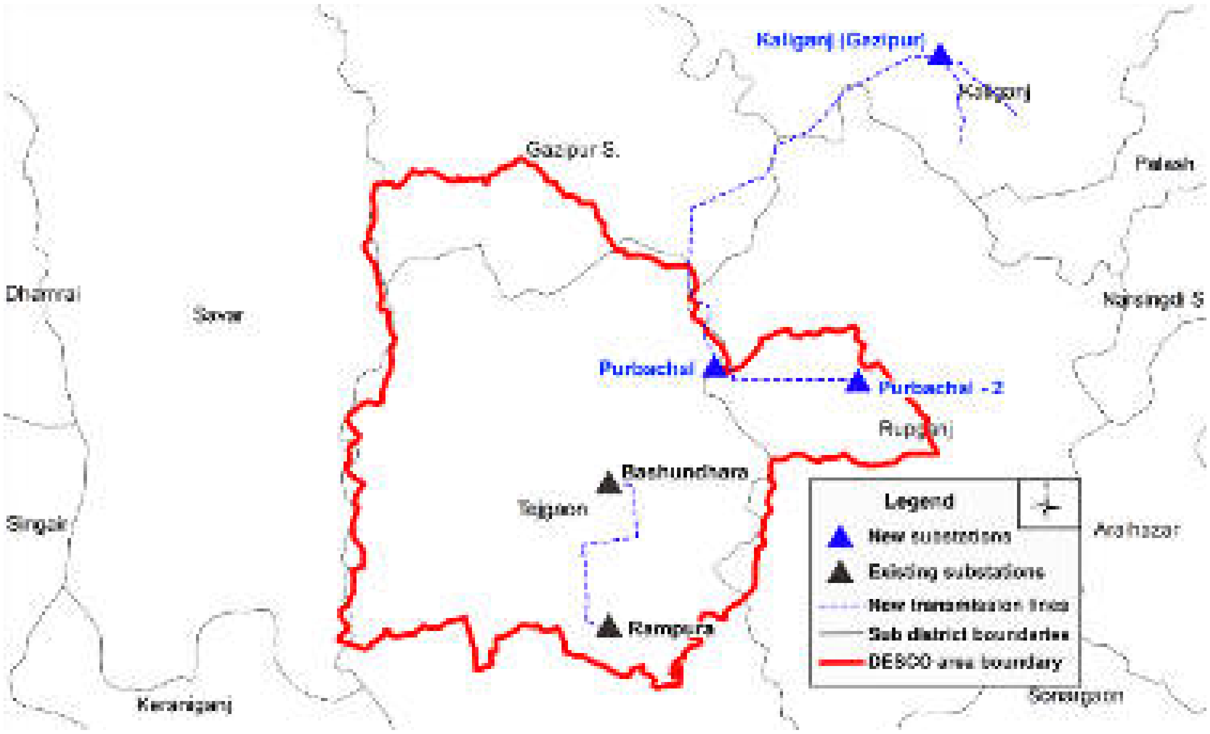
Component 1: Transmission system in Greater Dhaka expanded. The project will construct and commission substations with a total capacity of 4,450 MVA and 40 km of transmission lines in Greater Dhaka.

Component 2: Transmission system in Western Zone expanded. The project will construct and commission substations with a total capacity of 3,070 MVA and 368 km of transmission lines in western zone.

Component 3: Institutional Capacity of PGCB strengthened. The project will enhance capacity by (a) supporting installation and operation of an enterprise resource planning (ERP) system to assist PGCB in optimally managing its capital-intensive assets; (b) establishing a Drone Inspection Center within the operation and maintenance department of PGCB with some gender equality element.

74. In order to meet the growing demand for electricity in Greater Dhaka, PGCB envisages to construct a ring of 400 kV transmission lines around the Dhaka metropolitan area with 230 kV transmission lines leading into the city, fed by the 400 kV ring. Component 1, which is based on this plan, includes: i) construction of 400 kV, 230 kV and 132 kV transmission lines with cumulative line lengths of 22 km, 9 km and 9 km respectively; ii) construction of 400/230 kV and 230/132 kV substations with cumulative capacities of 3,750 MVA and 900 MVA respectively; and iii) construction of two 230 kV bay extensions at an existing substation. Given this situation, finding suitable corridors for construction of overhead transmission lines is difficult. As such, the proposed 230 kV and 132 kV transmission links of Component 1 will be underground cables except in narrow river crossing areas.

Figure 3-2 : Subprojects in Greater Dhaka, Component 1



3.3 Rationale and Detailed Project Description

3.3.1 Rationale

75. The Power System Master Plan 2016[13] establishes the need for major transmission capacity to be developed to transfer power from the new power plants to be developed in southern Bangladesh. The master plan envisages the following specific generating capacities to be located in southwestern Bangladesh: Mongla (1,320 MW), Payra (1,320 MW). The recently approved ADB-financed power plant project at Rupsha (800 MW) would increase the total new generating capacity to be located in southern Bangladesh to 3,440 MW. PSMP 2016 envisages that by 2022, all the above key generating facilities would be operational, and the power flow toward Dhaka and western zone would increase significantly.

76. **Transmission system in Greater Dhaka expanded:** Demand for electricity is growing rapidly in Dhaka and in its adjacent industrial areas as well. At present, electricity distribution in Dhaka is carried out by Dhaka Electricity Supply Company Limited (DESCO) and Dhaka Power Distribution Company Limited. Demand forecast studies carried out by DESCO has revealed that the demand in the area served by DESCO will increase to 8,000 MW by 2035 and has identified substations that will be required to serve the growing demand.

77. Transmission system studies carried out by PGCB for Dhaka considering the demand forecast prepared by DESCO has identified considerable improvements required in transmission

[13] Power System Master Plan 2016, Power Division, Ministry of Power, Energy and Mineral Resources, supported by Japan International Cooperation Agency (JICA), September 2016. No Strategic Environment Assessment conducted for this plan.

network. Accordingly, new 400/230 kV and 230/132 kV grid substations with interconnecting transmission lines are required to enhance the reliability of electricity supply in the Dhaka service area. It is anticipated that the new grid substations and transmission interconnections will not only increase operating contingency, but also will help overcome the limitations of supplying uninterrupted electricity to end-users.

78. **Transmission system in Western Zone expanded:** The government has prioritized the power sector development and has taken a large initiative to build a country wide power network (transmission & distribution) targeting to reach electricity for all by 2021. With the aim of realizing government's vision, PGCB has undertaken numerous projects to strengthen the national grid in order to meet the proliferating demand of electricity throughout the country.

79. The overall objective of this component is to strengthen the power transmission system in western Bangladesh and enhance its reliability and efficiency. The project area comprises of agricultural land, where, due to inadequate surface water supply, cultivation mostly depends on groundwater. Hence electricity demand is at its peak during the irrigation season. As there aren't adequate electricity generating capacity in the region, electricity is transmitted from distant regions at 132 kV. Long distances, lower transmission voltages, high demand and lack of reactive power compensation have resulted in severe voltage drops in this area resulting low water pumping rates and damages to electrical equipment. Furthermore, the electricity demand in the area is expected to rise in the near future with large scale industrialization expected in Southern Bangladesh after completion of construction of the Padma Bridge. In addition, it is also necessary to establish secondary transmission infrastructure for transmission of electricity expected to be generated at upcoming power plants at Payra and Bhola area to major load centres. In this respect PGCB has taken action to implement the proposed project in the western region of the country.

3.4 Project Scope

80. The three project components under the DWZTGEP are (i) Transmission system expanded in Greater Dhaka (ii) Transmission system expanded in Western Zone and (iii) Institutional Capacity Development of PGCB(Table 3-1). Component 3 will not involve any civil works. The detailed subproject description is listed in Annex 1.

Table 3-1: List of subprojects in component 1 & 2 of the DWZTGEP

No.	Subproject	Size/Length	Upazila	Zila	Division	Environmental Issues[14]
	Component 1. Transmission system in Greater Dhaka expanded					
1	Kaliganj (Gazipur) 400/230 kV, 2x750 MVA, indoor gas insulated switchgear (GIS) substation, Future 132 kV provision	18 acres, Lat: 23.587122 Lon: 90.325799	Kaliganj	Gazipur	Dhaka	Land filling, 3-5 m
2	Purbachal 400/230 kV, 3X750 MVA, indoor GIS substation	14 acres, Lat: 23.853916 Lon: 90.521263	Rupganj	Narayanganj	Dhaka	Land filling, 4-6 m, sensitive receptors (Local market, Hordi Bazar, Jame mosque) within 500 m (site is adjacent to Turag river)
3	Purbachal-2 230/132 kV, 2x 350/450 MVA indoor GIS substation	1.32 acres, Rajuk land, Lat: 23.85394 Lon: 90.52116	Rupganj	Narayanganj	Dhaka	Land filling, Removal of vegetation
4	Kaliganj (Gazipur)-Purbachal 400 kV DC double circuit overhead transmission line	18 km, 15 Angle towers (AT) 27 suspension towers (ST)	Gazipur Sadar Kaliganj	Gazipur	Dhaka	
5	Purbachal-Purbachal-2 230 kV double circuit underground transmission cable with overhead transmission line section	5 km, Underground (UG)/0.5 km Overhead (OH)	Kaliganj	Gazipur	Dhaka	Line crossing Turag river, pond and canals. Minimum 150 m distance to the bank of river from tower footings
6	Basundhara-Rampura 132 kV double circuit underground transmission line	9 km	Basundara	Dhaka	Dhaka	
7	Line-in line-out connection from Bhulta-Kaliakair 400 kV double circuit transmission line to Kaliganj (Gazipur) substation	0.5 km Line traverses over the Kaliganj substation	Kaliganj	Gazipur	Dhaka	
8	Line-in line-out connection from Ghorashal-Tongi 400 kV double circuit transmission line to Kaliganj (Gazipur) substation	3.5 km, 4 AT	Kaliganj	Gazipur	Dhaka	
9	Line-in line-out connection from Ghorashal-Tongi 230 kV double circuit transmission line to Kaliganj (Gazipur) substation	3.5 km, 4 AT	Kaliganj	Gazipur	Dhaka	
	Component 2. Transmission system in Western Zone expanded					

[14] All marshes found at the site are temporary and cultivate in one season.

1	Bhola 230/33 kV, 2x 120/140 MVA, indoor GIS substation	5 acres, Lat:22.57811 Lon:90.66592	Daulat Khan	Bhola	Khulna	Land filling, 1-1.5 m
2	Rupsha 230/132 kV, 3x 250/350 MVA and 132/33 kV, 3x 80/120 MVA indoor GIS substation	5 acres, Lat: 22.77076 Lon: 89.61685	Fakirhat	Bagerhat	Khulna	Land filling, 1.5-3 m (1 acre waterbody)
3	Bhanga 132/33 kV indoor GIS substation	2 acres, Lat:23.41919 Lon: 89.96184	Bhanga	Faridpur	Dhaka	Land filling, 3-5 m
4	Domar 132/33 kV outdoor GIS substation	5 acres, Lat:26.105169 Lon: 88.803787	Domar	Nilphamari	Rangpur	Land filling, 1-1.5 m tree felling (26 nos)
5	Hatibanda 132/33 kV outdoor GIS substation	3 acres, Lat:26.20759 Lon: 89.09256	Hatibanda	Lalmonirhat	Rangpur	Land filling, 2.5 -3 m
6	Jhalokati 132/33 kV indoor GIS substation	5 acres, Lat:22.67789 Lon: 90.1975	Jhalokati Sadar	Jhalokati	Barishal	Land filling, 1.1.5 m
7	Maheshpur 132/33 kV indoor GIS substation	3 acres, Lat:23.3422317 Lon: 88.9123916	Maheshpur	Jhenaidah	Khulna	Land filling, 1.5 -2 m, Sensitive receptors (houses, markets, mosques) in 500 m radius, tube well to be relocated
8	Monirampur 132/33 kV indoor GIS substation	3 acres, Lat: 22.97617 Lon: 89.22928	Manirampur	Jashore	Khulna	Land filling, 1-1.5 m
9	Meherpur 132/33 kV indoor GIS substation	3 acres, Lat: 23.79119 Lon: 88.6796798	Meherpur Sadar	Meherpur	Khulna	Land filling, 1-1.5m, Sensitive receptors (houses, markets, mosques) in 500 m radius
10	Phultala 132/33 kV indoor GIS substation	2 acres Lat: 22.92388 Lon:89.48595	Phultola	Khulna	Khulna	Land filling, 1-3 m, (2 acres waterbody)
11	Pirojpur 132/33 kV indoor GIS substation	3 acres, Lat: 22.63538 Lon: 89.95208	Pirojpur Sadar	Pirojpur	Barishal	Land filling up to 2 m, (Agricultural & marshy land), sensitive receptors (houses, markets) within 500 m radius
12	Shibchar 132/33 kV indoor GIS substation	5 acres Lat: 23.3552513 Lon: 90.1847076	Shibchar	Madaripur	Dhaka	Land filling, 2-3 m, tree removal (5 nos)

13	Rupsha-Satkhira 230 kV double circuit transmission line (initially charged at 123 kV)	62 km, 80 AT, 82 ST	Fakirhat Batiaghata DumuriaSatkhira Sadar, Tala	Bagerhat, Khulna, Satkhira	Khulna	Line crossing 9 rivers, 6 canals, 1 khal, 150 m distance to the bank of river from tower footings
14	Domar-Purba Sadipur 230 kV double circuit transmission line (initially charges at 132 kV)	46.5 km, 46 AT, 75 ST	Birganj Kaharole Khansama Domar Nilphamari Sadar	Dinajpur Niphamari	Rangpur	Line crossing Rivers (Atai, Shewraphull, Karotoya), pond, Gorgram canal
15	Domar-Hatibanda 132 kV double circuit transmission line	35 km, 56 AT 50 ST	Hatibanda Dimla Domar	Lalmonihat Nilphamari	Rangpur	Line crossing Teesta Barrage Park (managed by the Bangladesh Water Dev. Board) next to the Teesta river, line crossing over the park
16	Kaliganj-Maheshpur 132 kV double circuit transmission line	28 km, 12 AT 72ST	Kaliganj Kotchandpur Maheshpur	Jenaidah	Khulna	
17	Manirampur-Satkhira 132 kV double circuit transmission line	33 km, 33 AT	Keshabpur Manirampur Patkelghata Satkhira Sadar, Tala	Jeshore Satkhira	Khulna	Line crossing Rivers (Kapotaksha, Betna, Buri Bhadra, Haribar), waterbodies, marshes
18	Kushtia-Meherpur 132 kV double circuit transmission line	48 km, 30 AT 115 ST	Kushtia Sadar Mirpur, Gangni	Kushtia Meherpur	Khulna	Line crossing Rivers (Kajla, Mathavurg, Pangashi, Sagar), 7canals, 2 waterbodies
19	Bagerhat-Pirojpur-Bhandaria 132 kV double circuit transmission line,	49.5km, 55 AT 94 ST	Bagerhat Sadar Kachua Bhandaria Kawkhali Pirojpur	Bagerhat Pirojpur	Khulna Barishal	Line crossing Rivers (Bhairab, Boleswar, Katcha, Goroyar ad Pona), 15 canals, 1 khal
20	Gopalganj (North)-Shibchar 230 kV double circuit transmission line	25 km, 21 AT 43 ST	Bhanga Rajoir Shibchar	Faridpur Madaripur	Dhaka	Line crossing Rivers (Kumar+Arialkhan), and canals (Purbo Kakoir, Moraganj, West Kachikat)
21	Niamatpur-Patnitola 132 kV double circuit transmission line	33 km, 23 AT 74 ST	Mahadebpur Niamatpur Patnitala	Naogoan	Rajshahi	Line crossing canals (Chatra, Singhadi, Esapur), and waterbodies

22	Line-in line-out connection from Barishal-Bhola-Burhanuddin 230 kV double circuit transmission line to Bhola substation	1 km, 1AT	Daulat Khan	Bhola	Barishal	
23	Line-in line-out connection from Bagerhat-Goalpara 132 kV double circuit transmission line to Rupsha substation	3.5 km, 6 AT 4 ST	Rupsha	Khulna	Khulna	Line crossing Poddabil Canal
24	Line-in line-out connection from Gallamari-Gopalganj 132 kV double circuit transmission line to Rupsha substation	0.5 km	Fakirhat	Bagerhat	Khulna	
25	Line-in line-out connection from Khulna (South)-Rupsha power plant 230 kV double circuit transmission line to Rupsha substation	0.5 km Line traverses over the substation	Rupsha	Rupsha	Khulna	
26	Line-in line-out connection from Faridpur-Madaripur 132 kV double circuit transmission line to Bhanga substation	0.5 km	Bangha	Faridpur	Faridpur	
27	Line-in line-out connection from Barishal-Bhandaria 132 kV double circuit transmission line to Jhalokati substation	1.5 km, 1AT 2ST	Jhalokati Sadar	Jhalokati	Barishal	
28	Line-in line-out connection from Khulna Central-Noapara 132 kV double circuit transmission line to Phultala substation	1 km, 1ST	Phultola	Khulna	Khulna	
29	Two 132 kV outdoor air insulated switchgear (AIS) bay extensions at Satkhira substation (existing)	5 acres +3 acres required for bay e	Satkhira Sadar	Satkhira	Khulna	Land filling for about 1 m at 3 acres new land
30	Two 132 kV outdoor GIS bay extensions at Purba Sadipur substation (existing)	10 acres	Sadipur	Dinajpur	Rangpur	
31	Two 132 kV outdoor AIS bay extensions at Kaliganj substation (under construction)	5 acres	Kaliganj	Gazipur		
32	Two 132 kV outdoor GIS bay extensions at Kushtia substation (existing)	14.3 acres	Kushtia Sadar	Kushtia	Khulna	
33	Two 132 kV outdoor AIS bay extensions at Bagerhat substation (existing)	7.6 acres	Bagerhat Sadar	Bagerhat	Khulna	
34	Two 132 kV outdoor GIS bay extensions at Bhandaria substation (existing)	2 acres	Bhandaria	Pirojpur	Barishal	
35	Two 132 kV outdoor AIS bay extensions at Gopalganj (North) substation (under construction, ADB funded)	60 acres	Mukshdpur	Gopalganj	Dhaka	
36	Two 32 kV outdoor AIS bay extensions at Niamatpur substation (existing)	5 acres	Niamatpur	Naogaon	Rajshahi	

37	Two 32 kV outdoor AIS bay extensions at Patnitola substation (under construction)	5 acres	Patnitola	Naogaon	Rajshahi	

AT=Angle Tower; ST=Suspension Tower

81. **Associated Facility.** There are no associated facilities for the project as the project will only provide system strengthening for power transmission system in Bangladesh. PGCB is not constructing any dedicated line/substation for any particular generation projects.

3.5 Components of Construction Works

82. The phasing of construction works for the transmission lines and the grid substations is indicated in Table 3-2 below. The construction methods are discussed separately for underground cable, overhead transmission lines and grid substations.

Table 3-2: The Phasing of Construction Works

<table>
<tr><th rowspan="2">Component</th><th colspan="3">Activities</th></tr>
<tr><th>Pre-construction</th><th>During Construction</th><th>Post Construction/ Operation period</th></tr>
<tr><td rowspan="9">Transmission Line</td><td>Route survey</td><td>Contractor and manpower recruitment</td><td>Clearing of RoW</td></tr>
<tr><td rowspan="8">Tender documents preparation</td><td>Establishment of construction camps for workers</td><td rowspan="8">O&M</td></tr>
<tr><td>Clearing of RoW</td></tr>
<tr><td>Establishment of temporary access tracks</td></tr>
<tr><td>Transport of materials and equipment to tower sites</td></tr>
<tr><td>Civil works (foundation work, RCC, etc.)</td></tr>
<tr><td>Tower erection</td></tr>
<tr><td>Conductor stringing</td></tr>
<tr style="display:none"></tr>
<tr><td rowspan="9">Grid Substation</td><td rowspan="9">Topographical survey</td><td>Establishment of material storage areas and work sites</td><td rowspan="9">O&M</td></tr>
<tr><td>Establishment of construction camps for workers</td></tr>
<tr><td>Establishment of temporary access tracks</td></tr>
<tr><td>Transport of materials and equipment to site</td></tr>
<tr><td>Clearing site</td></tr>
<tr><td>Civil works (land filling, foundation, RCC work)</td></tr>
<tr><td>Equipment installation</td></tr>
<tr><td>Testing and commissioning</td></tr>
</table>

O&M = operations and maintenance, RCC = reinforced cement concrete.

3.6 Construction of Underground (UG) Cable

83. Construction of underground cable involves the following activities: site preparation, excavations, bedding, tiling and warning tape, cable laying, and backfilling.

3.6.1 Route Survey and site preparation

84. Proposed cable route needs to be carefully surveyed to identify every possible obstacle prior to the excavations. As a part of the survey, trial pits shall be made at an interval of 15-20 m in the proposed cable route so that the soil condition and any parallel utility service lines can be identified. However, it is essential to contact relevant utility organizations such as water, telecommunication, etc. to identify the existing service network buried within the cable network area. While laying underground cables, every precaution must be made to prevent damages to the cable; as such damages may lead to the breakdown which causes disturbances to the supply.

Not like overhead lines, it is difficult to repair such damages immediately and hence zero damages to the cable while lying is essential.

85. During the survey, road crossings, culverts, railway and drain crossings shall be clearly identified and special cable laying constructions shall be developed for such sections.

3.6.2 Excavations

86. Trenching is the most difficult activity in the cable laying work. As most of the trenching activity will be done in roads and pavements, safety of the general public shall be ensured with minimized disturbances. Therefore, night work is preferred for trenching work as it will be less disturbing. During the excavations, barricading, danger signs, warning lights and boards shall be used to prevent any accidents.

87. One common method which is adopted by the utilities in laying cables in densely populated areas is to excavate the trench and temporarily backfilling with sand or quarry dust. Once the whole section excavation is completed, the trench will be re-excavated for cable laying. Depth and width of the trench depends on the type of cables laid in the trench. When two different cables are running on the same trench, cables shall be laid in layers to maintain minimum buried depths or on the same layer that satisfy the minimum depth requirement of the highest voltage cable.

88. To prevent any mechanical damages to the cable (which alter the geometry of the inside cable), the cable route shall be carefully designed to match the minimum bending radius of the cable. This measurement will slightly vary with different manufactures and hence shall check the technical data sheet for the selected conductor.

3.6.3 Bedding, tiling and warning tape

89. Once the trench excavation is completed, the bottom of the trench shall be prepared for cable laying. As the cable is dragged along the trench while laying, there is a possibility to get damaged if the trench bed is not well prepared. Therefore, 100 mm depth of sand layer is spared at the bottom of the trench prior to the cable laying. This sand bed also serves as a good medium for heat conduction which needs for cooling the cable during the operation. Once the cable is laid, again sand layer of 100 mm above the conductor is applied as a back- filling layer.

90. The cable shall be protected from the impacts in case of excavations by unknown parties. For that concrete cable tiles will be laid on the sand layer to cover the cable from impacts. General dimensions of such covering tile will be 400 x 200 x 50 mm (L x W x H). If multiple cables were laid, bottom of the trench will be fully covered with tiles. As a measure of conveying the danger of the cables laid below, a warning tape (Black and Yellow colour Polyethylene tape) will be laid at the depth of 300 mm from the top level.

3.6.4 Cable Laying

91. For laying the cable, the cable drum shall be in a suitable place at the end of the trench with supports from jacks such that the drum can be easily rotate to pull the cable out. The cable will be pulled out from the top of the drum and not from the bottom as follows.

Figure 3-3: Placement of cable drum and correct method of pulling

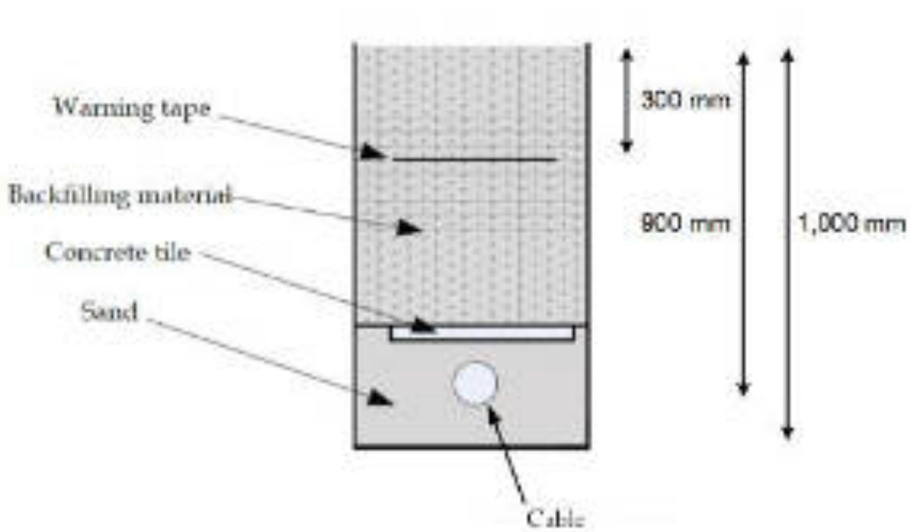
92. Once the trench is prepared for cable laying with spreading of sand at the bottom, cable can be pulled along the trench. To prevent any damages to the cable and also for the ease of pulling, rollers must be placed along the route within a gap of 5 m. The correct method of pulling is to use a winch and apply suitable tension which is below the maximum pulling tension specified by the manufacturer.

93. As most of the damages to the sheath occur during the pulling of the cable, the activity shall be completed with extreme care. If multiple cables are laid on the same trench, cables shall be laid in the trench first and each cable shall be adequately separated from each other manually before the backfilling with sand. Generally, it takes much time for completing the end terminations and hence both ends of the cable will be protected from moisture by properly sealing with end caps.

3.6.5 Backfilling

94. Materials used for backfilling will vary as different authorities recommend specific various methods of backfilling. Generally backfilling shall be done with quarry dust up to the top 200 mm limit and top surface shall be backfilled with uniformly graded aggregates. In by roads, soil backfilling is permitted, however the backfilling soil shall be smooth and free from heavy particles. If the excavated soil is not suitable for backfilling, suitable material shall be transported to the site.

Figure 3-4: Typical cross-section of a trench profile



3.6.6 Special locations

95. Special locations such as road crossings, culverts, railway crossings, drain crossings, etc. are locations where additional protection for the cable is necessary. For such location's ducts shall be used as a special protective measure in addition to the covering tile shield. For road and railway crossings, type 1000 PVC pipes will be used as ducts whereas at culvert and drain crossings thickness 3.5 mm steel GI ducts will be used. In any other location where possibility of cable damage is high, suitable protective measures shall be adopted. A detailed traffic plan will be prepared by EPC contractor after consultation with relevant authorities.

3.6.7 Cable Testing

96. Before laying the cables, insulation resistance shall be checked to ensure that the cable is health before the installation. At the time of starting the end terminations, again insulation resistance shall be checked to verify that the cable has not suffered insulation failures at the time of installations.

97. Once the end terminations were completed, high potential test shall be carried out to ensure that the whole cable is ready for service. In High Pot test, 100 % of original factory test voltage in accordance with manufacturer's recommendations is applied to the cable and leakage current is measured at the specified durations (normally 1 min). The manufacturer specifies the maximum leakage current for the cable and High Pot test readings shall be within that limit for the acceptance for operations.

3.7 Construction of overhead transmission lines (OHLs)

98. Construction of OHLs involves the following activities, site preparation; foundation construction; structure construction and wire-stringing operations.

99. Site Preparation: Tower locations are cleared of vegetation prior to construction of the towers. Access roads may need to be upgraded or new roads constructed to accommodate construction vehicles and equipment access to each tower site.

	
Transmission line tower construction site	Foundation construction for an LST

100. **Foundation Construction:** Most structures have a concrete foundation. The size of the foundation depends on the type of structure and the terrain. Foundation construction begins with

the auguring of holes for footings (four for lattice steel towers [LSTs]). For LSTs, each hole is usually 3 to 4 feet wide and 15 to 30 feet deep. Regardless of the structure type, foundations typically have a slight projection above the ground. After the footing holes are excavated, they are reinforced with steel and then concrete is poured into the holes. Once the concrete has cured, crews can begin the construction of the structure itself.

A crane carrying the top section of an LST for installation

101. **Structure Construction:** Generally, structures are built from the ground up. Structures are assembled in sections near the new tower location and a crane is used to lift the sections into place. Crews then bolt the sections together. The method used is determined by terrain and available space next to the structure site. Tower erection is usually performed by crane, but helicopters are used in areas that are inaccessible to large ground-based construction equipment.

102. **Wire-Stringing Operations:** Wire stringing includes all activities associated with the installation of the primary conductors onto the transmission line structures. These activities include the installation of conductor, ground wire, insulators, stringing sheaves (rollers or travellers), vibration dampeners, weights, suspension and dead-end hardware assemblies for the entire length of the route.

103. To string the wire involves the following five steps:

(i) Stringing the pilot line to install the conductor

A light-weight sock line (pilot line) is flown from tower to tower by helicopter, threading the sock line through wire rollers attached to the insulators on each structure. A clam lock device secures the sock line in the rollers.

(ii) Pulling

The sock line is attached to a conductor pulling rope/cable, which is connected to a tensioning machine on a truck. The conductors are then pulled through by a puller machine. The puller and tensioner work together during the pulling operation to ensure that the conductor maintains the proper ground clearance at all times. Wire set-up sites or pulling stations, where the associated pulling machinery and equipment are staged, are located at intervals along the span.

	
Pulling phase of a wire-stringing operation. Note the reel of conductor on the right side of the photo	A guard structure being erected at a street crossing

(iii) Sagging and dead ending

Once the conductor is pulled through the length of the line, the tensioner is then used to sag the conductors to the proper tension. Conductors expand with changes in temperature (they are longer at higher temperatures), so they need to be installed at the proper tension such that they do not sag too low when temperatures increase. All phases (or bundled phases) between two towers must be sagged to the same tension.

(iv) Splicing

Once the conductor is pulled in and the proper tension of the conductor is reached, mid-span splicing is performed at dead-end tower locations to connect or splice segments together. Any temporary pulling splices are removed and replaced with permanent splices. Implosive sleeves may be used for splicing, which involves placing a layer of explosives around an aluminium sleeve. The layer of explosive is designed to create the required compression of the sleeve around the conductor. After splicing and sagging, conductors are affixed to dead-end towers.

(v) Clipping-in, spacers

After the conductors are spliced and affixed to dead-end towers, they are "clipped in", or attached to tangent towers. This process involves removing the rollers and replacing them with clamps and other final insulator hardware to secure the conductors to the insulators. Vibration dampeners, weights, and spacers between the conductors of a bundled phase are then installed.

104. Guard poles or guard structures may be installed at transportation, flood control, utility crossings, parks, and other sensitive locations to protect these underlying areas during wire stringing operations. The guard structures intercept wire should it drop below a conventional stringing height, preventing damage to underlying structures. These guard structures are temporary and are removed after conductor installation is complete. Figure 3-5[15] shows the associated civil works related to OHLs.

[15] Report on Environmental Impact Assessment (EIA) for Patuakhali- Payra 230 kV Transmission Line (Patuakhali - Payra 47 km 230 kV TL & Bakerganj - Barguna 50 km 132kV TL and Barguna 132/33 kV Substation) Project, 15 November, 2017 Dhaka, page 53.

Figure 3-5: Associated Civil Works for Transmission Line Installation

placing of steel ring bunds

tower piling works

pile cap reinforcement

Casting CC into tower foundation

Placing tower on its foundation

Tower erection work

3.8 Construction of Grid Substations

105. For this project, all equipment to be installed will be procured from outside Bangladesh. Construction materials such as bricks, sand, cement, and reinforcing rods, etc. will be from existing licensed sources.

3.8.1 Civil Works for Substation

3.8.1.1 *Earth Work in Foundation*

106. Construction of the substation requires earthwork excavating or filling for the foundation up to the required level. The excavated earth should be kept in a nearby vacant place and after completion of foundation work; back-filling of the excavated area will be done with local soil and sand. The substation civil designs will include drainage and flood control measures to avoid adverse impacts by land filling in new substation land and also specify that the soil/sand shall be

sourced only from licensed suppliers who are authorized by the government to supply soil/sand for land filling.

3.8.1.2 *Raising the land*

107. The lands earmarked for the construction of substations are low lying. These lands will be elevated 0.5m above the highest flood level before the construction of substation yard and the buildings by the contractor utilizing the soil/sands provided by existing licensed suppliers. The detailed design of drainage pattern will be provided by contractor, however, the following table provides the volume of landfilling estimated in the Development Project Proposal (DPP).

Table 3-3: Land filling requirements for substation lands estimated in the DPP

No	Name of the substation	Land filling requirement (m^3)[16]
1.	Kaliganj	333,819.4
2.	Purbachal (400 kV)	348,070.4
3.	Purbachal-2 (230/132 kV)	5,341.8
4.	Bhola	24,685.8
5.	Rupsha	64,952.1
6.	Banga	37,543.0
7.	Domar	30,351.4
8.	Hatibanda	36,907.3
9.	Jhalokhati	30,756.0
10.	Maheshpur	29,919.2
11.	Meherpur	22,217.2
12.	Manirampur	18,210.8
13.	Phutola	24,281.0
14.	Pirojpur	24,281.0
15.	Shibchar	61,714.6
16.	Satkhira	12,140.6

3.8.1.3 *Foundation Treatment*

108. Geo-technical investigation will be conducted to assist in designing foundations of the structures. It will help to identify whether foundation treatment will be required or not. The type of treatment like pre-cast reinforced cement concrete (RCC) piling or cast in-situ concrete piling, removal of peat or loose soil will be suggested as per results of geo-technical investigation. Bored cast in-situ piles will eliminate noise and vibration problems of pile driving. Pilling will be done for 9-20m depth varying with soil type. Piling type will be determined by contractors.

3.8.1.4 *Back Filling with Local Sand*

109. Back filling of the excavated area of the foundation and floor of the building will be carried with local sand.

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[16] The first two substations are identified as new development areas in Dhaka. Large scale land filling of adjacent areas are ongoing at present.

3.8.1.5 *RCC Work*

110. The RCC works would be required for roof, column, beam, floor, foundation of transformer, circuit breaker and steel structure etc.

3.8.1.6 *Brick Work up to Plinth Level and Superstructure*

111. Brickwork will be done for constructing the substation building with first class bricks and coarse sand and cement up to roof level.

3.8.1.7 *Plastering and Finishing*

112. Concealed electric wiring of good quality and proper size is to be done and bulbs and switchboards are to be provided. Plastering of walls inside and outside as well as the roof of the building will be done accordingly with proper curing for at least three weeks. After that, distemper or plastic painting will be done on the walls and roof of the building.

3.8.1.8 *Wood Works/ Thai Aluminum, Windows and Glass Fittings*

113. Wood/aluminum works are to be done on door shutters and windows of the building along with glass fittings.

3.8.1.9 *Sanitary Works*

114. Sanitary works such as lying of sewerage line (either PVC or RCC), installation, fittings and fixing of toilet accessories will be done in the buildings.

3.8.1.10 *Water Supply System*

115. The water supply system meeting Bangladesh drinking water standards will be activated for the workers and staff of the substation.

3.8.1.11 *Boundary Fencing with Concrete Pillar and Barbed Wire*

116. The project area will be protected from any unauthorized entrance of public by fencing the boundary with a ten (10) feet height wall with barbed wire fitted with concrete pillars three (3) meters apart.

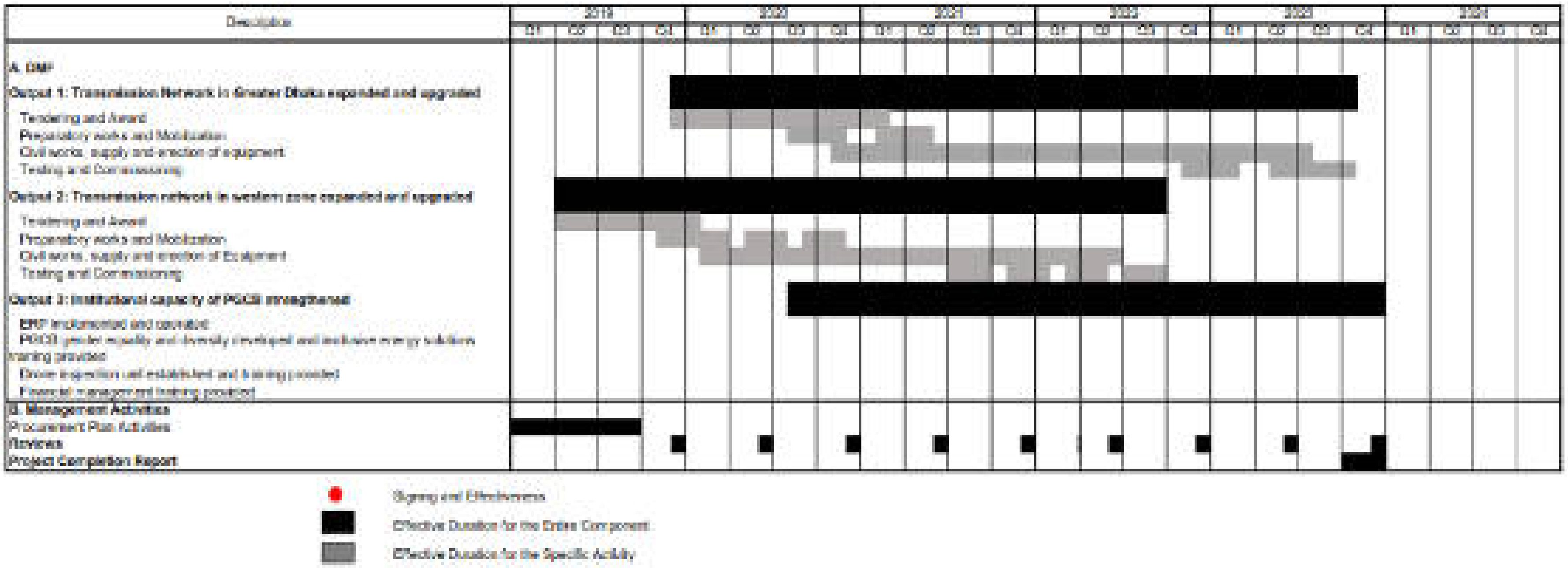
3.8.2 Electrical Works and Towers

117. For GSSs, installation of equipment will include transformers, circuit breakers, isolators, lightning arresters, panel boards, batteries, and battery chargers, etc. All equipment will be installed at the GSSs (outdoors and indoors) as per design specifications and standards. For this project, all material will be procured from foreign countries. Domestic materials like bricks, sand, cement, and reinforcing rods, will be sourced locally from existing licensed sources for the installation works.

3.9 Work Schedule

118. The completion of works is proposed to take place in 56 months (after loan effectiveness) as indicated below in Figure 3-6.

Figure 3-7: Project Implementation Schedule



4. DESCRIPTION OF ENVIRONMENT (BASELINE DATA)

119. Information on the baseline environmental status of the project area is required for the impact assessment process, to assess and predict the possible environmental consequences of the project interventions. Based on the existing environmental scenario, the potential impacts of subprojects were identified and accordingly an environmental management plan was prepared (see subsequent sections of this IEE). The baseline environmental conditions will help in comparing and monitoring the predicted negative and positive impacts resulting from the project during the pre-construction, construction and operation phases. The impact assessment focused on the direct adverse changes that might be caused by project activities, including effects on the quality of habitats, flora, fauna and humans, socio-economic conditions, current use of land and resources, climate change aspects, physical and cultural heritage properties and biophysical surroundings.

4.1 Methodology

120. The baseline environmental information was assessed through secondary data and field studies within the project's area of influence (PAI) for various components of the environment; physical, ecological/biological, and socio-economic parameters.

121. Data/information was collected from secondary sources for the macro-environmental setting, including climate (temperature, rainfall, humidity, and wind speed), topography, geology, and soil. Primary information was collected to record the micro-environmental features within and adjacent to PAI. Collection of primary/field data/information included extrapolating environmental features to cover all project footprints, including establishing tree inventories, and the location and measurement of socio-cultural features adjoining proposed subprojects. Data on ambient air, noise quality, surface water and ground/drinking water quality were gathered from secondary sources, and from previous projects conducted in the area. FGDs were carried out in PAI to investigate local environmental conditions, issues, and possible impacts.

122. The baseline environment is discussed in three broad categories: (i) Physical Environment which includes factors such as topography, geology, earthquake risk, climate, hydrology/drainage, and environmental pollution related elements; (ii) Biological Environment, which includes flora, fauna, Protected Areas, wildlife sanctuaries, forest reserves, and the general ecosystem; and; (iii) Socio-economic Environment, which includes anthropological factors like demography, income, land use, land requirements and infrastructure. As mentioned in Chapter 3, all the subprojects under the DWZTGEP of PGCB are located in five administrative divisions and twenty districts of Bangladesh; one in Rajshahi division (Noagoan), six in Dhaka division (Dhaka, Narayangonj, Gopalganj, Madaripur, Gazipur, and Faridpur), seven in Khulna division (Jhenaidah, Bagerhat, Kustia, Meherpur, Jessore, Satkhira, and Khulna), three in Barishal (Bhola, Jhalokaki and Pirojpur), and three districts in Rangpur division (Dinajpur, Lalmonirhat and Nilphamari).

4.2 Physical Environment

4.2.1 Climate

123. Although less than half of Bangladesh lies within the tropics, the presence of the Himalaya mountain range has created a tropical macro-climate across most of the east Bengal land mass. Bangladesh is divided into seven climatic zones and the sub projects are located in five climatic zones.

124. **Northern part of the northern region (C)**. This is an area of extremes. In summer the mean maximum temperature is well above 32°C whereas in winter the mean minimum is below 10°C. The summer is dry, with a scorching westerly wind, but the rainy season is very wet, with 2,000 to 3,000 mm of rainfall (Figure 4-2,Figure 4-3).

125. **North-western zone (D).** Except that the extremes are less, and the rainfall is lower than other zones, this zone is similar to northern part of the northern region. The lower rainfall makes this area drier than other zones.

126. **Western zone (E).** This zone comprises the greater Rajshahi district and parts of adjacent districts, with rainfall generally below 1,500 mm (annually) and summer humidity less than 50%. In summer, it is the hottest and driest of all the climatic zones in Bangladesh. Mean summer maximum temperature is over 35°C.

127. **South-western zone (F).** Here the extremes of the zones to the north are somewhat moderated. Rainfall is between 1,500 mm and 1,800 mm. Mean summer maximum temperature is below 35°C. Dewfall is heavier than in Western zone.

128. **South-central zone (G).** In this zone rainfall is abundant, being above 1,900 mm/year. The range of temperature is, as can be expected, much less than to the west, but somewhat more than in south-eastern zone. This is a transitory zone among the south-eastern, north-western and south-western zones and most of the severe hailstorms, nor 'westers and tornadoes are recorded in this area.

129. Three distinct seasons can be recognized in Bangladesh: the post-monsoon season from November to February; the pre-monsoon hot season from March to May, and the rainy monsoon season which lasts from June through to October. The month of March may also be considered as the spring season, and the period from mid-October to mid-November may be called the autumn season.

130. The post-monsoon season (November-February) begins first in the west-central part of the country, where its duration is about four months, and it advances toward the east and south, reaching the eastern and southern margins of the country by mid-March, where its duration is about one month.

131. The pre-monsoon hot season (March–May) is characterized by high temperatures and the occurrence of thunderstorms. April is the hottest month when mean temperatures range from 27°C in the east and south to 31°C in the west-central part of the country. In the western part, summer temperatures sometimes reach up to 40°C. After the month of April, the temperature dampens due to increased cloud cover. The pre-monsoon season is the transition period when the northerly or north-westerly winds of the winter season gradually change to the southerly or south-westerly winds of the summer monsoon or rainy season (June–September). During the early part of this season, the winds are neither strong nor persistent. However, with the progression of this season, wind speed increases, and the wind direction becomes more persistent.

Figure 4-1:Climatic Zones of Bangladesh and Subproject Locations

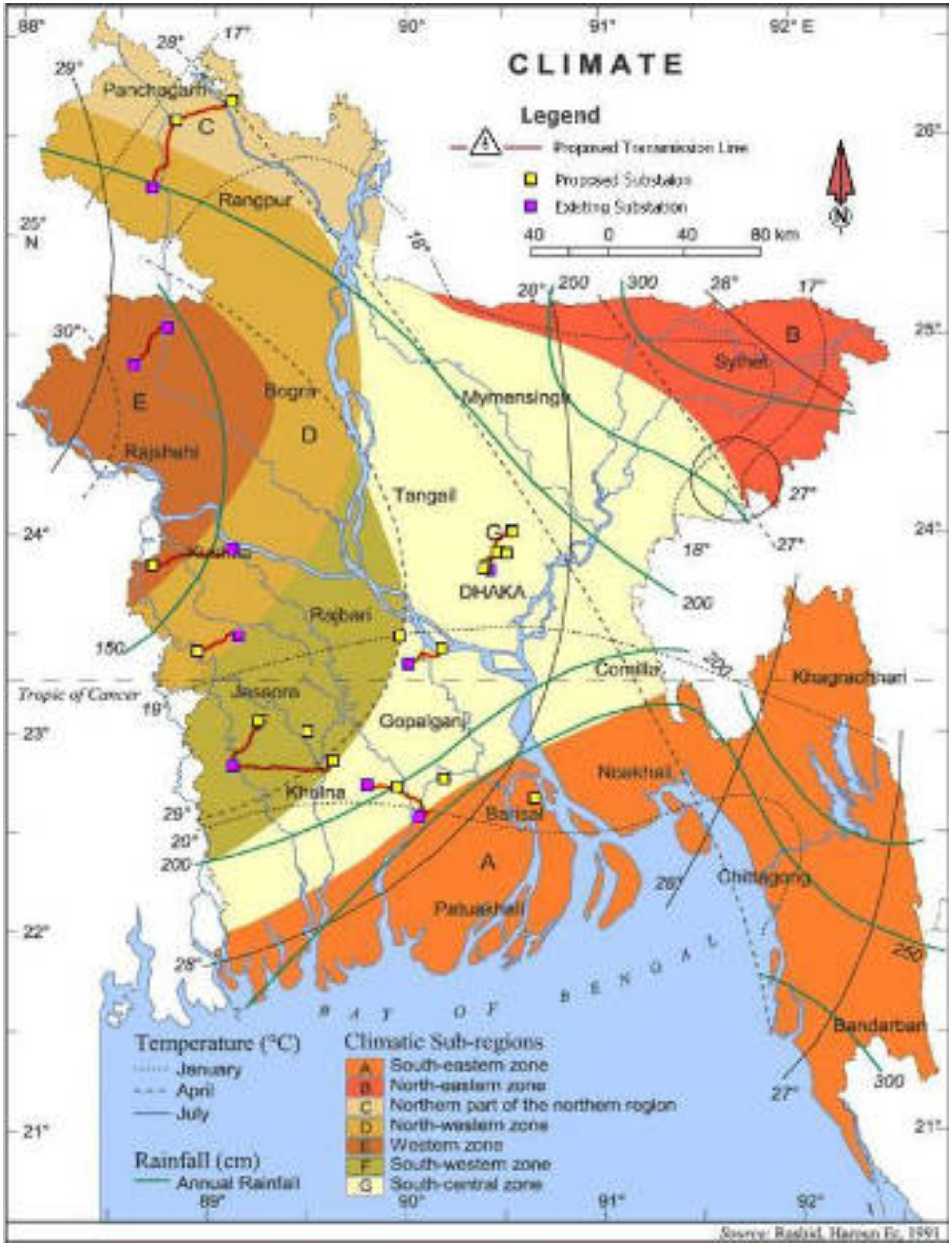


Figure 4-2 - Average Rainfall in Bangladesh

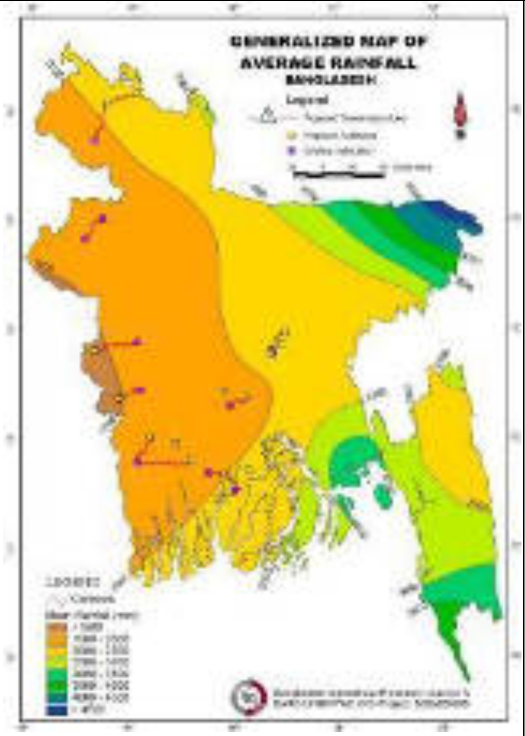
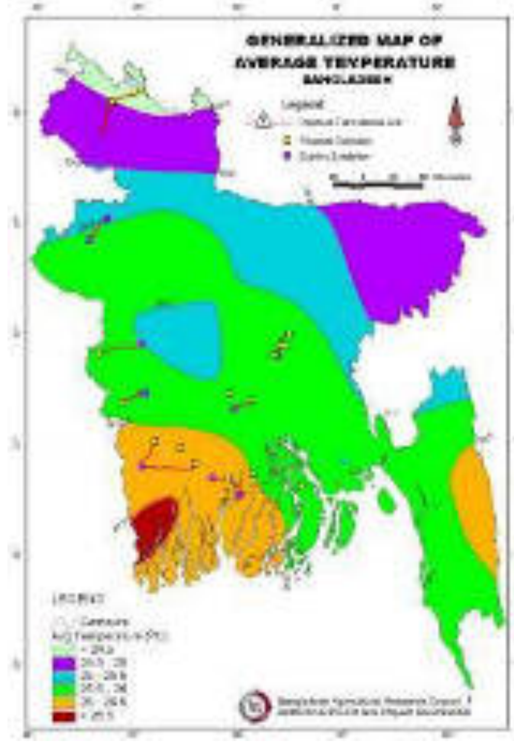


Figure 4-3 - Average Temperature



Climate at Dhaka

132. Dhaka, located in South-central zone (G), has a tropical climate. The Köppen-Geiger[17] climate classification is Aw. The average temperature in Dhaka is 25.9 °C, and rainfall is 1,557.2 mm. The driest month is January and most of the precipitation falls in June. August is the warmest month with an average of 29.13 °C and January is the coldest month with 17.8 °C (annual variation is 11.2 °C). The average precipitation varies 371 mm between the driest month and the wettest month.

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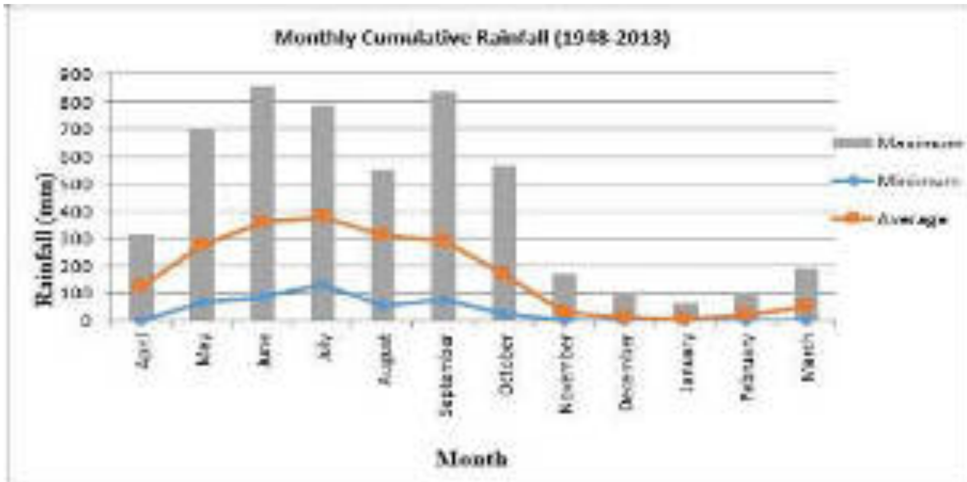
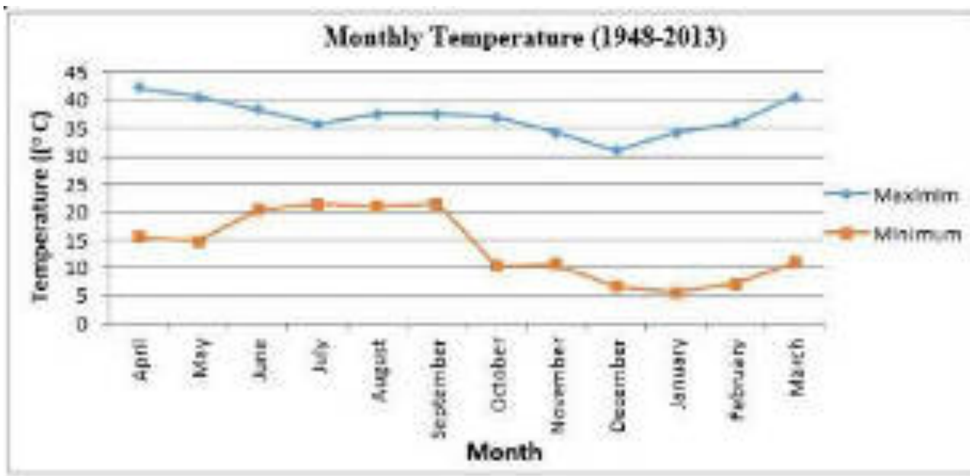
[17] The Köppen climate classification is based on the empirical relationship between climate and vegetation. This classification provides an efficient way to describe climatic conditions defined by temperature and precipitation and their seasonality with a single metric. Because climatic conditions identified by the Köppen classification are ecologically relevant, it has been widely used to map geographic distribution of long-term climate and associated ecosystem conditions. The Köppen climate classification divides climates into five main climate groups, with each group being divided based on seasonal precipitation and temperature patterns. The five main groups are A (tropical), B (dry), C (temperate), D (continental), and E (polar). The second letter indicates the seasonal precipitation type, while the third letter (if any) indicates the level of heat.

Figure 4-4: Monthly Cumulative Rainfall at Dhaka BMD Station



Ambient Air Temperature and Humidity in Dhaka

Figure 4-5 - Monthly Maximum and Minimum Temperatures at Dhaka BMD Station



133. The temperature of the country has a co-relationship with the period of rainfall. In general, cool seasons coincide with the period of lowest rainfall. Table 4-1 shows the monthly average temperature along with average monthly humidity of the project area. The maximum mean temperature of 29.13°C was observed in August and minimum average temperature was 17.8°C in January.

Table 4-1 - Temperature and Humidity for Project Area, 1975-2015

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
Mean Temp (°C)	17.81	21.16	25.96	28.57	28.82	29.02	28.87	29.13	28.85	27.47	23.78	19.35	25.73
Avg. Humidity (%)	75.93	70.49	65.5	71.41	78.6	84.9	86.31	84.9	84.6	80.9	77.1	77.51	77.61

Source: Bangladesh Meteorological Department.

134. According to the data collected from the Bangladesh Meteorological Department (BMD), April to September appears to be the hottest period of the year while November to February is

the coolest. Average annual rainfall in the project area is 1,557.2 mm, with a maximum in July (329.6 mm). During heavy rainfall, water logging can cause 20-25 cm inundation, which lasts for 4-8 hours.

135. May–October is observed to be the most humid period of the year, which matches the rainfall pattern of this region, as more than 70% of the yearly precipitation is encountered during this four-month period.

Wind Speed in Dhaka

136. Data for Dhaka shows monthly average wind speeds gradually decrease from a high of 2.07 m/s in April to a low of 0.46 m/s in November. Distribution and frequency of dominant wind force within the Study Area shows in Figure 4-6 and Figure 4-7.

Figure 4-6 - Monthly Variation of Average Wind Speed at Dhaka BMD Station

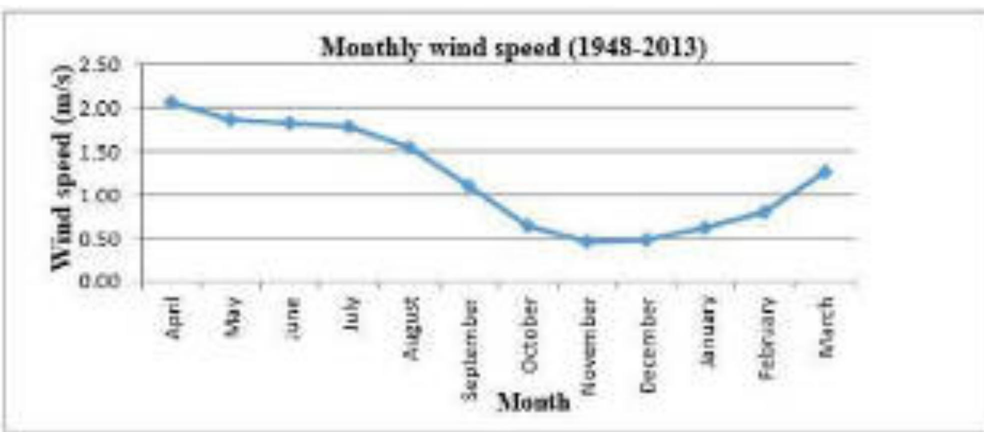
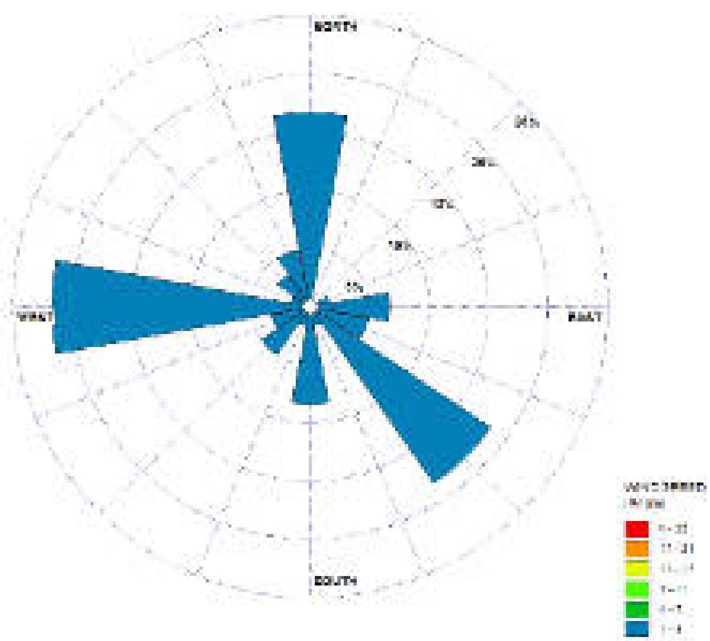


Figure 4-7 - Distribution and Frequency of Dominant Wind Force within the Study Area



137. Climate maps of main cities which are close to the sub project areas in southwest and northwest such as Barishal, Khulna, Satkhira, Niamatpur and Dinajpur are given here.

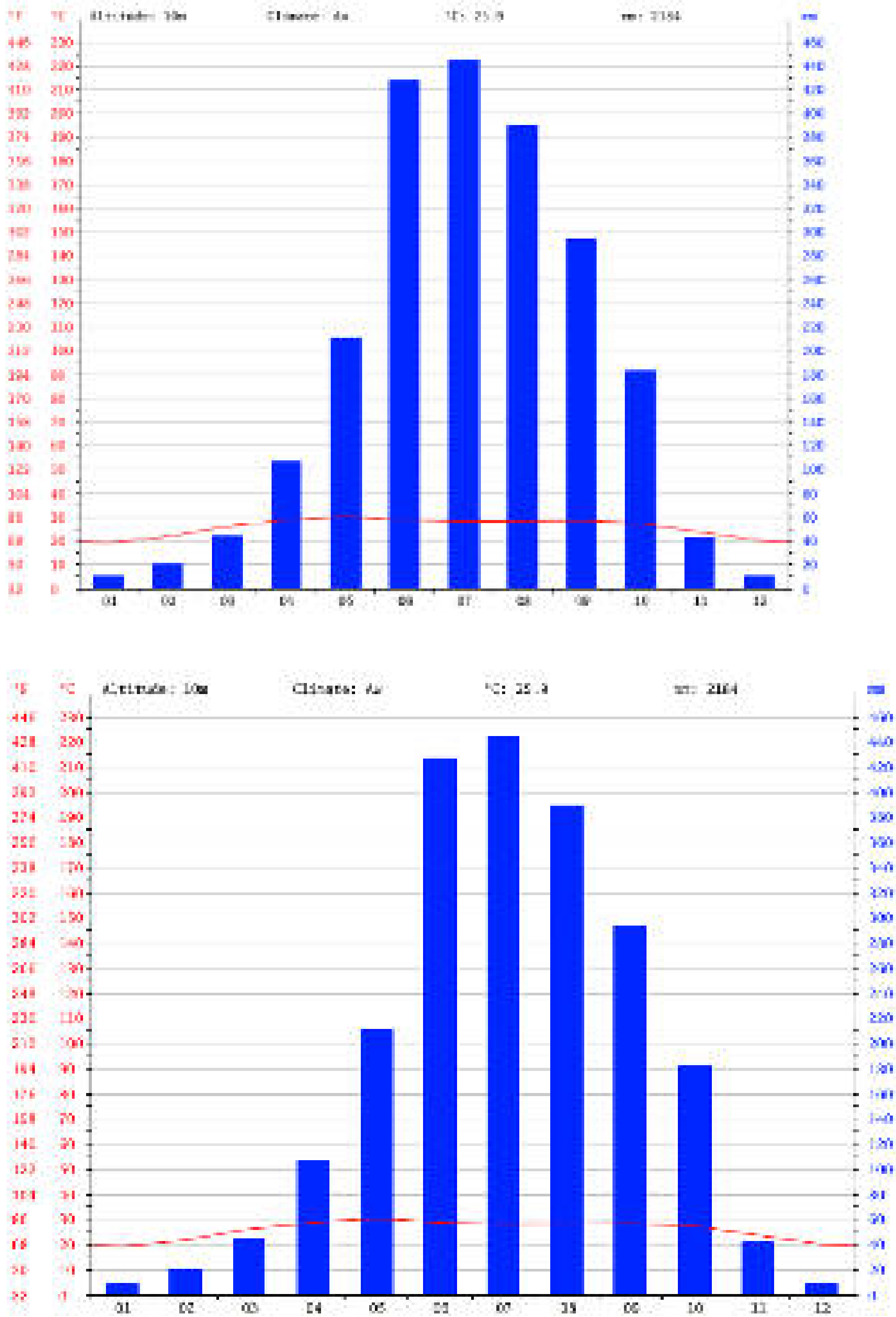
4.7.1.5 *Climate at Barishal*

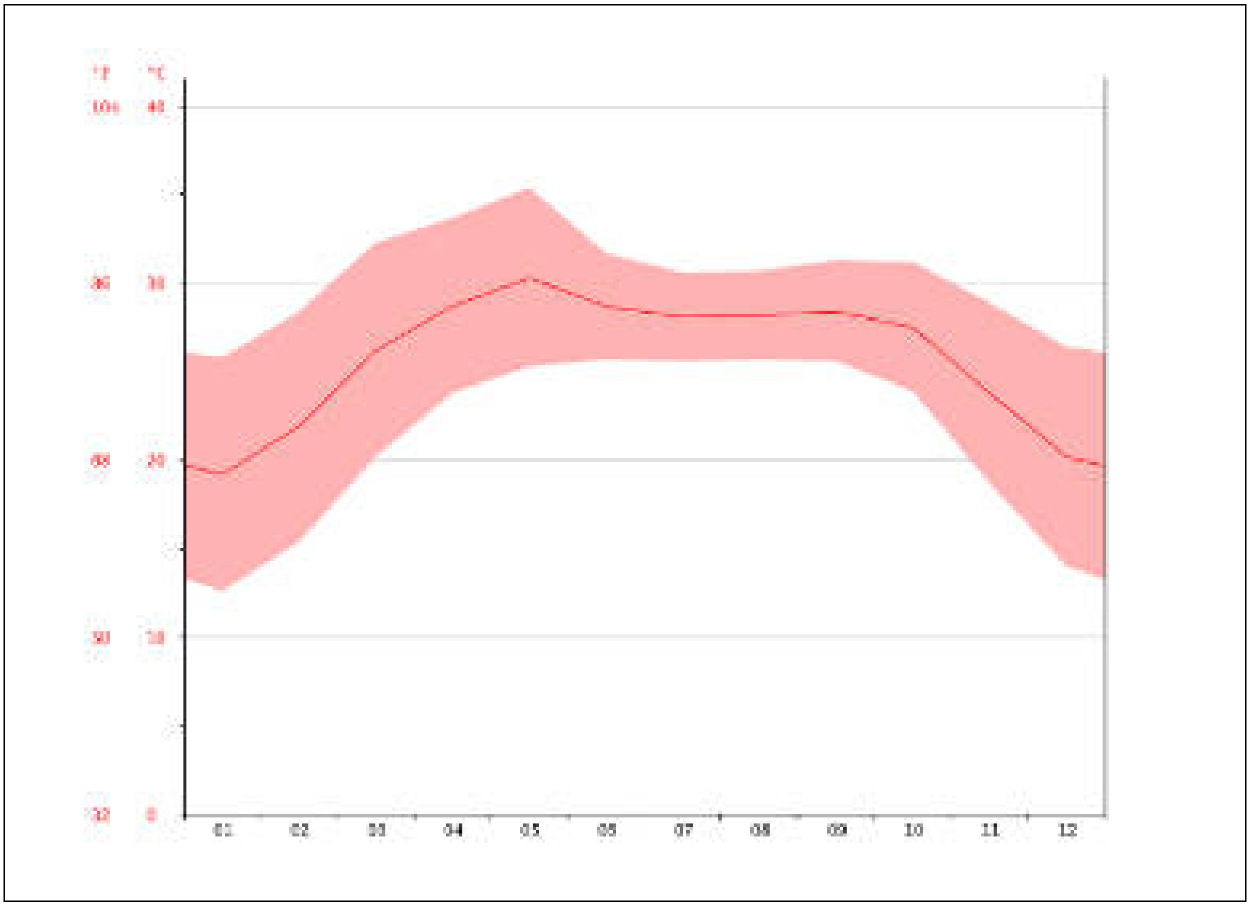
138. Barishal has a tropical climate. In winter, there is much less rainfall in Barishal than in summer. This location is classified as Aw by Köppen and Geiger. In Barishal, the average annual temperature is 25.9 °C. The average annual rainfall is 2184 mm. The driest month is January, with 10 mm of rainfall. With an average of 444 mm, the most precipitation falls in July. The warmest month of the year is May, with an average temperature of 30.3 °C. January has the lowest average temperature of the year. It is 19.2 °C. The difference in precipitation between the driest month and the wettest month is 434 mm. During the year, the average temperatures vary by 11.1 °C.

Table 4-2: Average Temperature and Rainfall at Barishal by month

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	19.2	21.9	26.2	28.7	30.3	28.7	28.1	28.2	28.4	27.5	23.8	20.2
Min. Temperature (°C)	12.6	15.4	20.2	23.8	25.3	25.7	25.6	25.7	25.6	23.9	18.7	14
Max. Temperature (°C)	25.8	28.4	32.3	33.7	35.4	31.7	30.6	30.7	31.3	31.2	28.9	26.4
Precipitation / Rainfall (mm)	10	20	45	107	211	427	444	390	294	183	43	10

Figure 4-8 Distribution of Rainfall & Temperature at Barishal





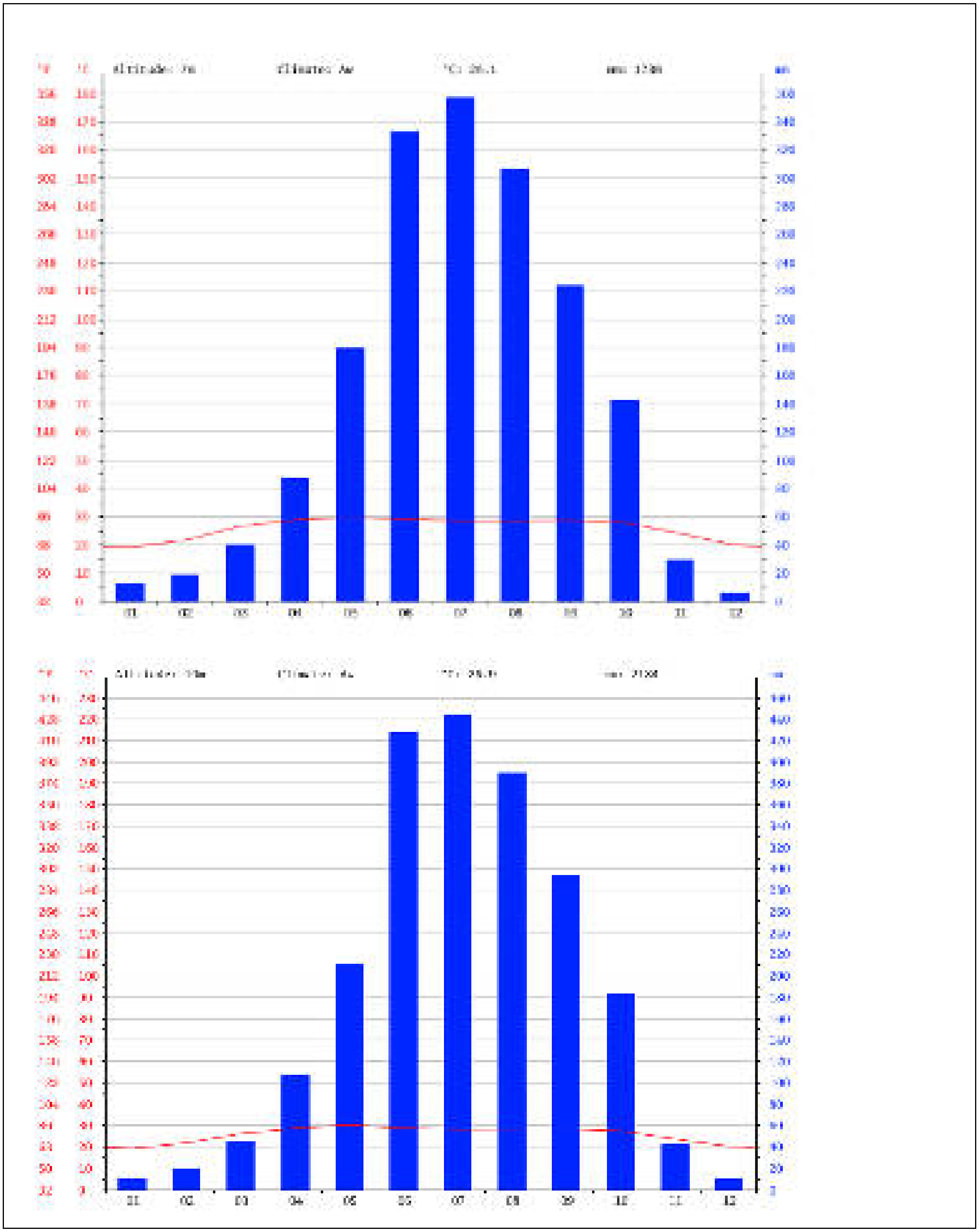
4.2.1.3 *Climate at Khulna*

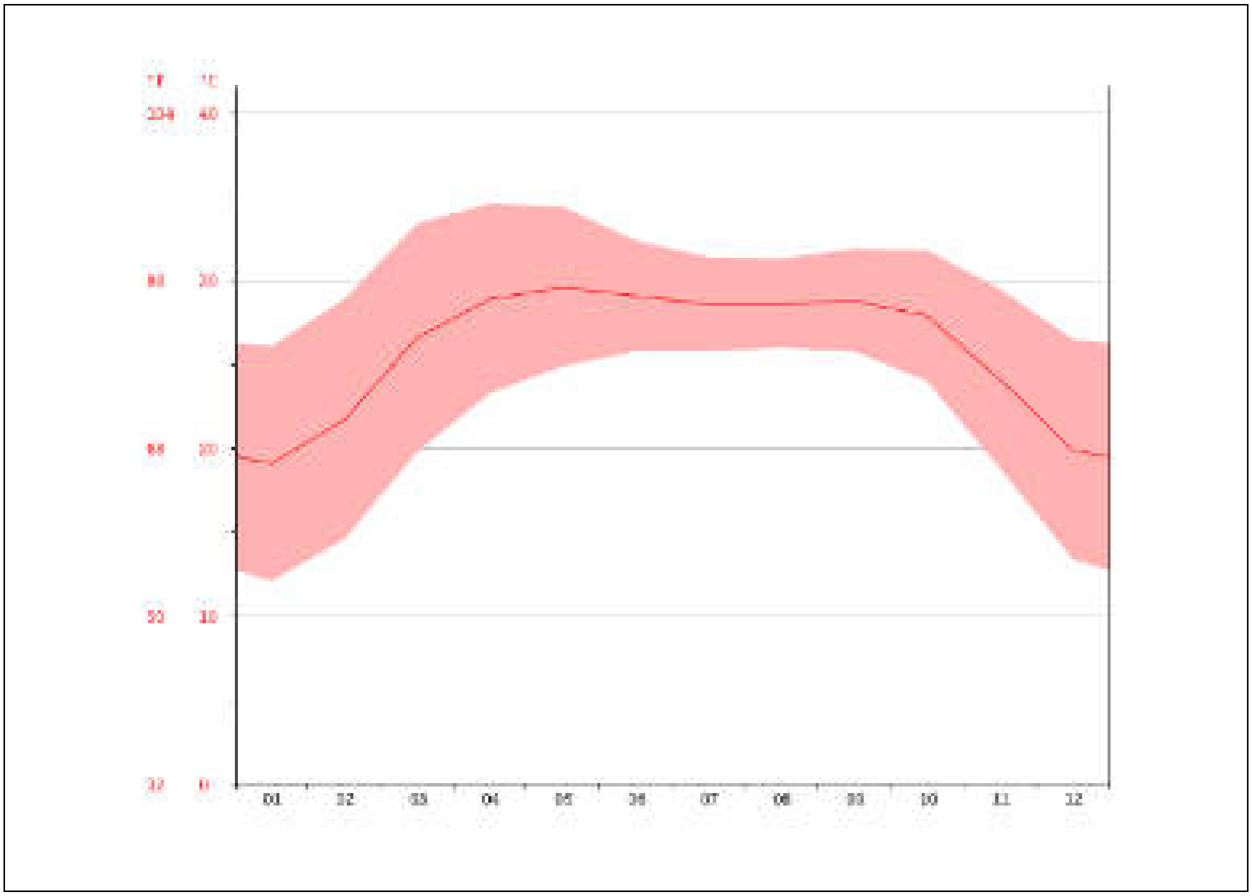
139. Khulna's climate is classified as tropical. According to Köppen and Geiger, this climate is classified as Aw. The average annual temperature in Khulna is 26.1 °C and rainfall is 1736 mm. Precipitation is lowest in December, with an average of 6 mm. Most of the precipitation falls in July, averaging 357 mm. Average temperature of 29.6 °C, May is the hottest month of the year while January is the coldest month, with temperatures averaging 19.1 °C. The difference in precipitation between the driest and wettest month is 351 mm, and temperature vary by 10.5 °C.

Table 4-3 : Average temperature and rainfall at Khulna by month

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	19.1	21.7	26.6	28.9	29.6	29.1	28.6	28.6	28.8	27.9	24.1	19.9
Min. Temperature (°C)	12.1	14.6	19.8	23.3	24.9	25.8	25.8	26	25.8	24	18.8	13.4
Max. Temperature (°C)	26.1	28.9	33.4	34.6	34.4	32.4	31.4	31.3	31.9	31.8	29.5	26.5
Precipitation / Rainfall (mm)	12	19	40	87	179	333	357	307	224	143	29	6

Figure 4-9: Distribution of Rainfall & Temperature at Khulna





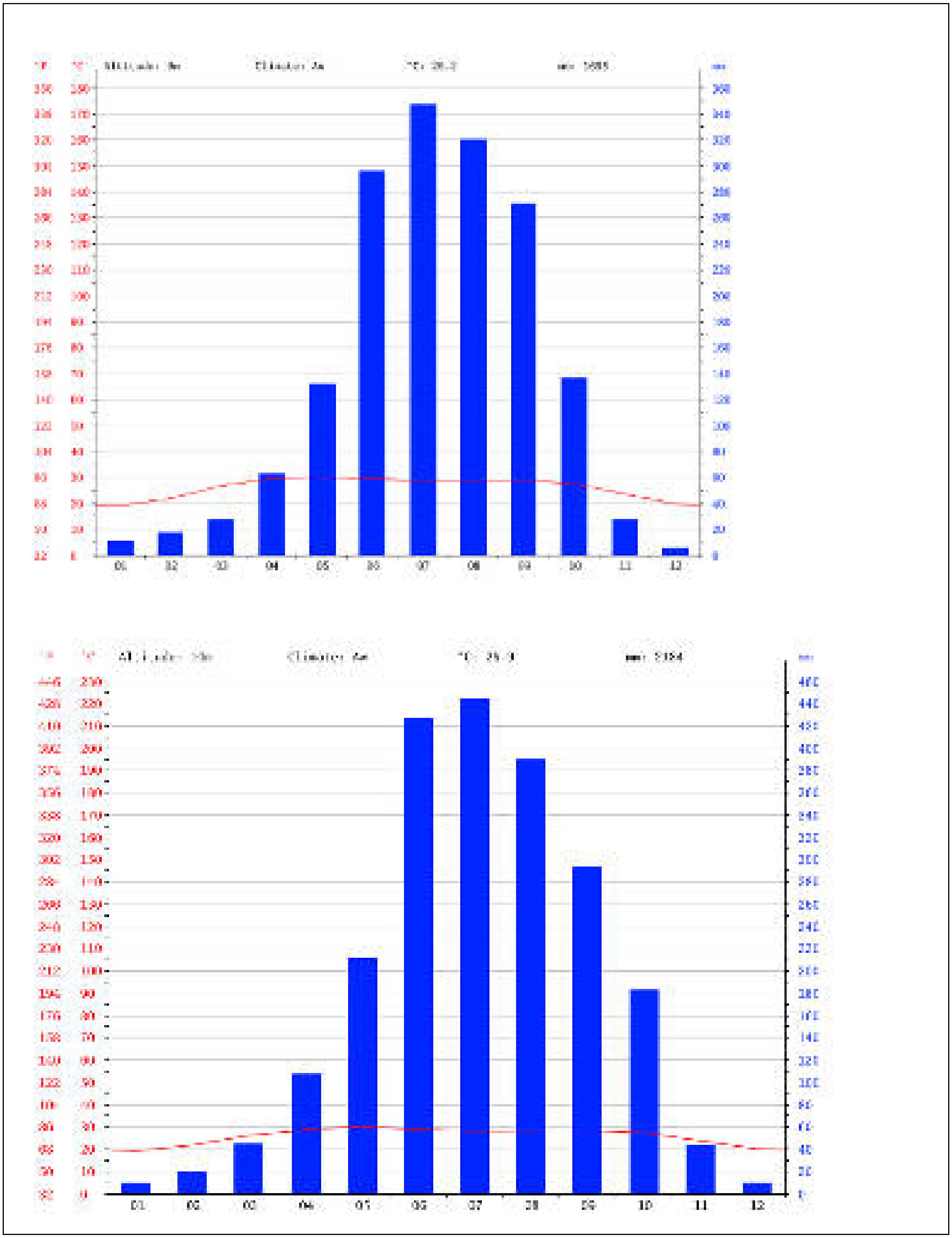
4.7.1.4 *Climate at Satkhira*

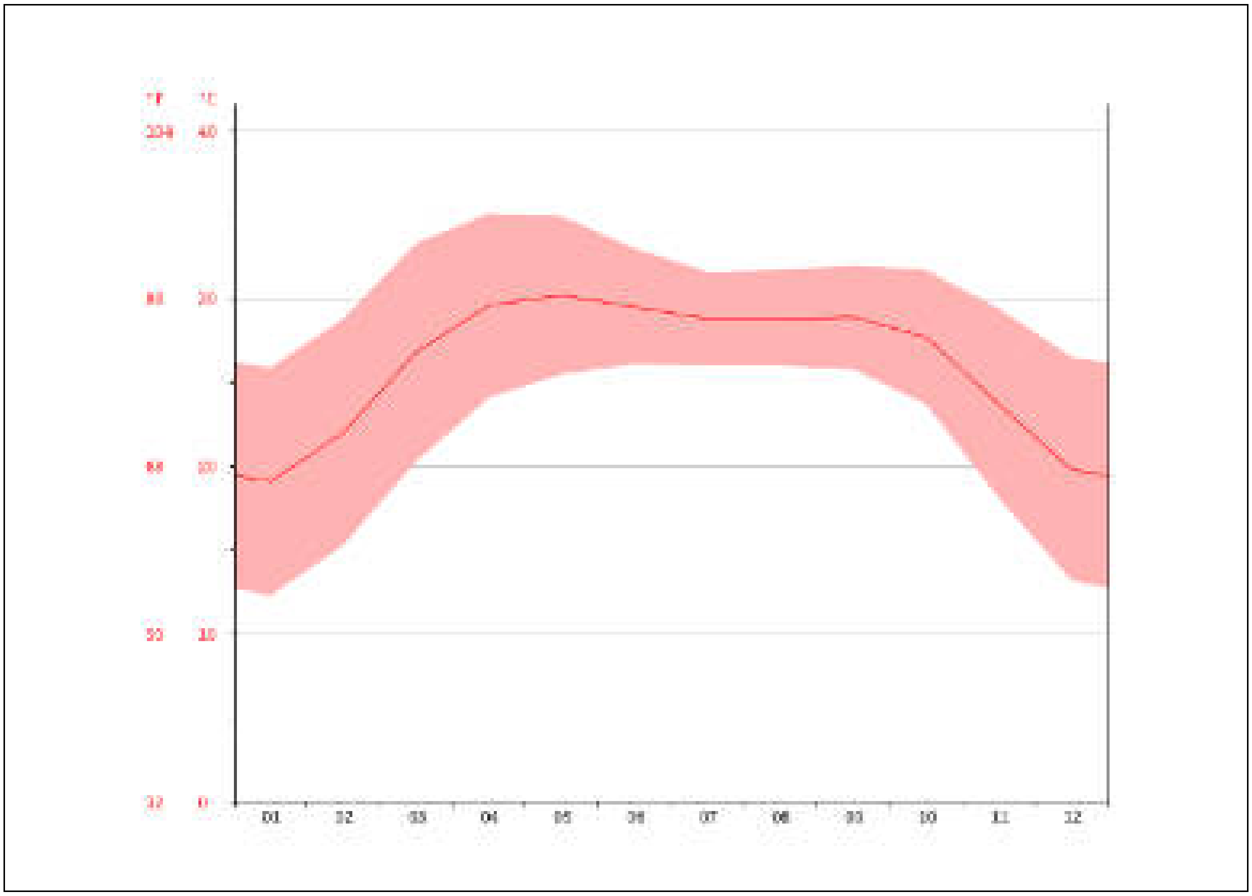
140. This city has a tropical climate. This climate is considered to be Aw according to the Köppen-Geiger climate classification. The average annual temperature is 26.2 °C in Satkhira. About 1655 mm of precipitation falls annually. The least amount of rainfall occurs in December. The average in this month is 6 mm. With an average of 347 mm, the most precipitation falls in July. The temperatures are highest on average in May, at around 30.2 °C. January has the lowest average temperature of the year. It is 19.1 °C. The variation in the precipitation between the driest and wettest months is 341 mm. During the year, the average temperatures vary by 11.1 °C.

Table 4-4: Average temperature and rainfall at Satkhira by month

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	19.1	22	26.8	29.6	30.2	29.5	28.8	28.8	28.9	27.7	23.7	19.8
Min. Temperature (°C)	12.3	15.3	20.3	24.1	25.5	26.1	26	26	25.8	23.7	18.1	13.2
Max. Temperature (°C)	25.9	28.8	33.3	35.1	34.9	33	31.6	31.7	32	31.7	29.4	26.5
Precipitation / Rainfall (mm)	11	17	28	63	132	296	347	320	271	136	28	6

Figure 4-10 :Distribution of Rainfall & Temperature at Satkhira





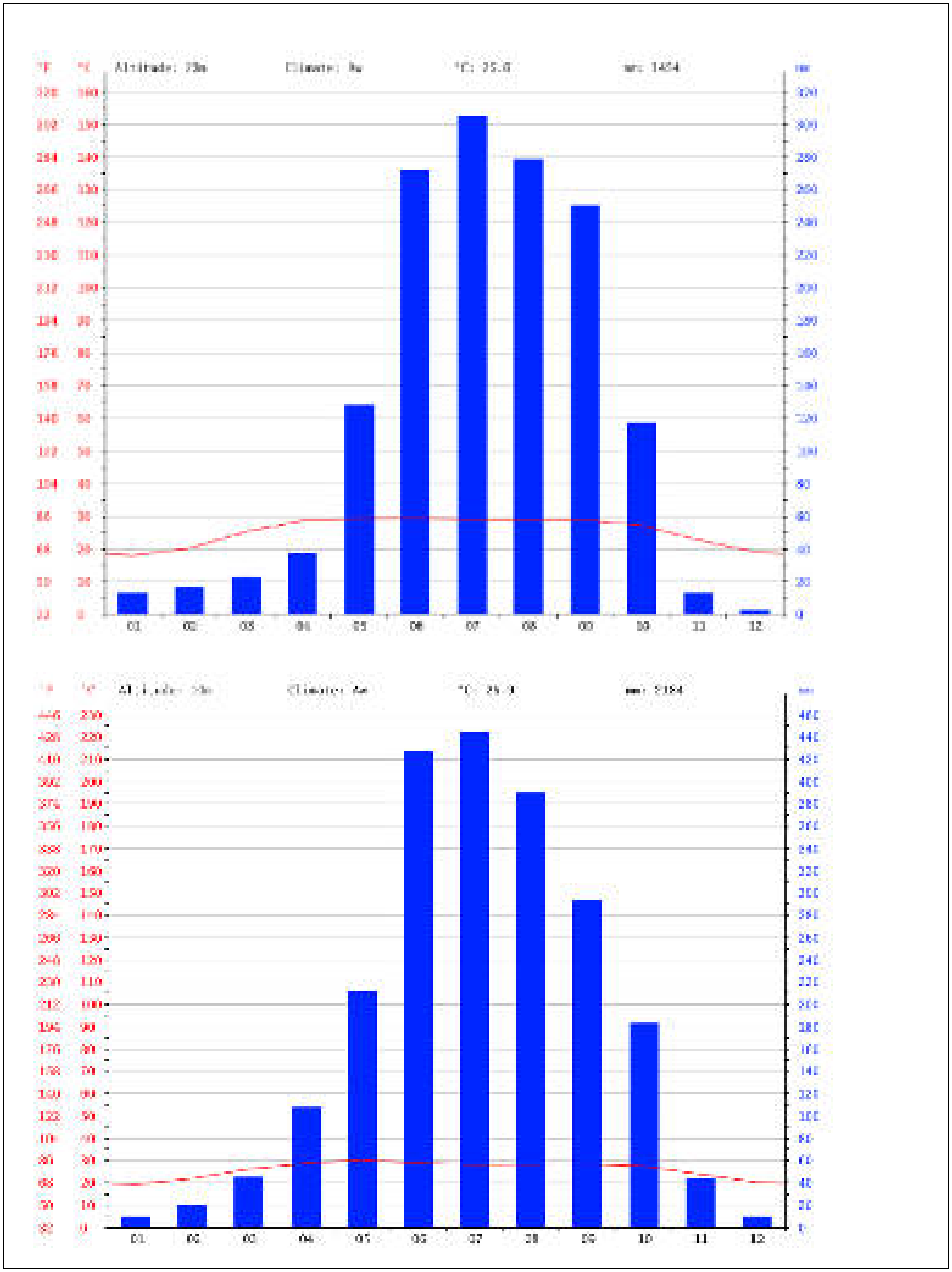
4.2.1.5 *Climate at Niamatpur*

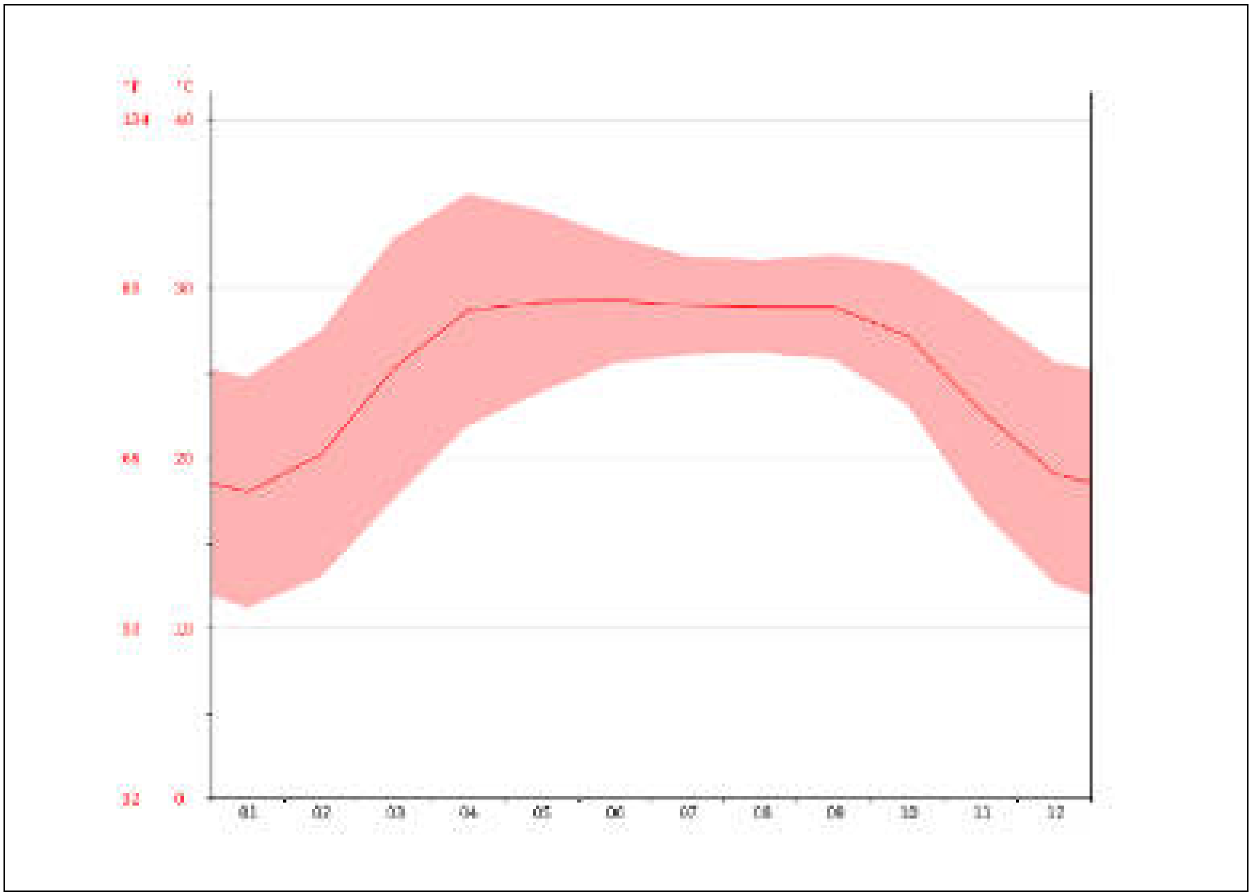
141. The climate is tropical in Niamatpur. The climate here is classified as Aw by the Köppen-Geiger system. In Niamatpur, the average annual temperature is 25.6 °C. In a year, the average rainfall is 1454 mm. The driest month is December. Most of the precipitation here falls in July, averaging 305 mm. With an average of 29.3 °C, June is the warmest month. January is the coldest month, with temperatures averaging 18.0 °C. The precipitation varies 303 mm between the driest month and the wettest month. Throughout the year, temperatures vary by 11.3 °C.

Table 4-5: Average temperature and rainfall at Niamatpur by month

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	18	20.2	25.3	28.7	29.2	29.3	29	28.9	28.9	27.2	22.8	19.1
Min. Temperature (°C)	11.2	13	17.6	21.9	23.9	25.6	26.1	26.2	25.8	23.1	16.9	12.6
Max. Temperature (°C)	24.8	27.5	33	35.6	34.6	33.1	31.9	31.7	32	31.4	28.8	25.7
Precipitation / Rainfall (mm)	13	16	22	37	128	272	305	279	250	117	13	2

Figure 4-11: Distribution of Rainfall & Temperature at Niamatpur





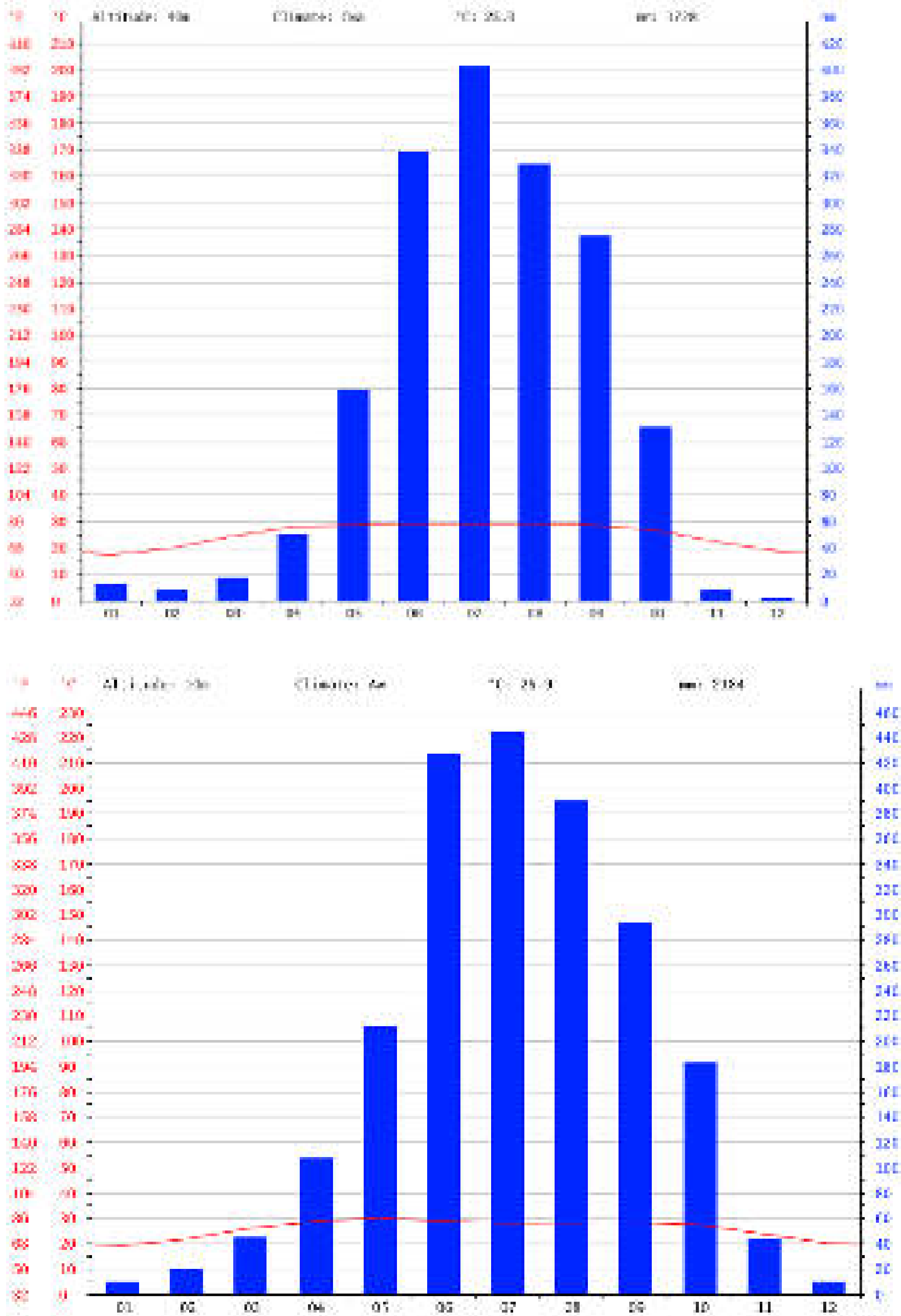
4.2.1.6 *Climate at Dinajpur*

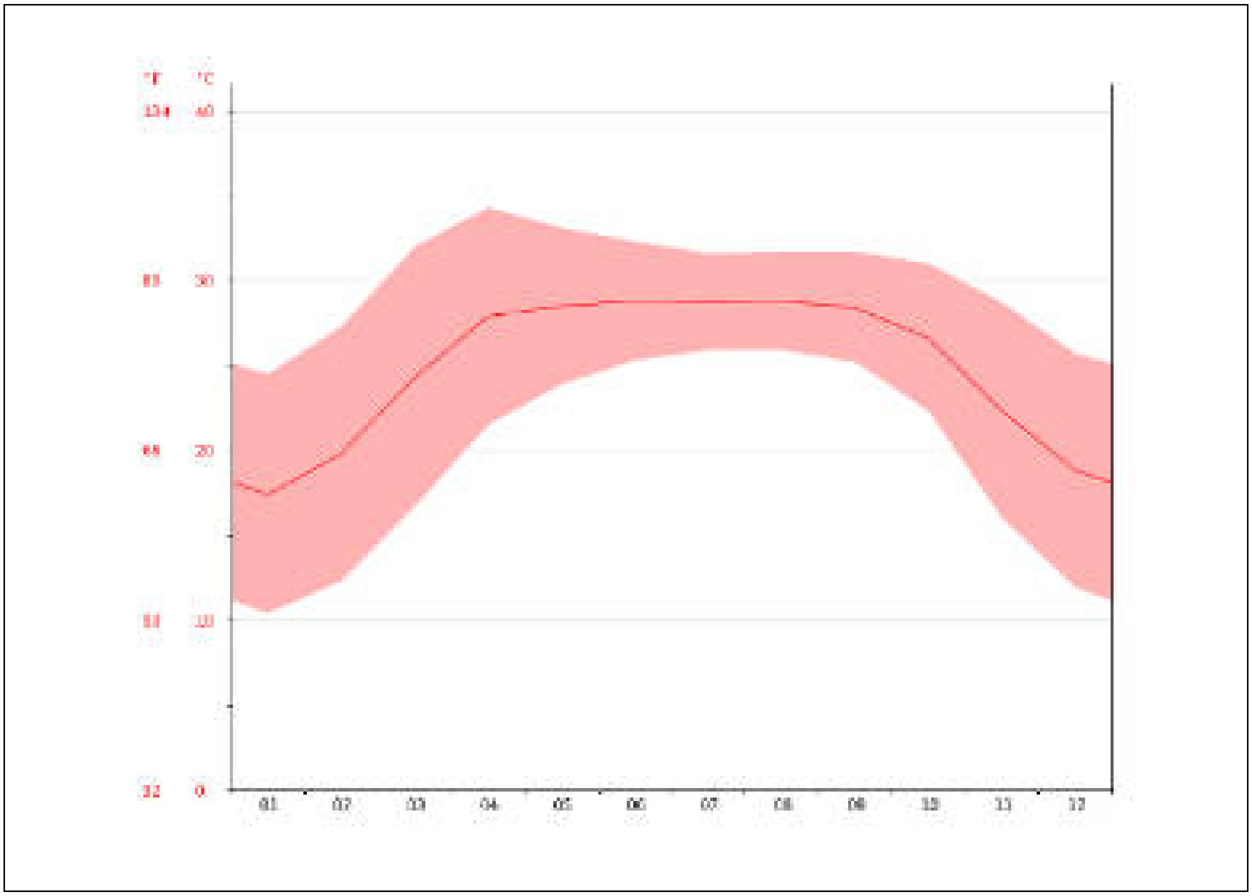
142. In Dinajpur, the climate is warm and temperate. The summers are much rainier than the winters in Dinajpur. This location is classified as Cwa by Köppen and Geiger. The average temperature in Dinajpur is 25.0 °C. Precipitation here averages 1728 mm. The driest month is December. The greatest amount of precipitation occurs in July, with an average of 402 mm. With an average of 28.8 °C, June is the warmest month. The lowest average temperatures in the year occur in January, when it is around 17.4 °C. The precipitation varies 401 mm between the driest month and the wettest month. The variation in temperatures throughout the year is 11.4 °C.

Table 4-6 : Average temperature and rainfall at Dinajpur by month

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	17.4	19.8	24.3	27.9	28.5	28.8	28.7	28.8	28.4	26.6	22.3	18.8
Min. Temperature (°C)	10.4	12.3	16.7	21.5	23.9	25.3	25.9	25.9	25.2	22.3	16	11.9
Max. Temperature (°C)	24.5	27.3	32	34.3	33.1	32.3	31.6	31.7	31.7	31	28.7	25.7
Precipitation / Rainfall (mm)	13	8	17	50	159	337	402	328	275	130	8	1

Figure 4-12: Distribution of Rainfall & Temperature at Dinajpur





4.2.2 Water Quality

4.2.2.1 *Surface Water*

143. Overhead transmission lines in Dhaka and Western zone cross 31 rivers (Table 4-8), such as Bahirab river, Boleswar river, Huldarhat river, Garia river, Buri Teesta river, Nautara river, Teesta river, Chika Dara river, Saniajan river, Jamuneshwari river, Kumar river, Arialkha river Turag river, Kapotakha river, Chitra river Kajla river, Mathavanga river, Pangasi river, Sagar river, Atrai river, Shewraphulli river, Karatoya river, Kapotaksha river, Betna river, Buri Bhadra river, Harihar river, Saltha river, Hatibanda river, Gengrail river, Vodra river, and Rupsha river. Also, these lines cross a large number of canals, khals, beels and ponds. The widest rivers in the project area are the Katcha (838 m) Teesta (690 m), Rupsha (590 m), Arialkhan (276 m), Bhairab (239 m), and Turag (175 m). All the rivers are tidal except Atrai and Teesta. The tidal river water is saline, with high sediment load and high turbidity. The detailed construction methods statement for river crossing are presented in chapter 3. The surface water will not be impacted as the tower footings will be located 150m away from the river banks with special care to mitigate the impacts on the river. The current techniques allow river crossings over rivers wider than 1.5 km by increasing the height of tower to avoid the impacts on navigation and fishing, also, stringing will be done using pilot wire (rope) which will substantially reduce the time required to pull the wire.

Table 4-7 : Name of rivers and transmission lines

No.	Overhead Transmission Line	Names and Widths of River
1	Kaliganj (Gazipur)-Purbachal 400 kV DC double circuit overhead transmission line	Turag river (175 m)*
2	Rupsha-Satkhira 230 kV double circuit transmission line (initially charged at 132 kV)	Betna river, Kapotaksha river, Saltha river, Hatibanda river (213 m), Gengrail river, Vodra river (224 m), Saltha river, Rupsha river (590 m)
3	Domar-Purba Sadipur 230 kV double circuit transmission line (initially charges at 132 kV)	Atrai river (149 m), Shewraphulli river, Karatoya river
4	Domar-Hatibanda 132 kV double circuit transmission line	Buri Teesta river, Nautara river, Teesta river (690 m), Chika Dara river, Saniajan river, Jamuneshwari river
5	Kaliganj-Maheshpur 132 kV double circuit transmission line	Kapotakha river, Chitra river (all rivers are <100 m)
6	Manirampur-Satkhira 132 kV double circuit transmission line	Kapotaksha river, Betna river, Buri Bhadra river, Harihar river (all rivers <100 m)
7	Kushtia-Meherpur 132 kV double circuit transmission line	Kajla river, Mathavanga river, Pangasi river, Sagar river
8	Bagerhat-Pirojpur-Bhandaria 132 kV double circuit transmission line,	Bahirab river (239 m), Katcha river (838 m width) Boleswar river, Huldarhat river, Garia river
9	Gopalganj (North)-Shibchar 230 kV double circuit transmission line	Kumar river, Arialkha river (276 m)
10	Niamatpur-Patnitola 132 kV double circuit transmission line	Atrai river (124 m)

*- width of river is given at the crossing, if the width is > 100m

144. To develop a reliable project baseline, as per the monitoring plan (see Table 9.4-6, Chapter 9), the EPC contractor shall collect the full set of data on surface water quality during pre-construction phase (RoW within 500m to any waterbody).

145. The surface water quality parameters of government are given in the Table 4-8.

Table 4-8: Bangladesh National Standard (ECR 1997)

Water sample parameters	Unit	Bangladesh Standard / (ECR, 97)
		Inland surface water
pH	-	6-9
Total dissolved Solid (TDS)	mg/L	2100
Dissolved Oxygen (DO)	mg/L	4.5-8
Biological Oxygen Demand $(BOD)_{5\ days}$	mg/L	50
COD	mg/L	200
Salinity	ppt	-
Electro Conductivity (EC)	Micro mho/cm	1200
Ammonium (NH_4-N)	mg/L	5
Hardness	mg/L	-

146. To get some understanding of the water quality, secondary data is available for some of the major rivers. Turag river is at the boundary of proposed Purbachal substation land. A study was conducted by L. Rahman et. al. (2012) to assess the degree of pollution of Turag river water by determining various physico-chemical parameters. Water samples were collected six times per year during wet and dry season at the following three locations: Tongi Railway Bridge (11km from Purbachal substation land), Bishwa Ijtema (12km) field and Ashulia (13 km). Most of the measured physicochemical parameters exceeded permissible limit of drinking water. The recorded pH ranged from 6.6 to 7.98 and Electrical Conductivity (EC) from 160 to 1,107 μs/cm. The recorded dissolve oxygen (DO) varied from 0.11 to 6.8 mg/L and biological oxygen demand (BOD) ranged from 10 to 180 mg/L while chemical oxygen demand ranged from 21 to 220 mg/L and free CO_2 value from 5 to 22 mg/L. The concentration ranges of heavy metals and arsenic in ppb were as follows: Zinc (Zn) (0.04 to 0.4), cadmium (Cd) (0.043 to 2), arsenic (As) (1.15 to 4.8), (lead) Pb (2.29 to 18.62) and mercury (Hg) (0.12 to 1.45). Due to the increased values of the parameters pH, DO, BOD, COD and free CO_2 water from these locations was not suitable for human consumption without appropriate treatment (African Journal of Pure and Applied Chemistry Vol. 6 (10), pp. 144-148, 30 May 2012).

Table 4-9: Physicochemical parameters of Turag river (Source: Rahman et al (2012))

Parameters	August-10	October-10	December-10	February-10	April-10	June-10
pH	7.96	7.42	6.95	6.65	7.19	7.48
EC/ μScm-1	215	354	658	766	715	458
Salinity (ppt)	0.1	0.19	0.4	0.48	0.38	0.14
TDS (mg/L)	125	219	400	420	353	210
DO (mg/L)	6.5	5.1	4.5	3.5	4.8	5.4
BOD (mg/L)	30	24	50	60	46	28
COD (mg/L)	25	31	84	91	68	25
Hardness (mg/L)	45.8	58.5	133.8	139.8	129.4	49.5

Table 4-10: Concentration of heavy metals of Turag river in dry season.

Metals (ppb)	Name of stations								
	Railway bridge			Ijtema field			Ashulia		
	Point 1			Point 2			Point 3		
As	4.5	3.45	4	2.5	4.8	2.85	3.15	2.15	2
Cd	1	1	1	1	1	1	2	2	2
Pb	8.24	16.71	18.62	5.87	4.74	5.53	2.06	5.89	4.25
Zn	0.05	0.04	0.4	0.3	0.2	0.058	0.45	0.05	0.06
Hg	0.25	1.25	0.3	0.56	0.65	0.15	0.45	1.45	1.25

Table 4-11: Concentration of heavy metals of Turag river in wet season.

Metals (ppb)	Names of Stations								
	Railway bridge			Ijtema field			Ashulia		
As	1.15	1.43	2.58	1.36	2.3	1.85	1.25	1.6	1.25
Cd	0.06	0.043	0.272	0.166	0.168	0.05	0.153	0.092	0.143
Pb	7.47	11.04	2.29	4.55	3.25	2.79	2.69	2.85	3.25
Zn	nf	nf	nf	nf	nf	nf	nf	nf	nf
Hg	0.17	0.19	0.18	0.18	0.21	0.18	0.23	0.24	0.12

nf = Not found

147. The water quality parameters of rivers around Khulna City Corporation, especially Bhairab and Rupsha River were analysed to evaluate suitability of river's water for the city dwellers. The

water samples which were collected from different locations of Bhairab and Rupsa River were analysed to determine water quality parameters. The determined values were compared with the Bangladesh standards for drinking water. The results indicate that values of Mn, Cu, Zn, Cr, Cd, As, Pb, PO_4^{3-}, NO_3^-, NO_2^-, and SO_4^{2-} were below the standard limit for both rivers in contrast other values like total dissolved solids, total suspended solids, biological oxygen demand, chemical oxygen demand, turbidity, Fe, Ca and Cl- values were higher than the permissible level. It seems that water quality parameters of Rupsha River are worse than Bhairab river. The river water was not suitable for drinking and household work which could lead health risks for city dwellers. (Rahman et. al. (2016) Water quality monitoring of major rivers at Khulna city corporation, Bangladesh: A sustainability assessment Department of Public Health Engineering, Zonal Laboratory, Khulna-9100, Bangladesh).

Table 4-12: Water quality data of Rupsha River and Standard values

Parameters	**Minimum**	**Maximum**	**Health based guideline by the WHO**
pH	8.1	9.0	6.5-8.5
Temperature (0C)	27	34	<40
Alkalinity/ mgL-1	64	126	-
EC/ µScm-1	13730	20470	750
% NaCl	36.8	24.9	-
TDS/ mgL-1	6900	11000	Max. 500
TSS/mgL-1	0.578	4.768	-
Chloride/ mgL-1	444	724	Max. 250

Source: M. Shahidul Islam *et. al.*; Physiochemical assessment of water quality parameters in Rupsha river of Khulna region, Bangladesh; The International Journal of Engineering and Science (IJES), Volume 7, Issue 1, PP. 73-78, 2018.

Table 4-13: Water quality data of Rupsha River at Rupsha bridge

Sampling Station	**Location**		**DO (mg/l)**	**pH**	**EC(µS/cm)**	**Turbidity (NTU)**	**T.H. (mg/l)**
Rupsha River	Rupsha Bridge	Monsoon	5.3	7.3	193	583	85.04
		Post-monsoon	4.1	8.02	284	321	64.68
		Dry	4.4	7.38	2990	873	467.69

Source: Sadia Ashraf *et. al.* Assessment of water quality of the Bhairab- Rupsha river system using water quality index (ccme-wqi) 6th International Conference on water & flood management (ICWFM-2017)

Table 4-14: Water quality parameters of the Teesta River at Kaunia point in Rangpur

Parameters (Unit)	Wet season (Sep-Nov) mean	Dry season (Dec-Feb) mean
Temperature (˚C)	25.86	18.18
TDS (ppm)	53.2	73.86
BOD (ppm)	1.64	1.89
pH	7.72	8.03
Alkalinity (mg l_{-1})	40.94	43.40
Total hardness (ppm)	98.48	102.46

Source: M. S. Islam et, al. Status of Water Quality in the Tista River at Kaunia Point and its Impact on Aquatic Environment; *J. Environ. Sci. & Natural Resources,* 8(1): 29-33, 2014 ISSN 1999-7361

148. A study was carried out on the Bhairab-Rupsha river system flowing through Khulna city for assessing its water quality by using the Canadian Council of Ministry of the Environment Water Quality Index (CCME WQI). CCME WQI values of 63.68, 57.45, 49.35, 47.26 and 42.86 for

Noapara, Fultola, Jailkhana Ghat, Mirerdanga and Chorerhat were recorded on the upstream river (Bhairab), and 44.23, 39.75 and 39.1 for Rupsha Ghat, Lobonchora and Rupsha Bridge on the downstream river (Rupsha), respectively. The study estimated all stations on the upstream river, except Chorerhat, falls in the 'marginal category' (45-64), whereas downstream river water including the remaining upstream station concentrates in the 'poor category' (0-44). This study evaluated that water quality of the downstream river is more impaired than that of the upstream river. Whereas, the estimated average index values of 52.12 (upstream) and 41.03 (downstream) indicate that these rivers are highly vulnerable to disposal of wastewater, sea water intrusion, suspended sediment load and agricultural runoff. The main outcome of the index is its ability to represent measurements of an array of variables into a single value. Despite being a single value of WQI which can't differentiate between pollution from organic waste load and seawater intrusion, it is useful for the evaluation of overall water health status of any water body (Sadia Ashraf et.al. Assessment of water quality of the Bhairab-Rupsha river system using water quality index (ccme-wqi), 6th International Conference on Water & Flood Management (ICWFM-2017))

149. Physico-chemical assessment of water quality parameters in Rupsha river of Khulna region, was carried out by Shahidul Islam et.al. (2018) to determine heavy metal concentrations in water of Rupsha River, Khulna, Bangladesh. The water quality parameters were measured for samples collected from twenty-two (22) sampling stations throughout the year 2016-2017. Obtained results were compared with the standard values of "Bangladesh Standards and Testing Institution (BSTI)"and "World Health Organization (WHO)" values. The results are as follows: pH: 8.1-9.0, alkalinity: 64-126 mgL-1, EC: 13730-20470 mgL-1, TDS: 6900-11000 mgL-1, total hardness: 1410- 2500 mgL-1, TSS: 0.578-4.678 mgL-1, chloride: 444-724 mgL-1, Cr: <0.005-4.33 mgL-1, Cd: <0.001 mgL-1, Co: <0.01 mgL-1, Cu: <0.10-0.28 mgL-1, Fe: 6.97-45.64 mgL-1, Pb: <0.10-0.15 mgL-1, Mn: 0.20-2.19 mgL-1, Ni: <0.10-0.14 mgL-1, Hg: <0.10-0.10 mgL-1, Zn: <0.05-0.63 mgL-1. Among the parameters, some values like pH, EC, TDS, and total hardness were found very much higher than BSTI and WHO allowable limits in water. The accumulations of heavy metals concentrations like Cr, Fe, Pb, Mn, Ni, and Hg were found higher than the standard values of World Health Organization. Significant positive and negative correlations were found among different physicochemical parameters from Pearson Correlation Program. Therefore, the water of the Rupsha river in this area is highly polluted and needs monitoring of water quality as well as protective measure to reduce pollution (The International Journal of Engineering and Science (IJES), Vol. 7, Issue 1, pages 73-78, 2018)

150. Table 4-15 shows ambient water quality standard (inland surface water), and Table 4-16 shows national standards for drinking water.

Table 4-15: National Standards for inland Surface Water

No.	Best Practice Based Classification	pH	BOD mg/1	Dissolved Oxygen (DO), mg/l	Total Coliform Bacteria quantity/ml
a)	Potable water source supply after bacteria freeing only	6.5-8.5	2 or less	6 or above	50 or less
b)	Water used for recreation purpose	6.5-8.5	3 or less	5 o above	200 or less
c)	Potable water source supply after Conventional processing	6.5-8.5	3 or less	6 or above	5000 or less
d)	Water used for pisci-culture	6.5-8.5	6 or less	5 or above	5000 or less
f)	Water used for irrigation	6.5-8.5	10 or less	5 or above	1000 or less

In water used for pisciculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l. Electrical conductivity for irrigation water – 2250 µmhoms/cm (at a temperature of 25◦C); Sodium less than 26%; Borone less than 0.2%. Source:

DoE, BOD = Biological oxygen demand, mg/l = milligram per litre, pH = negative logarithm of the hydrogen ion activity in a solution.

Table 4-16: National Standards for Drinking Water

No.	Parameter	Unit	Standard Limit	WHO Guidelines
1	Aluminium	mg/l	0.2	0.2
2	Ammonia (NH_3)	mg/l	0.5	-
3	Arsenic	mg/l	0.05	0.01
4	Barium	mg/l	0.01	0.7
5	Benzene	mg/l	0.01	0.01
6	BOD_5 20◦C	mg/l	0.2	-
7	Boron	mg/l	1.0	0.5
8	Cadmium	mg/l	0.005	0.003
9	Calcium	mg/l	75	-
10	Chloride	mg/l	150-600	-
	Chlorinated Alkanes			-
11	Carbon Tetrachloride	mg/l	0.01	-
	1.1 Dichloroethylene	mg/l	0.001	-
	1.2 Dichloroethylene	mg/l	0.03	-
	Tetrachloroethylene	mg/l	0.03	-
	Trichloroethylene	mg/l	0.09	-
12	Chlorinated Phenols			
	Pentachlorophenol	mg/l	0.03	-
	2.4.6 Trichlorophenol	mg/l	0.03	-
13	Chlorine (residual)	mg/l	0.2	-
14	Chloroform	mg/l	0.09	0.3
15	Chromium (hexavalent)	mg/l	0.05	-
16	Chromium (total)	mg/l	0.05	0.05
17	COD	mg/l	4	-
18	Coliform (faecal)	n/100ml	0	-
19	Coliform (total)	n/100ml	0	-
20	Colour	Huyghens unit	15	-
21	Copper	mg/l	1	-
22	Cyanide	mg/l	0.1	-
23	Detergents	mg/l	0.2	-
24	DO	mg/l	6	-
25	Fluoride	mg/l	1	1.5
26	Hardness (as $CaCO_3$)	mg/l	200-500	-
27	Iron	mg/l	0.3-1.0	-
28	Nitrogen (Total)	mg/l	1	-
29	Lead	mg/l	0.05	0.01
30	Magnesium	mg/l	30-35	-
31	Manganese	mg/l	0.1	0.4
32	Mercury	mg/l	0.001	0.006
33	Nickel	mg/l	0.1	0.07
34	Nitrate	mg/l	10	3
35	Nitrite	mg/l	Less than 1	-
36	Odour		Odourless	-
37	Oil & Grease	mg/l	0.01	-
38	pH		6.5-8.5	-
39	Phenolic compounds	mg/l	0.002	-
40	Phosphate	mg/l	6	-
41	Phosphorus	mg/l	0	-
42	Potassium	mg/l	12	-
43	Radioactive Materials (gross alpha activity)	Bq/l	0.01	-
44	Radioactive Materials (gross beta activity)	mg/l	0.1	-

No.	Parameter	Unit	Standard Limit	WHO Guidelines
45	Selenium	mg/l	0.01	-
46	Silver	mg/l	0.02	-
47	Sodium	mg/l	200	-
48	Suspended particulate matter	mg/l	10	-
49	Sulphide	mg/l	0	-
50	Sulphate	mg/l	400	-
51	Total dissolved solids	mg/l	1000	1000
52	Temperature	◦C	20-30	-
53	Tin	mg/l	2	-
54	Turbidity	JTU	10	-
55	Zinc	mg/l	5	-

Source: DOE, BOD = biological oxygen demand, mg/l = milligram per litre, ml = millilitre
Notes: In coastal area 1000. Reference. Bangladesh Gazette, Addendum, August 28, 1997.

4.2.2.2 *Groundwater*

151. Water aquifers are present beneath the vast majority of Bangladesh, which are being recharged by the major river systems and by infiltration of rainwater. Most groundwater is available within 5 m of the surface. This level fluctuates seasonally, approaching the ground surface over most of the country during the months July to September (during the monsoon).

152. The present source of drinking water supply for the project area is based completely on groundwater. The local groundwater level is lowered to approximately 6 m below ground level during the dry season, with levels returning to their normal level before the end of the monsoon, as reported by the Department of Public Health. This fall in groundwater levels is an entirely natural process that arises because of the hydrological link with the river. The surface water would be utilized for the construction activities of the project. Total volume of water consumption will be calculated by contractors.

4.2.2.3 *Tube Well*[18]

153. A tube well is located in the land earmarked for the construction of Maheshpur substation. It will be decommissioned and a new tube well will be constructed by the owner[19]. The construction of tube well within a 500 m radius from the existing tube well at the proposed site would provide the same volume of water as this area consists of the same aquifer. The owner utilizes the groundwater for his cultivations and sell the excess water to the neighbouring farmers. Therefore, changing the location of the tube well will not bring any additional impact on the groundwater.

[18] Tube wells close to project site will be carefully avoided.

[19] The location will be selected to ensure outside zone of influence of septic tanks etc.. PMU will provide complementary groundwater quality testing service to ensure same quality water as they had before.

	
Plate 5.1 A tube well and water pump (with the protective structure) in the middle of paddy field	Plate 5.2 A tube well and water pump adjacent to a main road

4.2.2.4 *Sand for land filling*

154. Sand for filling substation lands will be obtained from existing licensed suppliers who are authorized by the government to supply soil/sand for land filling.

4.2.3 Air Quality

155. The subprojects are located in suburban areas of Bangladesh (smaller cities and towns, mixed in the rural context). In the suburban areas, ambient air quality is dependent on many factors like air movement, traffic volume, congestion, emissions from motor vehicles, and suspended dust particles. A continuous monitoring scheme is essential to evaluate air quality and for the development of any plan for mitigation of health risks caused by polluted air. The "criteria pollutants," particulate matter (PM_{10}, $PM_{2.5}$), CO, SOx and NOx must be monitored. Hence, to establish the baseline air quality, as per the monitoring plan, a primary analysis of air quality is proposed, before commencing the construction activities of subprojects (see Table 9.4- 9.6 in Chapter 9). Careful dust management during construction will be provided.

Table 4-17: Bangladesh National Ambient Air Quality Standards Compared to the WHO Guideline and US EPA Standard

Pollutant	Averaging Period	Bangladesh Standards[a]	WHO[b] Guideline Values (µg/m^3)	US EPA Standards (µg/m^3)[d]
CO	8-hour	10,000 µg/m^3 (9 ppm)	10,000[c]	10,000
	1-hour	40,000 µg/m^3 (35 ppm)	30,000[c]	40,000
Pb	Annual	0.5 µg/m^3	0.5	–
NO_x	Annual	100 µg/m^3 (0.053 ppm)	–	–
TSP	8-hour	200 µg/m^3	–	–
PM_{10}	Annual	50 µg/m^3	20	revoked
	24-hour	150 µg/m^3	50	150
$PM_{2.5}$	Annual	15 µg/m^3	10	15
	24-hour	65 µg/m^3	25	35
O_3	1-hour	235 µg/m^3 (0.12 ppm)	–	235
	8-hour	157 µg/m^3 (0.08 ppm)	100	157
SO_2	Annual	80 µg/m^3 (0.03 ppm)	–	78
	24-hour	365 µg/m^3 (0.14 ppm)	20	365

CO = Carbon monoxide, NO_x = Nitrogen oxide, O_3 = ozone, Pb = lead, PM_{10} = particulate matter with a diameter of not more than 10 microns, $PM_{2.5}$ = particulate matter with a diameter of not more than 2.5 microns, SO_2 = Sulfur dioxide, S.R.O. = ..., US EPA = United States Environmental Protection Agency, TSP = total suspended particulates, WHO = World Health Organization, µg/m^3 = microgram per cubic meter, ppm = parts per million, – = no value.
Source: [a]S.R.O. No. 220-Law, 2005; [b]WHO, 2005; [c]WHO, 2000; and [d]US EPA, 2006.

4.2.4 Acoustic Environment

156. Sound is usually measured in decibels (dB). A decibel is a relative measure that is accompanied by a reference scale. Sound (noise) levels can be measured and quantified in several ways. All of them use the logarithmic decibel (dB) scale. The dB scale is logarithmic to accommodate the wide range of sound intensities found in the environment. Table 4- shows typical sound levels generated by common indoor and outdoor activities, along with its effect on humans.

Table 4-18: Sound Levels and Human Response[20]

Common Sounds	Noise Level (dB)	Effect
Carrier deck jet operation; Air raid siren	140	Painfully loud
Thunderclap	130	Painfully loud
Jet take off (200 feet); auto horn (3 feet)	120	Maximum vocal effort
Pile driver; rock concert	110	Extremely loud
Garbage truck; firecrackers	100	Very loud
Heavy truck (50 feet); city traffic	90	Very annoying; hearing damage (8 hours)
Noisy restaurant; Freeway traffic; Business office	70	Telephone use difficult
Air conditioning unit; Conversational speech	60	Intrusive
Light auto traffic (100 feet)	50	Quiet

dB = decibel.

[20] https://www.researchgate.net/figure/Sound-Levels-and-Human-Response_tbl1_231088719

157. Existing ambient noise levels can serve as a baseline from which to measure potential disturbance caused by project activities. Hence, to establish the baseline noise quality, as per the monitoring plan, a primary analysis of noise quality is proposed before the start of construction at the proposed sites of subprojects. The standard for noise is shown in Table 4-19.

Table 4-19: Noise Quality Standards, by Zone and Time of Day

Zone Class	Limits in dB(A)	
	Daytime (6 am–9 pm)	**Night time (9 pm–6 am)**
Silent zone	45	35
Residential zone	50	40
Mixed (residential/commercial/industrial) zone	55	45
Commercial zone	70	60
Industrial zone	70	70

dB(A) = A-weighted decibel. Source: The Environmental Conservation Rules, 1997 (amended in 2017); IFC Environmental Health Safety Guidelines, 2008)
Note: The day time is considered from 6 a.m. to 9 p.m. and the night time is from 9 p.m. to 6 a.m.
Area within 100 meters of hospital or education institution or government designated / to be designated/ specific institution/ establishment are considered Silent Zone. Use of motor vehicle horn or other signals and loudspeakers are forbidden in Silent Zone.

4.2.5 Physiographic features

158. In the context of physiography, Bangladesh is classified into three distinct regions: (a) floodplains; (b) terraces; and (c) hills each having distinguishing characteristics of its own. Further, the physiography of the country has been divided into 24 sub regions and 54 units. The subproject areas in twenty districts are found in the following physiographic units.

159. The Ganges River floodplain comprises the active floodplain of the Ganges and the adjoining meander floodplain. The latter mainly comprises a smooth landscape of ridges, basins and old channels. The relief is locally irregular alongside the present and former river courses, especially in the west (in the project area), comprising a rapidly alternating series of linear low ridges and depressions. The Ganges channel is constantly shifting within its active floodplain, eroding and depositing large areas of new char land each flood season, but it is less braided than that of the Brahmaputra-Jamuna. Ganges alluvium is calcareous when deposited, but most basin clays and some older ridge soils have been decalcified and acidified in their upper layers; lime is found only in the subsoil or substratum of such soils. Clay soils predominate in basins and on the middle parts of most ridges, with loamy soils (and occasionally sands) occurring mainly on ridge crests.

160. Seasonal flooding is mainly shallow in the west and north, with the highest ridge crests remaining above normal flood levels, but flood depths increase towards the east and the south. Flooding is mainly by accumulated rainwater and the raised groundwater table, except on the active Ganges floodplain and close to distributary channels which cross the meander floodplain. In earlier small-scale maps, the Mahananda floodplain in the northwest and some detached areas of the Old Meghna estuarine floodplain in the southeast used to be included within this unit. The Mahananda floodplain comprises of all irregular landscapes of mixed Tista and Ganges sediments. The cut-off parts of the Meghna floodplain have a smooth relief and predominantly silty soils, which are deeply flooded (by rainwater) in the monsoon season. The unit covers most of the districts of Rajshahi, Natore, Pabna, entire Kushtia, Rajbari, Faridpur, Meherpur, Chuadanga, Jhenaidaha, parts of Manikganj, Narayanganj, Munshiganj, Shariatpur, Madaripur, Barishal, Gopalganj, Khulna, Bagerhat, Satkhira, and most of Jessore. This physiographic unit is

almost triangular in shape and bounded by the Ganges tidal floodplain on the south. On its southern end it traps the Gopalganj-Khulna Beels.

161. The Teesta Floodplain is a big sub region that stretches between the Old Himalayan Piedmont Plain in the west and the right bank of the N-S flowing Brahmaputra in the east. An elongated outlier representing the floodplain of the ancient Teesta extends up to Sherpur (Bogra district) in the south. Most of the land is shallowly flooded during monsoons. There is a shallow depression along the Ghaghat river, where flooding is of medium depth. The big river courses of the Teesta, Dharla and Dudhkumar cut through the plain. The active floodplain of these rivers, with their sandbanks and diaras (depressions), is usually less than six kilometres wide.

162. The Lower Atrai Basin is a small physiographic unit that occupies a low-lying area where mixed sediments from the Atrai and Ganges and from the Barind tract overlie the down-warped southern edge of the Barind Tract. The landscape north of the Atrai is mainly smooth, but floodplain ridges and extensive basins occur south of the river. Heavy clay soils predominate, but loamy soils occur on ridges in the south and the west. Drainage from this unit is blocked when high river levels in the Jamuna obstruct the exit through the Hurasagar. Seasonal flooding was formerly deep and extensive and Chalan Beel used to remain wet throughout the year. The construction of polder projects since the 1960s has improved drainage to some extent. However, deep flooding can still occur within polders as well as outside when there is heavy rainfall locally and when flash floods flow down the Atrai or off the adjoining Barind Tract, causing natural or manmade breaches of embankments.

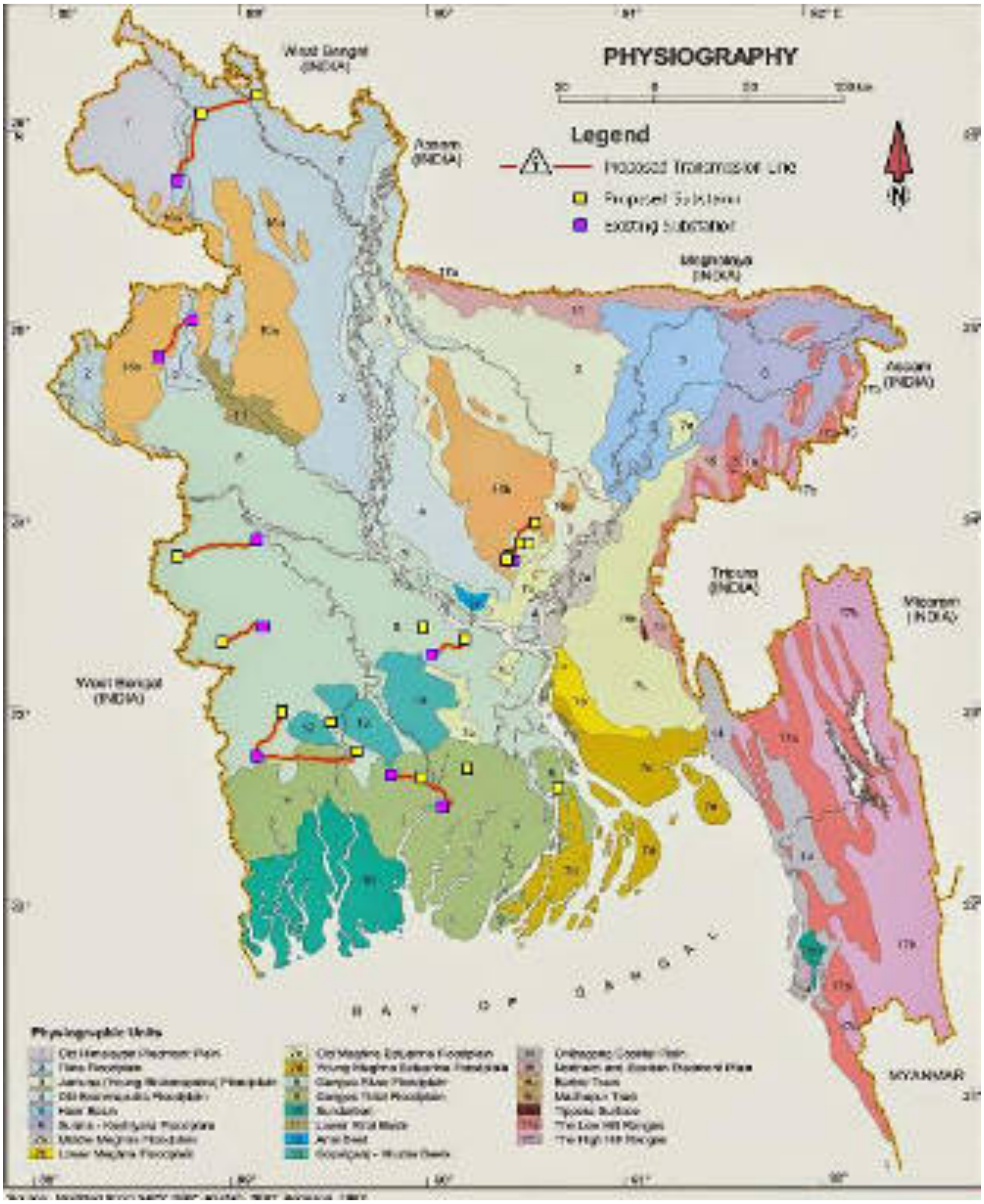
4.2.6 Topography

163. Bangladesh is one of the largest deltas in the world formed by the confluence of three Himalayan rivers: the Ganges (Padma); the Brahmaputra (Jamuna); and, the Meghna, with a long coastline along the Bay of Bengal. Floodplains (80%), terraces (8%) and hills (12%) cover the land area.

164. The country has a considerable topographic diversity. It has three distinctive features: (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 south is a highly irregular deltaic coastline of about 600 km fissured by many estuarine rivers and channels flowing into the Bay of Bengal. The alluvial plain is part of the larger plain of Bengal, which is sometimes called the Lower Gangetic Plain. Elevations of the plains are less than 10 m above the sea level; elevations further decline to near sea level in the coastal south. Most of the southwest project area in Khulna and Barishal divisions lies in the alluvial plain.

165. The hilly areas of the south eastern region of Chattogram, the northeasters hills of Sylhet and highlands in the north and northwest are of low elevation. The Chattogram Hills constitute the only significant hill system in the country. They rise steeply to narrow ridgelines, with elevation ranging between 600 m and 900 m above mean sea level. The highest point of 1,230 m is at Mt. Keokradong. In between the hilly ridges lie the valleys that generally run north to south. West of the Chattogram hills is a narrow, wet coastal plain lying parallel to the shoreline.

Figure 4-13 - Physiographic Units of Bangladesh and Subproject Locations



4.2.7 Geology

166. Bangladesh is situated to the east of the Indian sub-continental plate. Nearly 85% of Bangladesh is underlain by deltaic and alluvial deposits of the Ganges, Brahmaputra, and Meghna river systems. The project area consists of Holocene alluvial deposits in the floodplain and predominantly consisting of fine sand, silts and clay. The site is on deep Cenozoic deposits that overlie Precambrian basement rock. The Precambrian rocks form the basement of all geological formations of the Bengal Basin and shield areas. The materials deposited are a mixture of sediments transported by the old Brahmaputra and by the Jamuna (Brahmaputra) River. The generalized geological features of the project area are shown in the geological map of Bangladesh

(Figure 4-14). Majority of the area of the subprojects are under the Barishal Gravity High. However, some portions are also under the Hatia Trough and Barishal Gravity High.

4.7.7.- *Soil*

167. The subproject areas fall into seven different soil formation zones (Figure 4-16[21]). The general soil types of Barishal, Dhaka, Khulna, Rangpur and Rajshahi divisions include the following: acid sulphate, peat, and floodplain soils in the south; and, terrace and calcareous floodplain soils in the north.

4.7.7.5 *Flood prone areas*

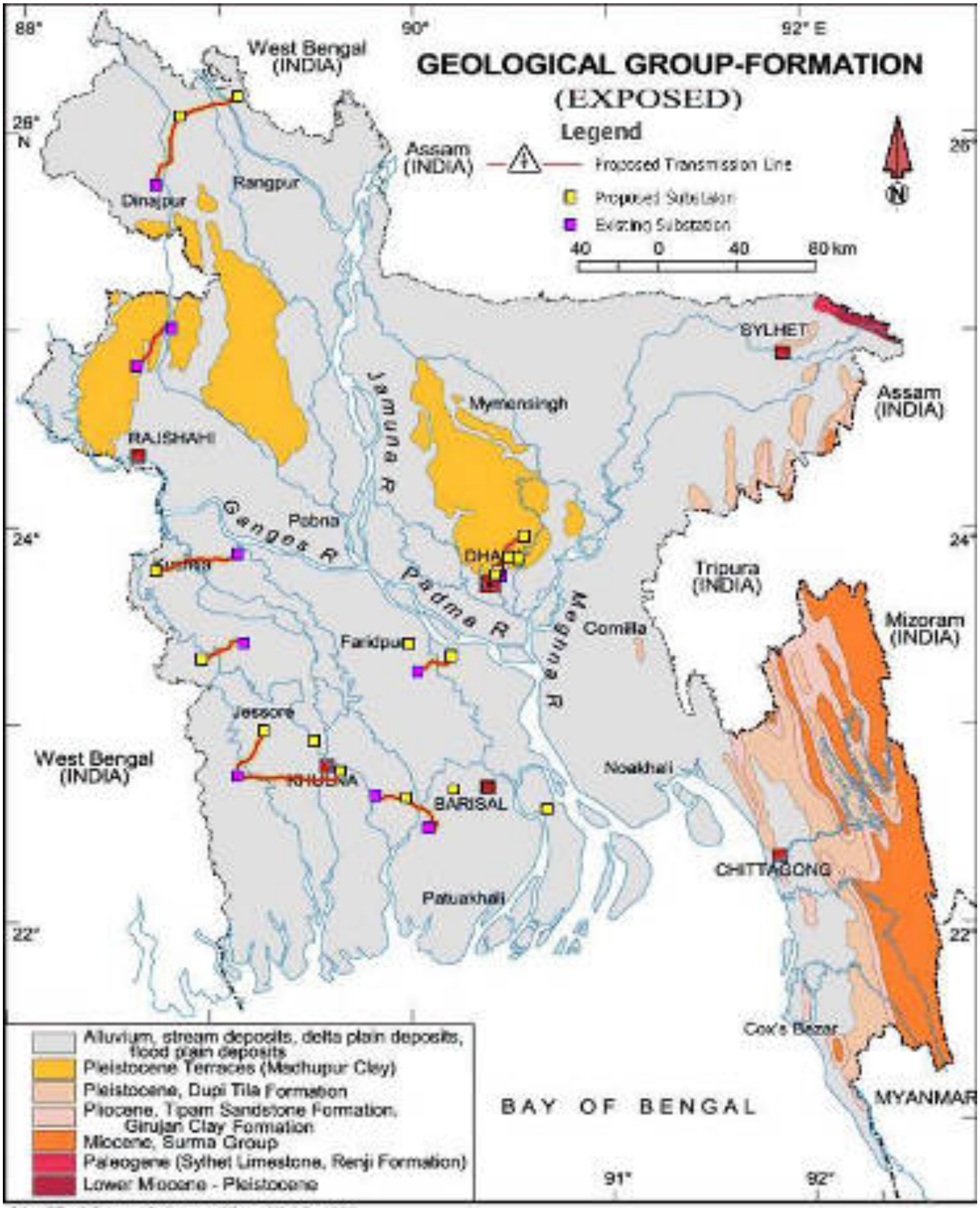
168. Bangladesh is prone to flooding, due to being situated on the Ganges Delta with many tributaries flowing into the Bay of Bengal. Flooding normally occurs during the monsoon season from June to September. The convectional rainfall of the monsoon is added to by relief rainfall caused by the Himalayas. Meltwater from the Himalayas is also a significant input and contributes to floods every year. This often lasts for about a month. Seventy-five percent of Bangladesh is less than 10 m above sea level and 80% is floodplain; therefore, the country is very much at risk of widespread damage due to floods, despite its development. Each year in Bangladesh about 26,000 km2 (around 18%) of the country is flooded. During severe floods, the affected area may exceed 75% of the country, as was seen in 1998 (**Error! Reference source not found.**[22] compared with

[21] http://en.banglapedia.org/index.php?title=Bangladesh_Soil

[22] Bangladesh Agricultural Research Council (BARC)/GIS Project, BGD/95/006)

Figure 4-18 main rivers of Bangladesh). However, small scale flooding in the country is required to sustain agriculture, as sediment deposited by floodwater fertilizes the fields, and the water is required to grow rice, so natural flooding replaces the requirement of artificial irrigation. However, salt deposited on fields (from high rates of evaporation of flood water) can preventing the land from becoming fertile.

Figure 4-14: Geological Map of Bangladesh and Subproject Locations



Modified from *Reimann, Klaus-Ulrich*, 1993

Figure 4-16: Soil Map of Bangladesh and Subproject Locations

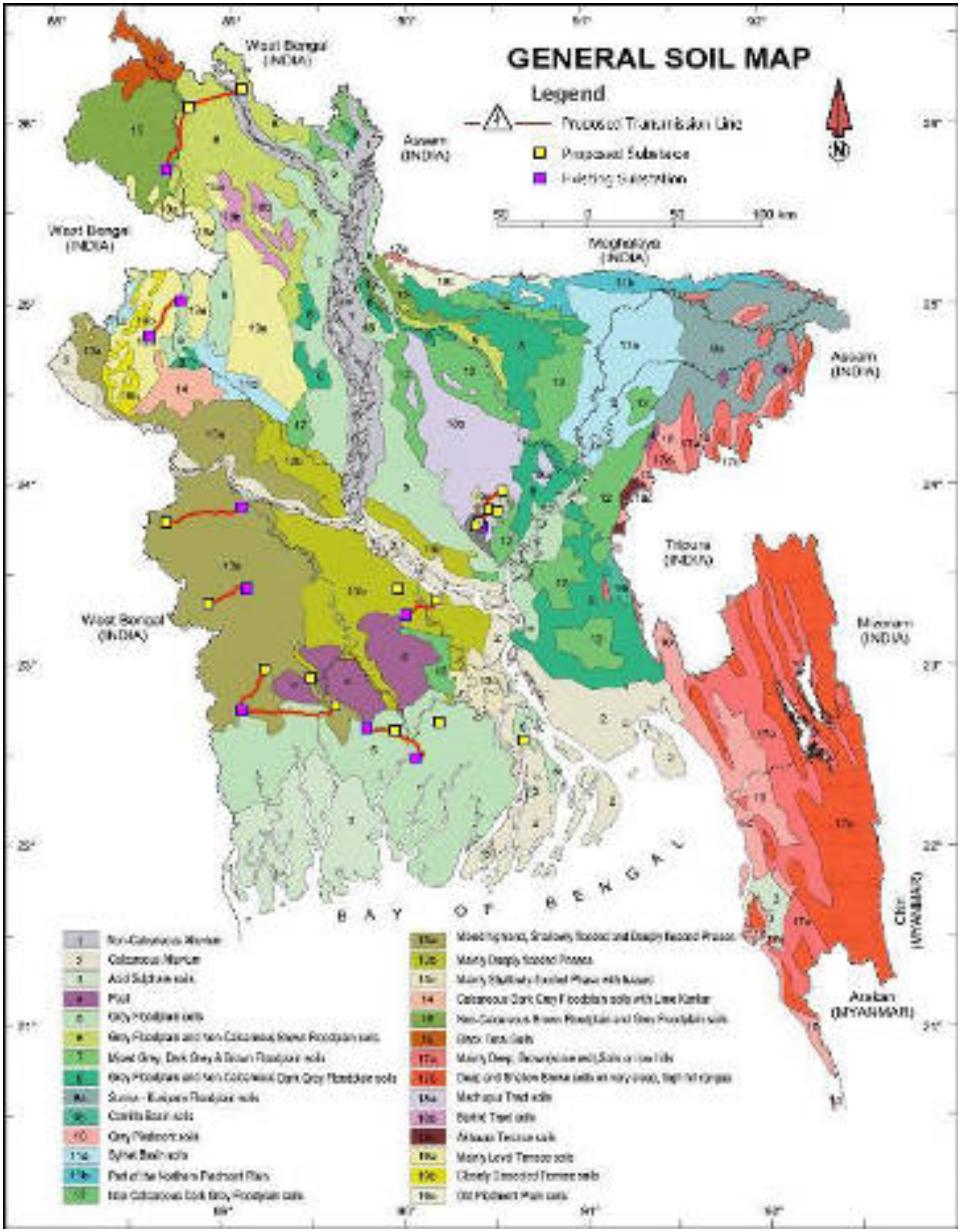


Figure 4-16: Flood Prone Areas of Bangladesh and subproject locations

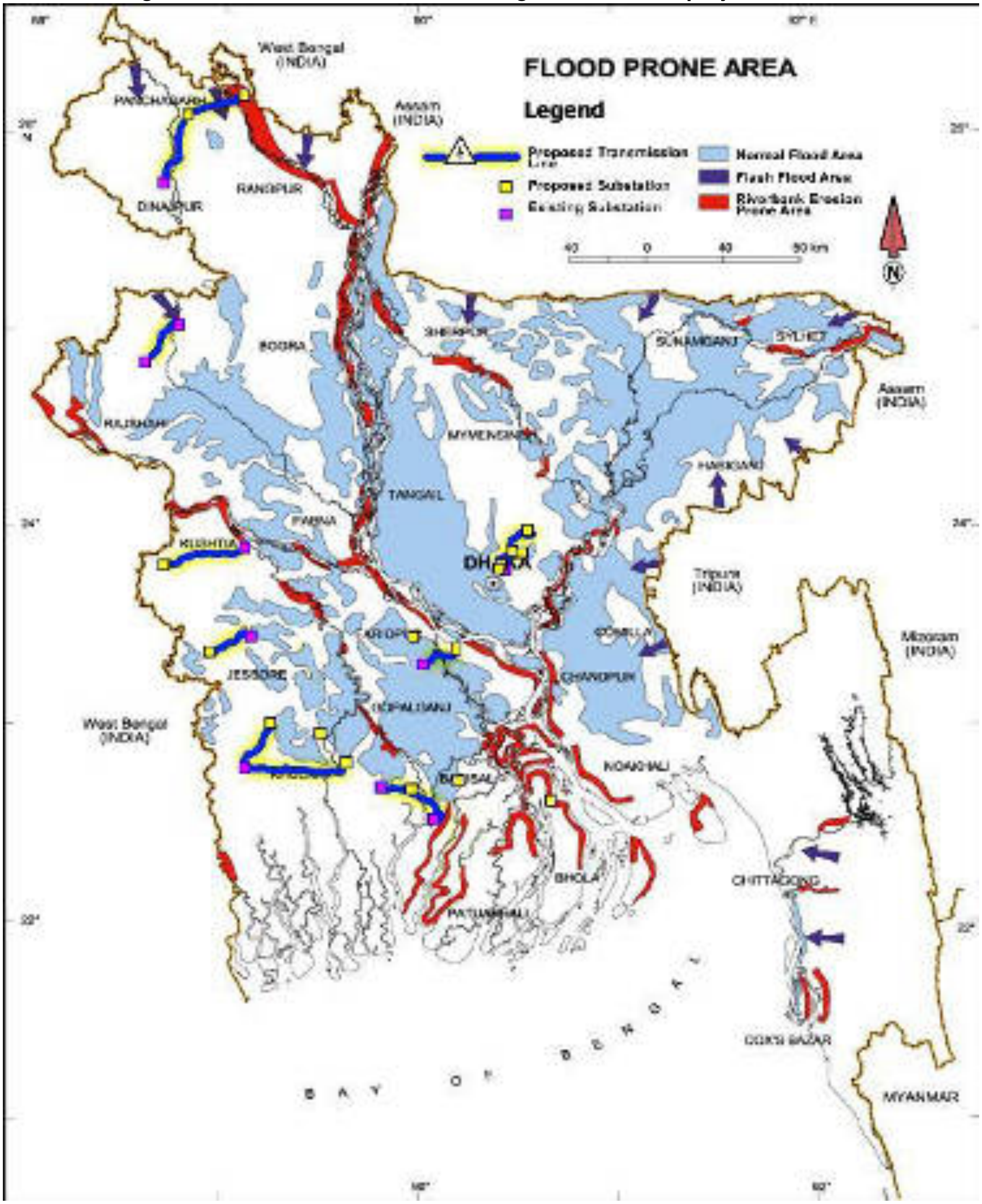
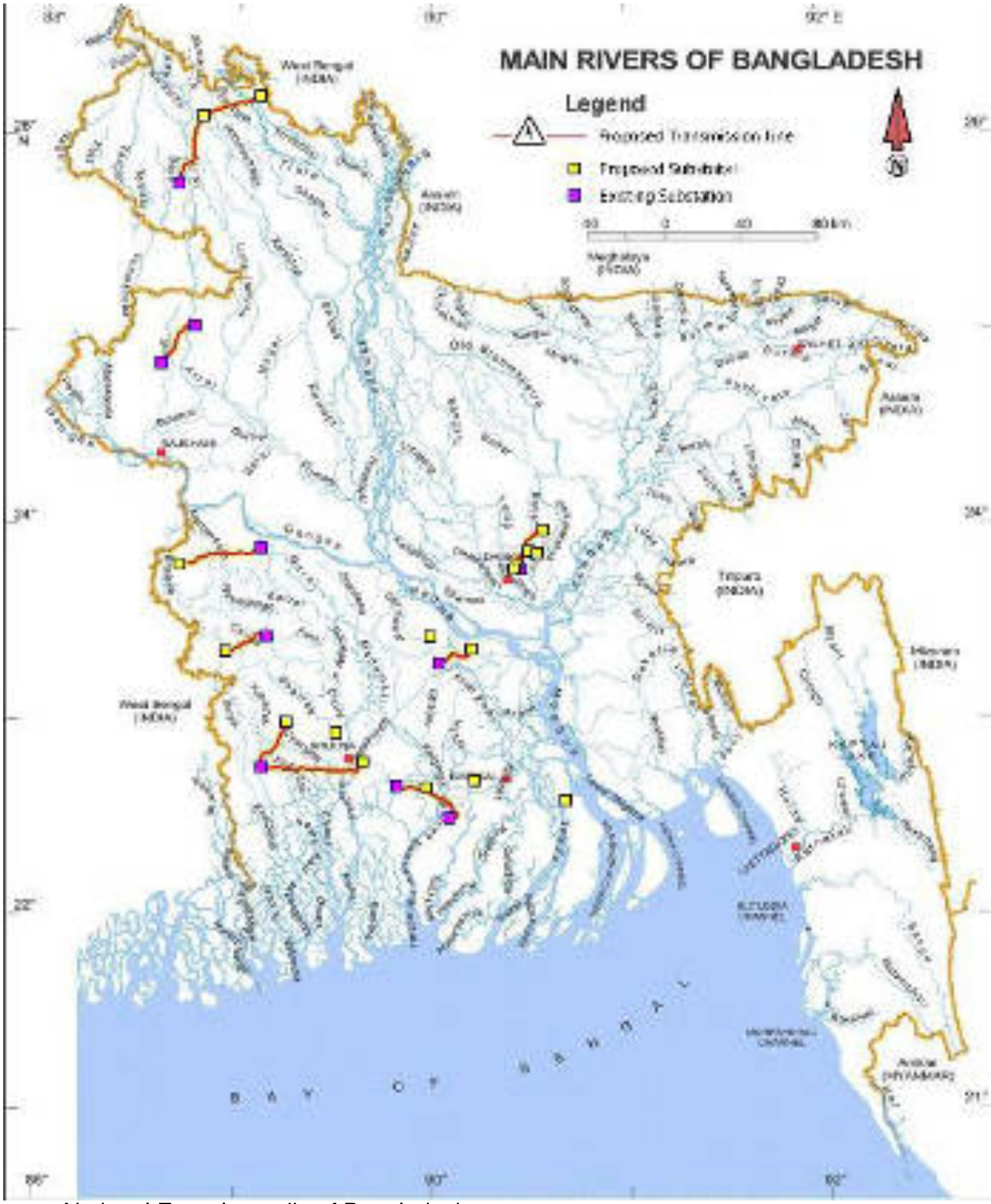


Figure 4-18: Main Rivers of Bangladesh and subproject locations



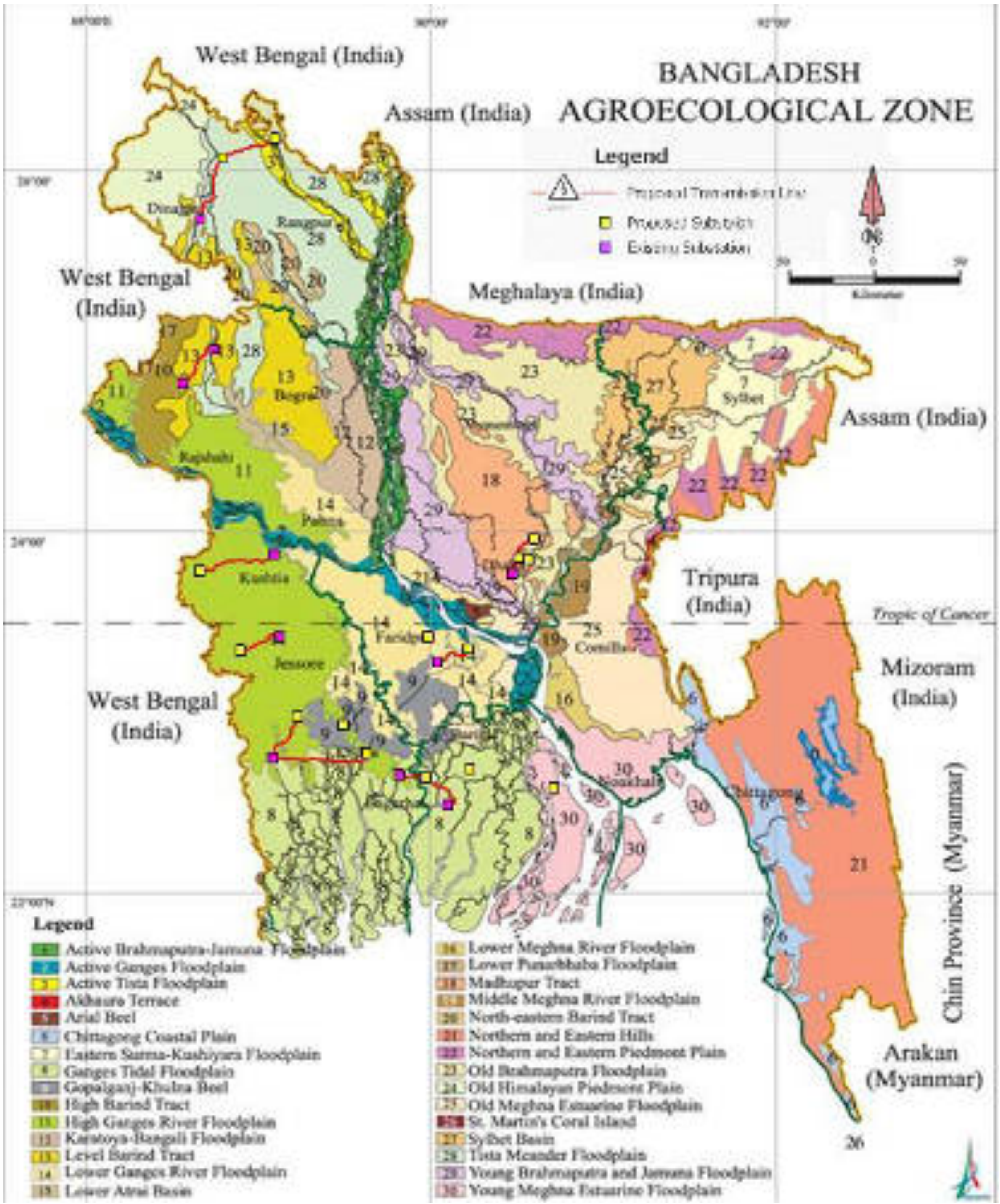
Sources: National Encyclopaedia of Bangladesh

4.2.8 Agro-ecological zones of Bangladesh

169. The agro-ecological zones of Bangladesh have been identified based on four elements including physiography, soils, land levels in relation to flooding, and agro-climatology. Bangladesh has been tentatively divided into 30 agro-ecological zones. These 30 zones have been further subdivided into 88 agro-ecological sub-regions, which have been further subdivided into 535 agro-ecological units.

170. The agro-ecological zones 8,9,10,11,13,14,18,24 and 28 are found in the project area. These are identified as the Ganges tidal floodplain, Gopalganj- Khulna beels, High Barind tract, High Ganges river floodplain, Level Barind tract, Lower Ganges river floodplain, Madhupur tract, Old Himalayan Piedmont Plain and Tista Meander Floodplain. Figure 4-18 shows the agro-ecological zones. (http://en.banglapedia.org/index.php?title=Agroecological_Zone)

Figure 4-18: Agro-ecological zones and subproject locations



171. ***Ganges Tidal Floodplain*** (Zone 8, 17,066 km^2) this region occupies an extensive area of tidal floodplain land in the southwest of the country. The greater part of this region has smooth relief having large areas of salinity. Riverbanks generally stand about 1 m or less above the level of adjoining basins. Non-calcareous grey floodplain soil is the major component of general soil types. Acid Sulphate soil also occupies a significant part of the area, where it is extremely acidic during the dry season. Most of the top soils are acidic and subsoils are neutral to mildly alkaline. Soils of the Sundarbans area are alkaline. General fertility level is high, with medium to high organic matter content.

172. ***Gopalganj-Khulna Beels*** (Zone 9, 2,247 km^2) the region occupies extensive low-lying areas between the Ganges river floodplain and the Ganges tidal floodplain. Soils of the area are grey, and dark grey, acidic, heavy clays overlay peat or muck at 25-100 cm. General soil types include mainly peat and non-calcareous dark grey floodplain soils. Organic matter content is medium to high. Fertility level is medium.

173. ***High Barind Tract*** (Zone 10, 16 km^2) it includes the southwestern part of the Barind Tract where the underlying Madhupur Clay had been uplifted and cut into by deep valleys. The soils include puddled silt loam to silty clay loam in the top soils and porous silt with mottled plastic clay at varying depth. Deep grey terrace soils and grey valley soils are major components of the general soil types of the area. General fertility status is low, having low status of organic matter.

174. ***High Ganges River Floodplain*** (Zone 11, 13,205 km^2) this region includes the western part of the Ganges river floodplain which is predominantly highland and medium highland. Most areas have a complex relief of broad and narrow ridges and inter-ridge depressions. The upper parts of high ridges stand above normal flood level. Lower parts of ridges and basin margins are seasonally shallowly flooded. General soil types predominantly include calcareous dark grey floodplain soils and calcareous brown floodplain soils. Organic matter content in the brown ridge soils is low but higher in the dark grey soils. Soils are slightly alkaline in reaction. General fertility level is low.

175. ***Level Barind Tract*** (Zone 13, 8 km^2) this region is developed over Madurpur clay. The landscape is almost level. The predominant soils have a grey, silty, puddled topsoil with plough pan. Shallow grey terrace soil and deep grey terrace soils are the major components of general soil types of the area. The soils are low in available moisture holding capacity and slightly acidic to acidic in reaction. Organic matter status is very low and most of the available nutrients are limiting.

176. ***Lower Ganges River Floodplain*** (Zone 14, 7,968 km^2) the region comprises the eastern half of the Ganges river floodplain which is low-lying. The area has a typical meander floodplain landscape of broad ridges and basins. Soils of this region are silt loams and silty clay loams on the ridges and silty clay loam to heavy clays on lower sites. General soil types predominantly include calcareous dark grey and calcareous brown floodplain soils. Organic matter content is low in ridges and moderate in the basins. General fertility level is medium.

177. ***Madhupur Tract*** (Zone 18, 4,244 km^2) this is a region of complex relief and soils developed over the Madhupur Clay. The landscape comprises level upland, closely or broadly dissected terraces associated with either shallow or broad, deep valleys. Eleven general soil types exist in the area of which deep red brown terrace, shallow red brown terrace soils and acid 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.

178. ***Old Himalayan Piedmont Plain*** (Zone 24, 4,008 km^2) this distinctive region is developed in an old Tista alluvial fan extending from the foot of the Himalays. It has a complex relief pattern. Deep, rapidly permeable sandy loams and sandy clay loams are predominant in this region. They are strongly acidic in top soil and moderately acidic in sub soil; low in weatherable potassium (K) minerals. Seven general soil types occur in the region, of which non-calcareous brown floodplain soils, black terai soils, and non-calcareous dark grey floodplain soils predominate. Organic matter contents are generally higher than in most floodplain soils of Bangladesh. The natural fertility of the soil is moderate but well sustained. Soil fertility problems include rapid leaching of N, K, S, Ca, Mg and B. Most of Panchagarh and Thakurgaon districts and the northwestern part of Dinajpur district are included in this zone.

179. ***Tista Meander Floodplain*** (Zone 28, 9,468 km^2) this region occupies the major part of the Tista floodplain as well as the floodplain of the Atrai, Little Jamuna, Karatoya, Dharla and Dudhkumar rivers. Most areas have broad floodplain ridges and almost level basins. There is an overall pattern of olive brown, rapidly permeable, loamy soils on the floodplain ridges, and grey or dark grey, slowly permeable, heavy silt loam or silty clay loam soils on the lower land and parent materials medium in weatherable K minerals. Eight general soil types occur in the region, moderately acidic throughout, low in organic matter content on the higher land, but moderate in the lower parts. Fertility level is low to medium. Soils, in general, have good moisture holding capacity.

4.2.9 Seismic zones of Bangladesh

180. Bangladesh can be affected by moderate to strong earthquake events due to its proximity to the collision boundary of the Northeast moving Indian plate and the Eurasian Plate. Strong historical earthquakes with magnitude greater than 7.0 (Richter scale) have affected parts of Bangladesh in the last 150 years; some of them had their epicentres within the country. Source: https://www.academia.edu/.../Earthquake_time_history_for_Dhaka_Bangladesh_as_co. Figure 4-19 shows the four seismic zones of Bangladesh.

181. On the distribution of earthquake epicentres and morpho-tectonic behaviour of different tectonic blocks, Bangladesh has been divided into four generalized seismic zones. The north eastern folded regions of Bangladesh are the most active and belong to Zone 4. The basic seismic coefficient of this zone is 0.36. Northwest Bangladesh is also a seismically active zone (Zone 3) with a basic coefficient of 0.28. Zone 2 consists of the Lower Central and North western part of Bangladesh and the basic coefficient for this zone is 0.20. Ground conditions (whether firm or soft) have not been taken into consideration during the seismic zonation of Bangladesh. Characteristic features of seismic zonation of Bangladesh are presented in the table below. The project area is situated in Seismic Zones 1, 2 and 3 (also relatively quiet). All structures will be seismically designed and checked by engineers to accord with good international practice.

Table 4-20: Seismic Zones of Bangladesh

Seismic Zone	Location	Seismic Intensity	Seismic Zone Coefficient, Z
1	Southwestern part including Barisal, Khulna, Jessore, Rajshahi	Low	0.12
2	Lower Central and Northwestern part including Noakhali, Dhaka, Pabna, Dinajpur, as well as Southwestern corner including Sundarbans	Moderate	0.20
3	Upper Central and Northwestern part including Brahmanbaria, Sirajganj, Rangpur	Severe	0.28
4	Northeastern part including Sylhet, Mymensingh, Kurigram	Very Severe	0.36

Source: https://www.academia.edu/.../Earthquake_time_history_for_Dhaka_Bangladesh_as_co.

Figure 4-19: Seismic Map of Bangladesh and subproject locations

4.3 Biological/Ecological Environment

182. The ecosystems of Bangladesh are broadly classified as terrestrial, inland waters, coastal and marine ecosystems. The forest cover in Bangladesh is 17.5%. Important terrestrial ecosystems are the Sundarbans, the Chattogram Hill Tracts and the Sal (*Shorea robusta*) forests

and inland freshwater ecosystems. Almost half of the total area of Bangladesh is wetlands[23]. These ecosystems are made up of a wide variety of habitats, including the main three rivers (the Ganges, the Brahmaputra and the Meghna) and their 700 plus tributaries and their floodplains; about 6300 beels (permanent and seasonal shallow lakes in floodplain depressions); at least 47 major haors (deeply flooded depressions in the northeast), baors (oxbow lakes); vast areas of seasonally flooded land, fish ponds and tanks.

183. Bangladesh currently has 39 Protected Areas (none of these are adjacent to the subproject areas). Among these, 38 are forest-based and managed by the Forest Department. These include 17 National Parks, 20 Wildlife Sanctuaries and one Special Biodiversity Conservation Area[24]. In all, these terrestrial and coastal protected areas cover about 2,662 km^2. The remaining one is a marine ecosystem that is managed by the Forest Department. Ramsagar National park (27. 76 ha) in Dinajpur district is about 23 km south of the proposed Purbasadipur substation.

4.3.1 Bio-ecological Zones

184. Within a relatively small geographic area, Bangladesh has 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 in Bangladesh. Temperature, rainfall, physiographic variations in soil and different hydrological conditions play vital roles in the country's diverse ecosystems. The ecosystems of Bangladesh are categorized into two major groups: (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.

185. In 2002, the International Union for Conservation of Nature (IUCN) classified the country into 12 bio-ecological zones (25 sub-bio-ecological zones) according to factors such as fauna and flora, geographical characteristics, annual average rainfall, administrative regions, soil types, water level in flooding, and land use. The subprojects are located in Zones 1, 2, 3, 4a, 4b, 4c, 6, 10 and 11 (Figure 4-20, source www.researchgate.net/figure/Bio-ecological-Zones-of-Bangladesh-SourceIUCN-2002_fig5_327691767).

4.3.2 Diversity of Floral and Faunal Species

186. The subproject impact areas are mixed with different vegetation. Crops and vegetables dominate and are cultivated in the surrounding areas and include mainly paddy (rice), jute, mustard, onion, garlic, potato and a variety of homestead vegetables. A sizeable number of fruit trees with economic value were observed in the project area. The fruit trees include jackfruit, mangoes, litchi, banana, coconut, and blackberry. Timber trees include Mahogany, Neem, Ipil, and Koroi. The trees, shrubs, herbs, bushes, and low-growing grasses in the RoW provide habitat for birds and other animals. 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 given in the Table 4-21 and 4-22.

[23] Biodiversity National Assessment 2015 (The Fifth National Report of Bangladesh to the Convention on Biological diversity)

[24] Red List of Bangladesh 2015, Vol. 1: Summary

Figure 4-20: Bio-ecological Zones of Bangladesh, subprojects are in Zone 1, 2, 3, 4a, 4b, 4c, 6, 10 and 11

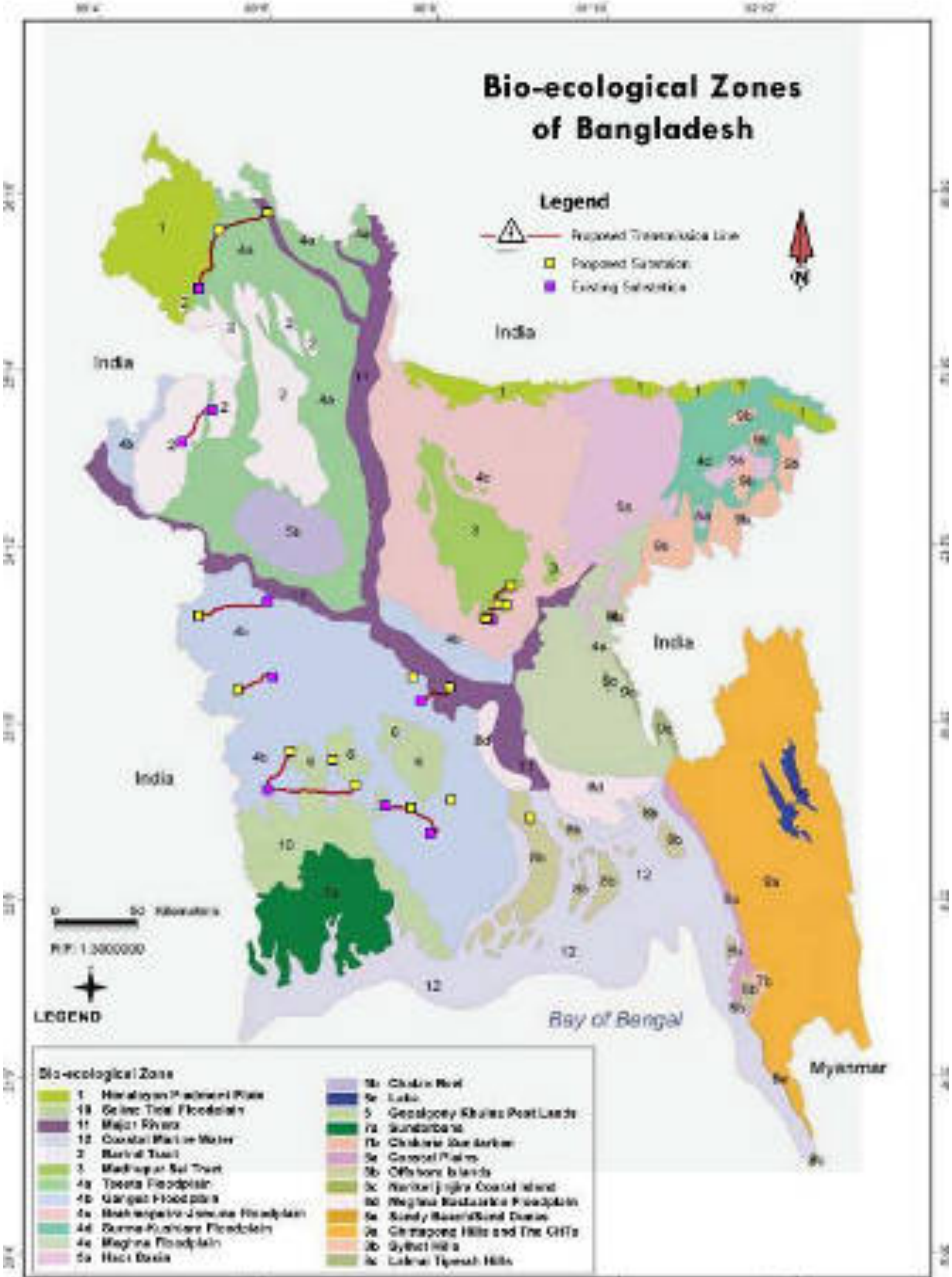


Table 4-21: List of Trees Recorded in the RoW and Surroundings of the Transmission Line Routes, proposed Substation lands in Greater Dhaka, and Southwest parts of Bangladesh

Scientific Name	Local Name or English Name	Habit	Habitat	National Status	Global Status
Timber/Wood Trees					
Swietenia mahagoni	Mahogony	T	RS, HS	C	EN
Azadirachta indica	Neem	T	HS	C	LC
Albizzia procera	Koroi	T	RS, HS	C	-
Eucalyptus citriodora	Eucalyptus	T	RS, HS	C	-
Dalbergia sisoo	Shishu	T	RS, HS	C	-
Bambusa vulgaris	Bash (Bamboo)	S	HS	C	-
Samanea saman	Raintree	T	RS, HS	C	-
Bombax ceiba	Shimul (Cotton Tree)	T	RS, HS	LC	-
Ficus benghalensis	Banyan tree	T	RS	C	-
Ficus infectoria	Pakur	T	HS	LC	-
Polyalthia longifolia	Debdaru	T	RS	LC	-
Acacia aurculiformis	Akashmoni	T	RS, HS	C	-
Areca catechu	Supari/ Betel nut	T	HS, RS	C	-
Tectona grandis	Shegun	T	RS, HS	LC	-
Terminalia arjuna	Arjun	T	HS, RS	LC	-
Dillenia indica	Chalta	T	HS, RS	C	-
Delonix regia	Krishnachura	T	HS	LC	LC
Artocarpus chama Buch-Ham		T	HS	C	-
Artocarpus heterophyllus	Jack fruit	T	HS	C	-
Phaleria macrocarpa	Dewa	T	HS	C	-
Instia bijuga	Ipil	T	HS	LC	-
Polyalthia longifolia	Debdaru	T	HS, RS	C	-
Castanea sp.	Chestnut	T	HS	C	-
Diospyros discolor	Gab	T	HS	C	-
Lagerstroemia speciosa	Jarul	T	RS	C	-
Litchi chinensis	Lichi	T	HS	C	-
Mangifera indica	Mango	T	HS	C	DD
Phyllanthus emblica	Amloki	T	HS, RS	LC	-
Olea europaea	Olive	T	HS	C	-
Borassus flabelilifer	Tal	T	HS, RS	C	-
Fruit Trees					
Musa sapientum	Kalagash (Banana)	H	HS	C	-
Psidium guajava	Piara (Guava)	T	HS	LC	LC
Cocos nucifera	Narikel (Coconut)	T	HS	C	-
Moringa oleifera	Sajna	T	HS	LC	-
Zizyphus jujuba	Boroi	T	HS	LC	-
Citrus grandis	Jambura/Badam	S	HS	C	-
Aegle marmelos	Bel	T	HS	C	-
Limonia acidissima	Kodbel/ woodapple	T	HS, RS	C	-
Phoenix dactylifera	Date Tree (Khejur)	T	HS, RS	C	LC
Areca catechu	Supari (Betel Nut)	T	HS	C	-
Carica papaya	Pepe (Papya)	T	HS	C	DD
Citrus aurantifolia	Labu (Lemon)	S	HS	C	-
Annona reticulate	Atafal	T	HS	C	-
Annona squamosa	Ata	T	HS	C	-
Averrhoa carambola	Kamranga	T	HS	C	-
Punica granatum	Dalim	S	HS	LC	LC
Manilkara sapota	Sobeda	T	HS	LC	-
Dillenia indica	Chalta	T	HS	LC	-
Fruit cum Timber Trees					
Artocarpus heterophyllus	Kathal (Jackfruits)	T	HS	LC	-
Mangifera indica	Aam (Mango)	T	HS	C	DD

Scientific Name	Local Name or English Name	Habit	Habitat	National Status	Global Status
Syzygium cumini	Jam (Blackberry)	T	HS	C	-
Tamerindus indica	Tetul (Tamarind)	T	HS	C	-
Borassus flabellifer	Tal (Palm Tree)	T	RS	LC	EN
Elaeocarpus robustus	Jolpai (Olive)	T	HS	LC	
Diospyros peregrina	Gub	T	HS, RS	LC	
Medicinal Trees					
Azadirachta indica	Neem	T	HS	C	LC
Teominalia arjunna	Arjun	T	HS, RS	LC	-
	Bohera	T	HS	LC	-
	Tejpata	T	HS	LC	-
Ocimum canum	Tulshi	H	HS	LC	-
Coccinea cordifolia	Telakachu	S	HS	C	-
Fuel Trees					
	Paiya	T	HS	C	-
Ficus benghalensis	Bot (Banyan Tree)	T	RS	LC	-
Acacia nilotica	Babla	T	HS	C	LC
Ricinus communes	Venna	T	HS	C	-
	Bonziga	T	HS	C	-
Ficus hispida	Dumoor	T	RS	C	-
Anthocephalus cadamba	Kadom	T	HS	C	-
	Shewra	T	HS	C	-
	Bakul	T	HS	LC	-
Aesthetic					
Delonix regia	Krisnochura	T	HS	LC	LC
Cassia fistula	Sonalu	T	HS	LC	LC
Codiaeum variegatum	Patabahar	S	HS	LC	-
Lawsenia inermis	Mehendi	S	HS	C	-
Gardenia coronaria	Gandha raj	S	HS	C	-
Casuarina littorea	Jaw	T	HS	LC	-
Nymphaea nouchalli	Shapla	H	Wild	C	-

C = Common, H = Herb, HS = Homestead, LC = Less Common for National status and Least Concern for Global status, DD = Data Deficient, EN = Endangered, RS = Road Side, S = Shrub, T = Tree.
The two globally endangered species are not endangered but common or less common in Bangladesh.
Source: Field survey, Sept/ Oct. 2018.

Table 4-22: Tree Species found in the subproject areas in north-western zone

Scientific Name	Local Name	English Name	Uses and IUCN status
Mangifera indica	Aam	Mango	Fruit, Timber. DD
Acacia auriculiformis	Akash Moni	Akash Moni	Fruit, Timber. LC
Phyllanthus emblica	Amloki	Emblic myrobalan	Fruit. NA
Terminalia arjuna	Arjune	White murdah	Timber, Fuel, Medicine. NA
Annona squamosal	Ata	Custard apple	Fruit. NA
Acacia nilotica	Babla	Acacia	Timber, Soil binder. LC
Bambusa vulgaris	Bhas	Bamboo	Fuel, building material. NA
Ziziphus mauritiana	Boroi	Jujube	Timber, Fuel. NA
Barringtonia acutangula	Hijol	Indian oak, Itchytree	Fruit. LC
Syzygium cumini	Jaam	Black-plum	Fruit. NA
Olea europaea	Jalpai	Olive	Fruit. NA
Citrus maxima	Jambura	Shaddock	Fruit. NA
Syzygium samrangenes	Jamrul	Malay apple	Fruit. NA
Lagerstroemia speciosa	Jarul	Crapu myrtle	Timber, Fuel. NA

Musa acuminata	Kala	Banana	Fruit. LC
Artocarpus heterophyllus	Kathal	Jackfruit	Fruit, timber. NA
Phoenix dactylifera	Khejur	Date plum	Fruit. LC
Delonix regia	Krishnachura	Royal Poinciana	Timber. LC
Albizia procera	Koroi	Raintree	Timber. LC
Mesua ferrea	Negeswar	Iron wood	Timber. NA
Cocos nucifera	Narikal	Coconut	Fruit. NA
Azadirachta indica	Neem	Margosa	Timber, Fuel. LC
Borassus flabellifer	Tal	Palm	Fruit, Timber. EN
Dalbergia sissoo	Shishu	Sissoo	Timber, Fuel. NA
Bombax ceiba	Shimul	Silk cotton	Cotton, Timber. NA
Cassia fistula	Sonali	Indian laburnum	Timber, ornamental. LC
Cinnamomum tamala	Tejpata	Bay leaf	Spice. NA
Tamarindus indica	Tetul	Tamarind	Fruit, Timber. LC

NA = Not Available; DD = Data Deficient; LC = Least Concern; EN = Endangered. Source: Field survey, Sept/ Oct. 2018.

187. The subprojects will require removal of trees of various sizes and species. The inventory carried out during September/October 2018 found a variety of trees on the RoW of the transmission line routes. On the other hand, the lands selected for the fifteen substations are agricultural fields and few trees are found on these lands. The total number of affected trees along the transmission line RoW are presented by category in the Chapter 5. The details of the counted trees are given in

Annex 3. The highest number of trees, which are more than 5 m in height, is found under the fruit bearing tree category (13,075) followed by timber trees (9,360) and trees with medicinal properties (355). The size of trees has been determined based on the girth category for the considered species, but the Forest Department will further assess it before paying compensation to the owners. All the PAPs (project-affected persons) will receive compensation for the trees and fruits. Also, they will be able to take away the timber. PAPs will get also additional compensation for fruit bearing trees.

188. While most of the aquatic plant species of the subproject areas are subject to seasonal water level fluctuations, the abundance of wetlands supports a wide variety of aquatic biota. The common aquatic plants are Helencha (*Enhydro fluctuans*), Kalmi (*Ipomoea aquatica*), DholKalmi (*Ipomoea fistulosa*), Cheicha (*Scirpus articulatus*), Kochuripana (*Eichornia crassipes*), Shapla (*Nymphaea nouchali*), Duckweed (*Spiredella sp.*), Khudipana (*Lemna minor*), and Topapana (*Pistia stratiotes*).

189. The diversified habitats and ecosystems in the project area support various types of wildlife. Primary and secondary data were used for identification of fauna that may be in the project area. Most of the faunal species (amphibians, reptiles, birds, and mammals) were identified in the project impact area of the subprojects by using books and the descriptions of the local people provided during the field survey (results given in the following table. Note that no endangered species have been encountered in the project area.

Table 4-23: List of Faunal Species found in the Substation/ Transmission Line Subproject Areas

Scientific Name	English Name	Local Name	Global IUCN Status	Local IUCN Status
Amphibians				
Bufo melanostictus	Common Toad	Kuno bang	LC	NT
Rana temporalis	Bull Frog	Kola bang	-	NT
R. pipens	Grass Frog	Sona bang	-	NT
Reptiles				
Hemidactylus flaviviridis	Common House Lizard	Tiktiki	-	NT
Calotes versicolor	Common Garden Lizard	Rokto-chosha	-	NT
Varanus bengalensis	Bengal monitor	Gui shap	LC	VU
Xenochrophis piscator	Checkered keelback	Dhora shap	-	NT
Amphiesma stolata	Stripped keelback	Dora shap	-	NT
Enhydris enhydris	Common smooth water snake	Paina shap	LC	NT
Coluber mucosus	Rat snake	Daraj shap	-	VU
Ahaetulla nasutus	Common vine snake	Laodoga shap	-	VU
Atretium schistosum	Olive keelback water snake	Maitta shap	LC	NT
Naja naja	Spectacled cobra	Khoia gokhra	-	NT
Birds				
Ardeola grayii	Indian pond-heron	Kani bok	LC	NT
Casmerodius albus	Great white egret	Sada bok	LC	NT
Ardea intermedia	Intermediate egret	Mazla bok	LC	NT
Egretta garzetta	Little egret	Choto bok	LC	NT
Nycticorax nycticorax	Black-crowned night heron	Nishi bok	LC	NT
Ixobrychus cinnamomeus	Cinnamon Bittern	Lal bok	LC	NT
Anastomus oscitans	Asian Openbill	Shamuk-khol	LC	NT
Haliastur indus	Brahminy kite	Shankho chil	LC	NT
Milvus migrans	Black kite	Bhubon chil	LC	NT

Actitis hypoleucos	Common sandpiper	Kada Khocha	**LC**	**-**
Spilopelia chinensis	Eastern Spotted dove	Tila Ghughu	LC	NT
Streptopelia decaocto	Eurasian collared dove	Raj Ghughu	LC	NT
Psittacula krameri	Rose-ringed parakeet	Tia	LC	NT
Amaurornis phoenicurus	White-breasted waterhen	Dahuk	LC	NT
Eudynamys scolopacea	Western Koel	Kokil	LC	NT
Centropus sinensis	Greater coucal	Kanakua	LC	NT
Cuculus micropterus	Indian cuckoo	Bou-kotha-kao Pakhi	LC	NT
Athene brama	Spotted owlet	Khuruley Pencha	LC	NT
Alcedo atthis	Common kingfisher	Choto Maachranga	LC	NT
Halcyon smyrnensis	White-brested kingfisher	Sadabuk Maachranga	LC	NT
Ceryle rudis	Pied kingfisher	Pakra Maachranga	LC	NT
Megalaima haemacephala	Coppersmith barbet	Choto Basanta Bauri	LC	NT
Oriolus xanthornus	Black-hooded oriole	Holdey Pakhi	LC	NT
Corvus splendens	House crow	Pati Kak	LC	NT
Dicrurus macrocercus	Black drongo	Fingey	LC	NT
Copsychus saularis	Oriental magpie robin	Doel	LC	NT
Acridotheres fuscus	Jungle myna	Jhuti Shalik	LC	NT
Acridotheres tristis	Common myna	Bath Shalik	LC	NT
Acridotheres ginginianus	Bank myna	Gang Shalik	LC	NT
Gracupica contra	Asian pied starling	Gobrey Shalik	LC	NT
Sturnia malabaricus	Chestnut-tailed starling	Kath Shalik	LC	NT
Pycnonotus cafer	Red-vented bulbul	Bulbuli	LC	NT
Turdoides striata	Jungle babbler	Satbhai	LC	NT
Orthotomus sutoriu	Common tailorbird	Tuntuni	LC	NT
Passer domesticus	House sparrow	Charui	LC	NT
Ploceus philippinus	Baya weaver	Babui	LC	NT
Upupa epops	Common Hoopoe	Hudhud Pahkhi	LC	NT
Mammals				
Pteropus giganteus	Indian Flying Fox	Badur	LC	NT
Pipistrellus coromandra	Indian Pipistrelle	-	LC	NT
Megaderma lyra	Greater False Vampire	Badur	LC	NT
Herpestes edwarsii	Indian Grey Mongoose	Bara benji	LC	VU
Herpestes auropunctatus	Small Indian Mongoose	Benji	LC	NT
Rattus rattus	House Rat	Indur	LC	NT
Bandicota indica	Greater Bandicoot Rat	Bara indur	LC	NT
Bandicota bengalensis	Lesser Bandicoot Rat	Indur	LC	NT
Mus musculus	House Mouse	Nengri indur	LC	NT
Suncus murinus	House Shrew	Chicka	LC	NT

VU- Vulnerable, NT = Near Threatened, LC = Least Concern Source: Field Survey, Literature Review and IUCN Red List of Bangladesh: (Vol. II, III & IV, 2015).

190. Fish are the most important aquatic fauna in the subproject areas along with invertebrate and amphibian groups. The aquatic fauna includes prawns (*Macrobrachium spp.*), crabs, snails (*Pila, Vivipara, Lymna*), freshwater mussels (*Lamellidens sp.*), Kolabang (*Rana tigrina*), and Matia sap (*Enhydrisen hydris*).

Table 4-24 - List of Fish Species found in the Subproject Areas- Greater Dhaka, Northwest and Southwest part of Bangladesh

Species name	English name	Local Name	Global Status	Local Status

Batasio batasio	Tista Batasio	Tengra	LC	NT
Puntius sophore	Spotfin Swamp Barb	Puti	LC	NT
Esomus danricus	Flying Barb	Darkina	LC	DD
Osteobrama cotio	Cotio	Dhela	LC	NT
Salmostoma acinaces	Silver Razor belly Minnow	Chela	LC	DD
Labeo rohita	Rohu	Rui	LC	DD
Gibelion catla	Catla	Catla	LC	NT
Cirrhinus mrigala	Mrigal	Mrigal	LC	NT
Sperata aor	Long-whiskered Catfish	Ayre	LC	VU
Chitala chitala	Humped Featherback	Chital	NT	EN[1]
Wallago attu	Freshwater Shark	Boyal	NT	VU
Pangasius	Pangas Catfish	Pungus	LC	EN[2]
Tenualosa ilisha	Hilsa	Elish	LC	NT
Awaous grammepomus	Scribbled Goby	Bele	LC	NT
Notopterus notopterus	Freshwater Knife fish	Foli	LC	VU
Anabas testudineus	-	Koi	DD	NT
Amblypharyngodon mola	-	Mola	LC	NT
Gonialosa manmina	Ganges River Gizzard Shad	Chapila	LC	NT
Mastacembelus armatus	Spiny eel	Baim	LC	EN[3]
Channa marulius	Giant Snakehead	Gajar	LC	EN[4]
Platanista gangetica ssp. gangetica	Ganges River Dolphin	Susu	LC	EN[5]

EN- Endangered, VU- Vulnerable, DD- Data Deficient, LC- Least Concern, NT- Near Threatened.
Source: Field Survey, Literature Review and IUCN Red List of Bangladesh (Vol. V, 2015)

EN[1] *Chitala* is an apparently widespread species in Bangladesh and found in the markets throughout the year (Alam 2007). However, local distribution ranges of the species are most probably becoming restricted to some areas of the country, which could be inferred from its reduced estimated Area of Occupancy (Date assessed- 25 June 2014)

EN[2] *Pangasius pangasius* is one of the uncommonly caught commercial fishes in Bangladesh. It is inferred that its population has been declined by about 50% over the last 20 years due to habitat destruction and over exploitation throughout the country Date Assessed: 25 February 2015

EN[3] - According to IUCN, different anthropogenic activities are the major reasons of squeezing of its natural habitats and corresponding reduction of its population. As per the assumption of IUCN, this species has been reduced by more than 50% in the last two decades (Ahmed et al. 2015). Therefore, it is assessed as EN species)

EN[4] - *Channa marulius* is a wide spread species but scarce in comparison to other species of *Channa*. Although, there is no reported population decline it is inferred that its population has been reduced over 50% in the last ten years due to over exploitation and habitat destruction. Therefore, this species is assessed as Endangered (Red list, Vol. V, 2015).

EN[5] Ganges River Dolphin is an apparently widespread species in Bangladesh.

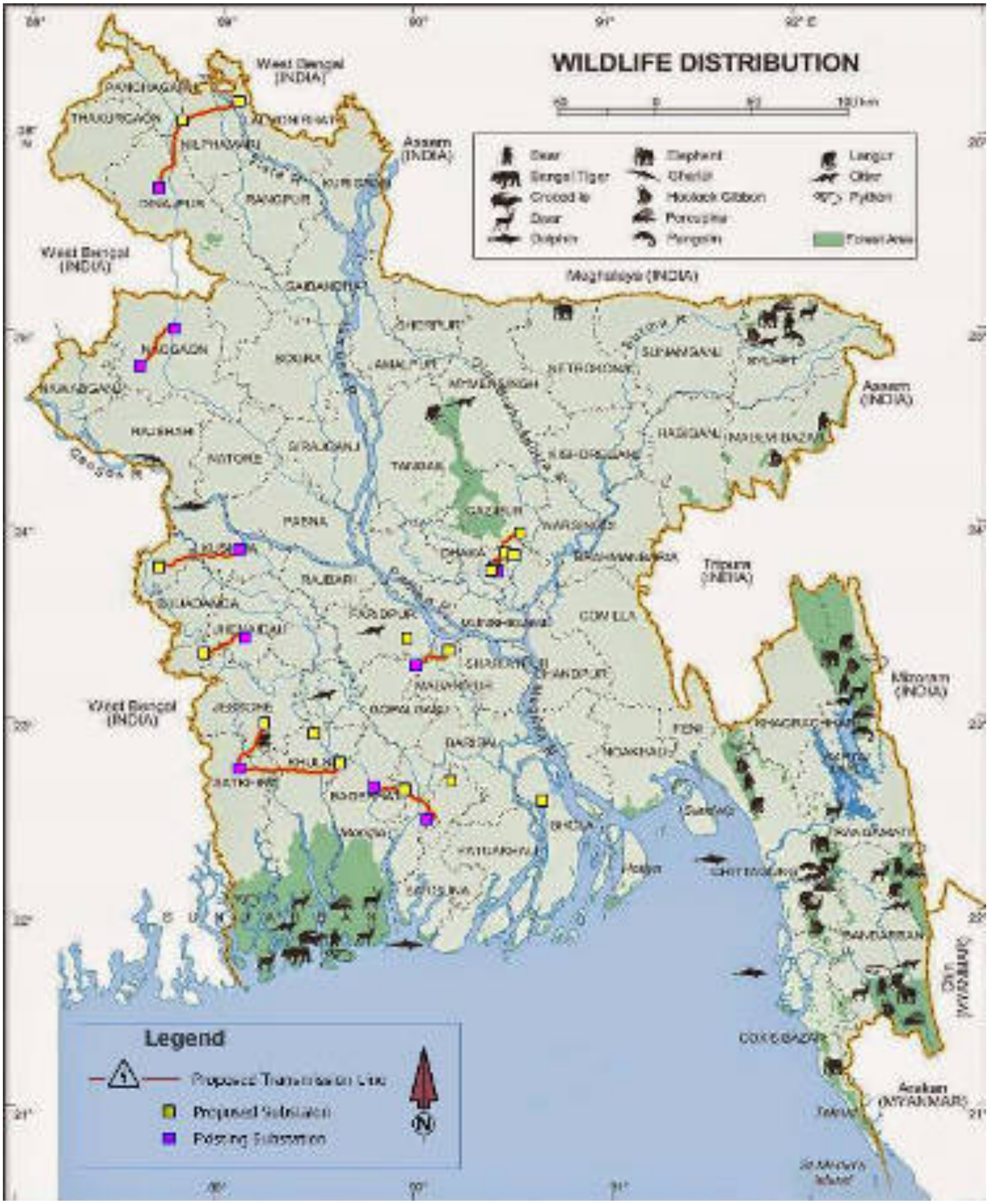
191. Ganges River Dolphins lives exclusively in freshwater river system and the estuaries where salinity level is low. It occurs in all connected rivers and tributaries of Ganges-Brahmaputra-Meghna system, and Karnaphuli-Sangu river system in southern Bangladesh. They also present

in seasonally flooded and lowlands. In general, this species mostly found in deep pools in river meanders and confluences. In the water ways of Bangladesh Sundarbans, their distribution is conditionally dependent on low salinity, high turbidity and moderate depth during both low and high freshwater flow. Ganges River Dolphin has already disappeared from most of the tributaries of Ganges-Brahmaputra-Meghna river systems due to siltation, insufficient water flow. It is now a vulnerable species in Bangladesh (Endangered globally) and restricted to a very few larger channels (IUCN Red List Vol. II 2015). Proposed transmission lines cross several rivers where dolphins are found, e.g. Rupsha, Katcha, Bahirab and Arialkhan. As the towers are not located in the river, there will be no impact on this species. Surveys conducted by the IUCN for 800 MW Rupsha power plant EIA, from May 2017 to January 2018, showed a total of 284 sightings from four surveys (one pre-monsoon, two monsoon and first post-monsoon) of Ganges River Dolphins, with overall encounter rate is 1.18/ km including 13.76% calves. The most important area determined from the surveys for dolphins is the confluence of Atai- Bhairab- Rupsha Rivers where feeding behaviour was recorded and a large number of calves were seen. As the towers are not located in the river, there will be no impact on this species.

192. There are two substation lands with a total extent of 3-acre waterbody might be permanently lost[25]. PGCB will get the permission from DoE before commencement of any civil work. These include Rupsha (1 acre) and Phultala (2 acres), supporting fish culture especially for the major carp, rui, catla, mrigal, exotic carp like silver carp, grass carp, common carp, mirror carp, big head, tilapia and live fishes like koi, shing, magur are using extensive culture methods. One acre of waterbody provides maximum income of BDT 10,000 per year from fishing.

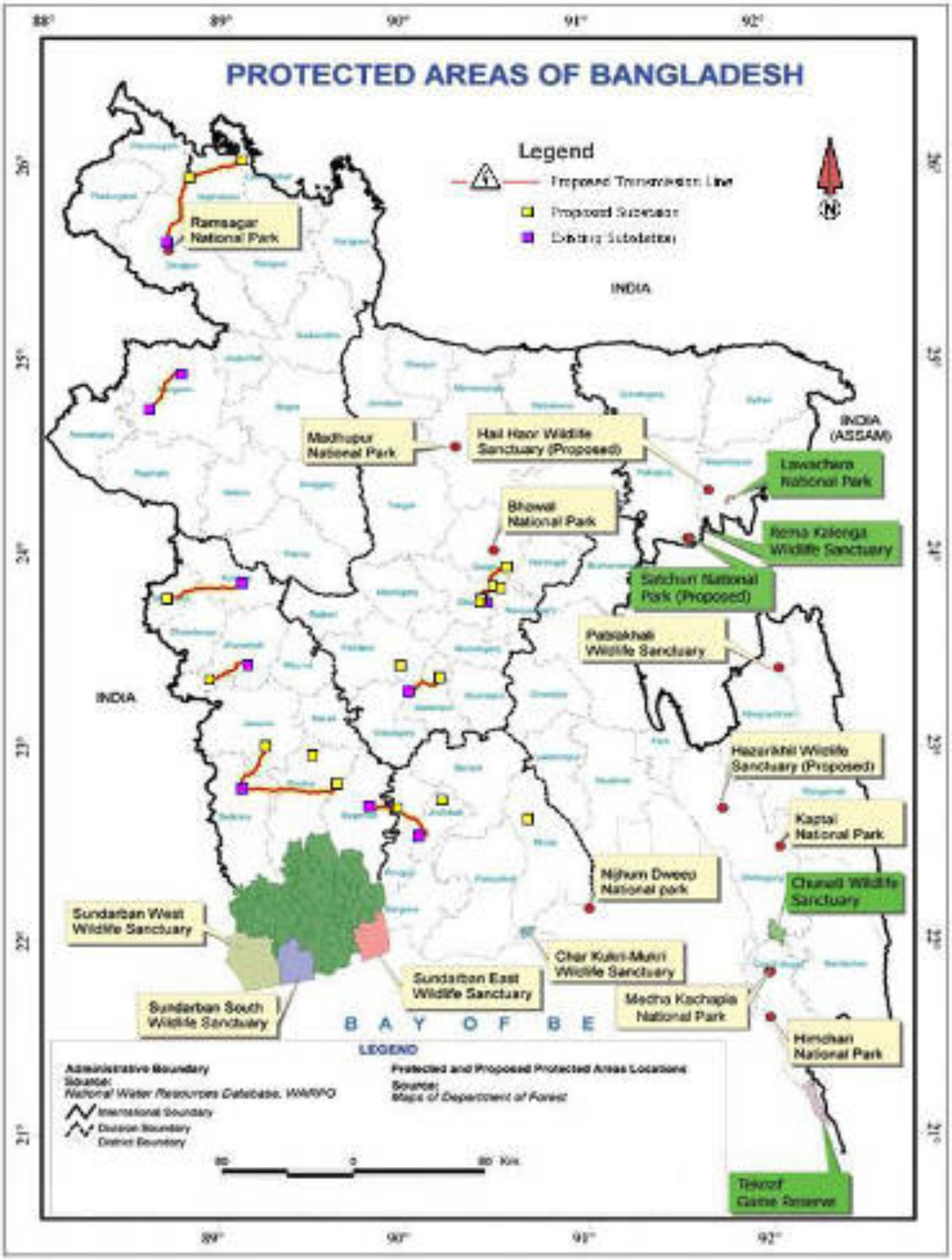
[25] PGCB will work with contractors to figure out the possibility of retaining the waterbody, if not feasible, PGCB will ensure the restoration of the waterbody prior to fill up the waterbody.

Figure 4-21: Wildlife Distribution Map of Bangladesh - subproject locations and distribution of fauna



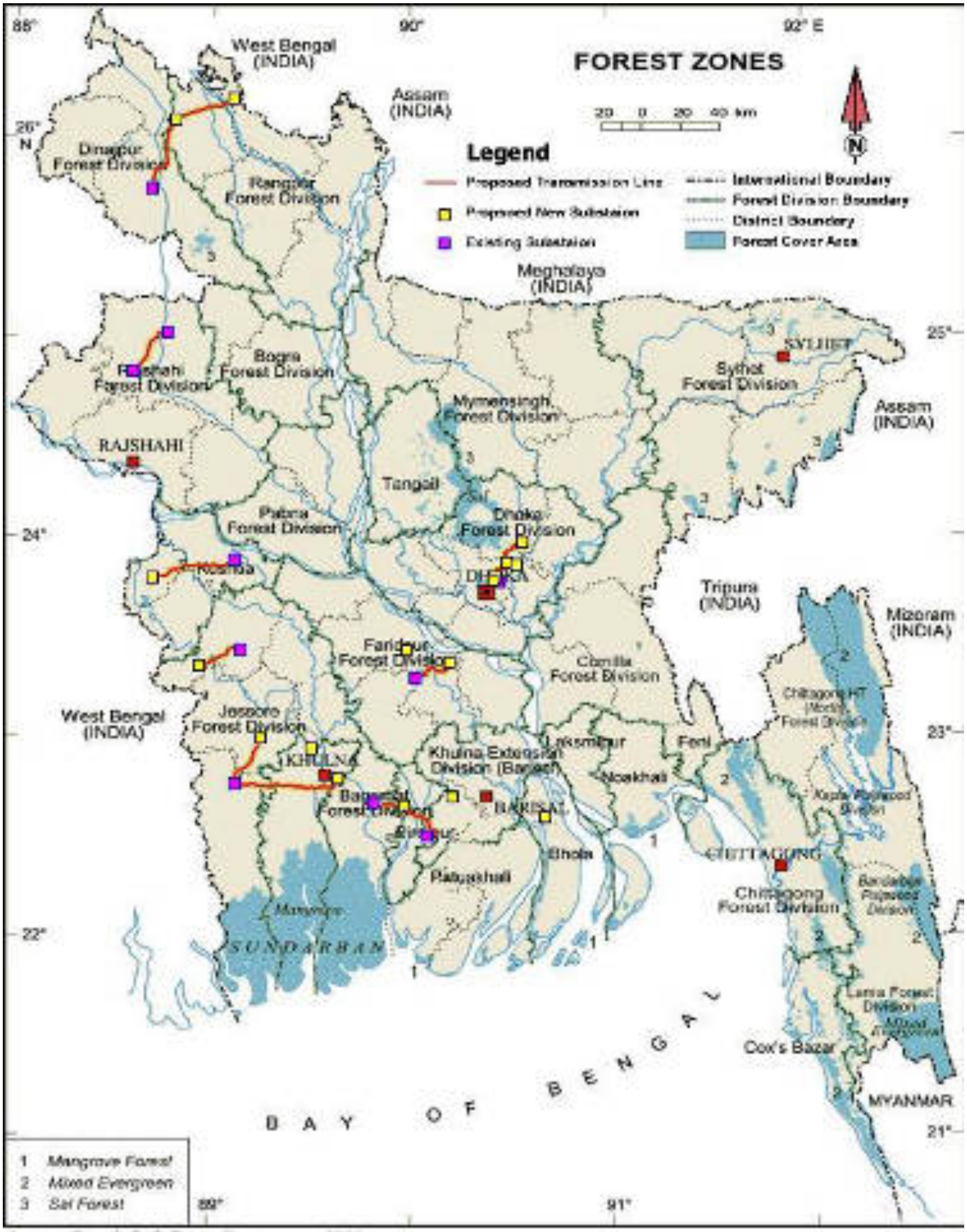
Source: https://map.janlewala.com/2014/11/wildlife-distribution.html

Figure 4-22: Protected Area Map of Bangladesh and subproject locations



Source: www.researchgate.net/figure/Protected-areas-of-Bangladesh_fig2_236171067

Figure 4-23: Forest Cover Map of Bangladesh and subproject locations

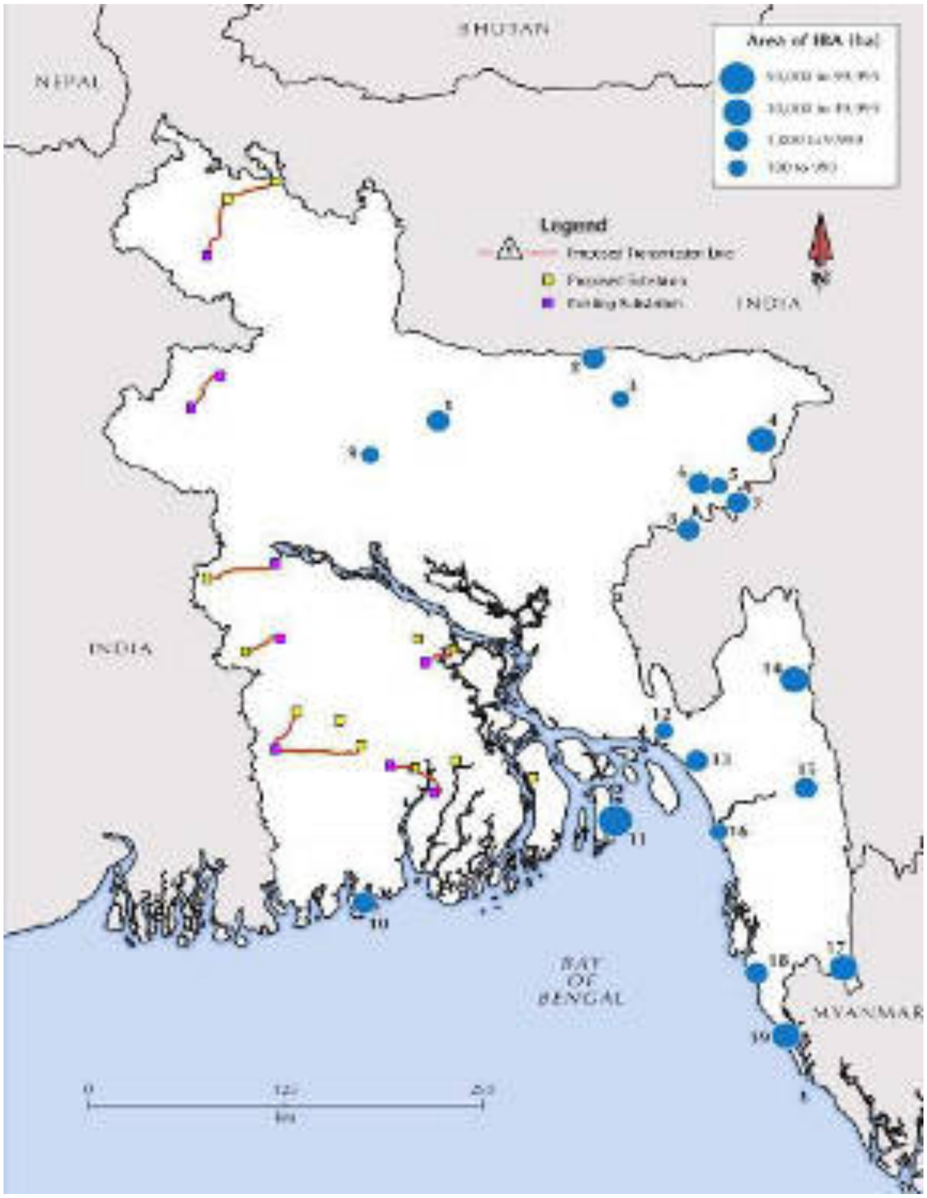


Source: *Bangladesh Forest Department, 1999*

4.3.2. *Important Bird Areas in Bangladesh*

193. Bangladesh's Important Bird Areas (IBAs) cover less than 4% of the total land area of the country, reflecting the great reduction and fragmentation of natural habitats. However, additional sites are likely to be added to this preliminary list of IBAs in the future. Of the 20 IBAs in Bangladesh, 11 support globally threatened species, 10 have biome-restricted species and nine qualify as IBAs because they hold large congregations of water birds. Ten IBAs (53%) contain examples of terrestrial forest ecosystems, which together cover all significant areas of forest known to remain in Bangladesh. They include the Indo- Malayan tropical dry forests in Madhupur National Park (IBA 1) to the north of Dhaka, three IBAs in north-eastern Bangladesh where Indochinese tropical moist forest is the dominant biome, and six IBAs in the Chattogram hill tracts in the south-east of the country, where Indochinese tropical moist forest and Sino-Himalayan subtropical forest are the main habitats. As shown on Figure 4-23, none of the PAI will be located in the IBAs.

Figure 4-24: Subproject locations and Important Bird Areas (IBA) in Bangladesh.



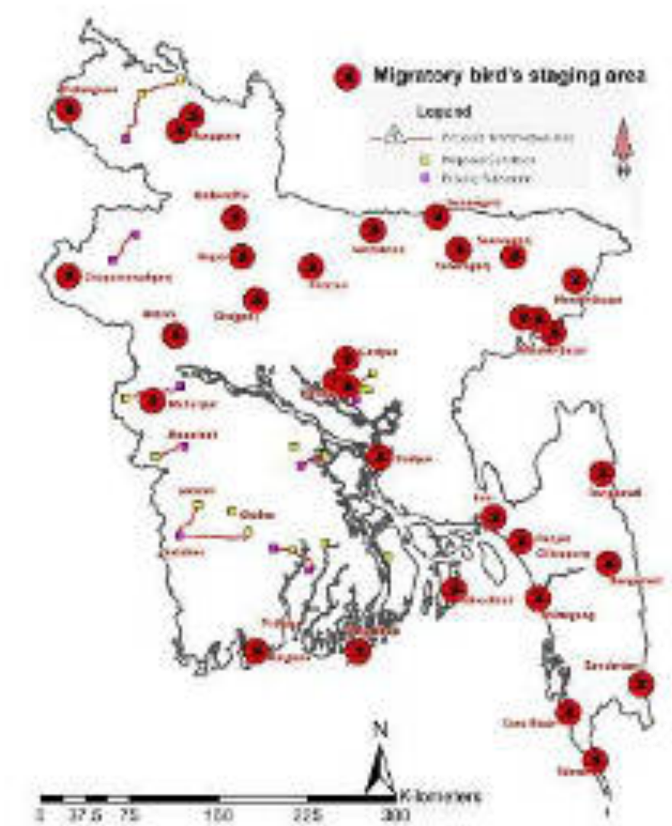
Source: [http://www.cms.int/sites/default/ files/document/inf_04_8_bangladesh_0.pdf](http://www.cms.int/sites/default/files/document/inf_04_8_bangladesh_0.pdf)

194. Five IBAs contain freshwater ecosystems and some also have remnants of natural grassland. Tanguar Haor (IBA 2) and Hakaluki Haor (IBA 4) in north-east Bangladesh are outstanding because of their breeding population of Pallas's Fish-eagle, and for their large wintering concentrations of water birds, including Baer's Pochard. Coastal ecosystems are represented at five IBAs. The intertidal mud and sand flats of the Ganges-Brahmaputra-Meghna delta (IBA 11) IBA support the largest known concentrations of Spotted Greenshank, Spoon-billed Sandpiper and Indian Skimmer in the world. The Sundarbans (IBA 10) is globally outstanding for its vast mangrove forests and associated intertidal wetlands. (Source: BirdLife International (2004). Important Birds Areas in Asia: key sites for conservation. Cambridge, UK: BirdLife International. (BirdLife Conservation Series No. 13, http://datazone.birdlife.org).

195. Birds migration routes are yet to be identified in Bangladesh (http://www.cms.int/sites/default/ files/document/inf_04_8_bangladesh_0.pdf.). However, however, basic data of key breeding areas (KBAs) are available that can be used in delineating the same. KBAs of these waterbirds are the haor areas, Sundarban and the offshore islands. The proposed transmission lines are not located close to the KBAs as shown on Figure 4-25 (the shortest distance is 12km to one breeding area in Dhaka). Therefore, regular migratory bird movements are not expected in the PAI. Bird deflectors are only likely to be needed in areas with high bird movement, e.g. along ridge lines and across wetlands. However, further studies will take place prior to the construction. On the other hand, transmission towers and conductors may be supportive to local birds as resting, roosting and look-out locations, so they will be positively impacted. All vegetation layers (emergent, canopy and under-story) allow for bird habitat and nesting, and therefore the removal of vegetation may impact negatively on these activities.

196. ***Collision of Birds with Overhead Wires.*** Collision of birds with overhead wires has been identified as one of the most significant impacts of transmission lines on avifauna. However, the preferred routes pass through areas that are not particularly important for birds, which reduces the chance of collisions. On the other hand, wires and towers provide roosting areas for birds, and some, such as kingfishers, and they will benefit from these perches such as being able to hunt fish from them.

Figure 4-25: Project Footprints and Migratory bird's staging area



Source: Ecological Determinants of Highly Pathogenic Avian Influenza (H5N1) Outbreaks in Bangladesh Syed S. U. Ahmed ,Annette K. Ersbøll,Paritosh K. Biswas,Jens P. Christensen,Abu S. M. A. Hannan, Nils ToftPublished: March 21, 2012https://doi.org/10.1371/journal.pone.0033938

4.4 Physical Cultural Resources

197. As per ADB's SPS 2009 "Physical Cultural Resources (PCRs)" are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. PCRs may be located in urban or rural settings and may be above or below ground or under water. Their cultural interest may be at the local, provincial, national, or international level.

198. Field surveys and secondary information on archaeological/cultural sites did not reveal any PCRs along the transmission line RoWs or lands proposed for the substations. Encountering PCRs in construction related excavations is a distinct possibility. Thus, it is important that any chance findings during excavations for project activities be protected.

199. Bangladesh has two significant religious sites as well as a biodiverse area that has been listed by UNESCO as World Heritage Sites. The Ruins of the Buddhist Vihara at Paharpur and the Historic Mosque City of Bagerhat have been listed as cultural World Heritage Sites in Bangladesh. The Sundarbans is designated as a natural World Heritage Site in the country in 1987. It is a mangrove area, approximately 140,000 ha, in the delta formed by the confluence of Ganges, Brahmaputra and Meghna rivers in the Bay of Bengal. It spans from the Hooghly river in India's state of West Bengal to the Baleswar river in Bangladesh. The number of archaeological heritage sites in the country stands at 475. None of these sites are in PAI.

4.5 Socio-Economic Environment

200. A socioeconomic household survey was conducted with a sample of 766 households living in different subproject impact areas during the period September to October 2018. The sample included 486 households who lived in the corridors of transmission lines and affected by the impacts of transmission lines on their land, structures and common property resources; 255 households who were affected by the acquisition of their land for substations; and 25 landowners affected by the acquisition of land for bay extensions (Satkhira substation).

4.5.1 Demographic Characteristics

201. The total population of the 766 households accounted for 3,234. The average household size is 4.2. The female population exceeds their counterpart males with 53.1% and 46.9% respectively. The children below the age of 6 years are 10.4% of the population. Both children and adolescents in the age group of 6 to 15 years constitute 17.6%. The young adults between 15-30 years comprise one-third (31%) of the population. The population that falls into the age group of 30-60 years is 35%. The rest 6% represents the population over and above 60 years of age. The married population is 55% against an unmarried population of 41%. Persons who are widows and divorced from their spouses are 4%. The composition of the households includes 690 nuclear families (90%) while the extended families account for 76 (10%). The households that have a male head are715 (93%) and the households headed by women are 51 (7%). In terms of ethnicity, the majority, 710 (93%) are Muslims while the rest 54 (7%) are Hindus, representing the same proportions of Islamic and Hindus in their religious faiths.

4.5.2 Education

202. The analysis of the educational achievements of the population above 5 years of age, points to that except for 4.59% who had never been to a school, rest had accessed formal education at varying levels. Around 37% has education less than 5 years of schooling or religious

education in a Madrasha. Another one-third (35%) has pursued education for 6-10 years. The population that attained senior school certificate (SSC) and higher school certificate (HSC) or equivalent is 12% and 7% respectively. The graduates and those with postgraduate qualifications constitute 5%. The student population comprises 28% of the population (Table 4-25).

Table 4-25: Educational achievements of the population

No	Level of education	Gender				Total	
		Male	%	Female	%	No.	%
1	Up to class five/ Ebtedaye Madrasha (religious education)	521	32.87	570	40.66	1,091	36.52
2	Class six to ten	537	33.88	512	36.52	1,049	35.12
3	SSC or equivalent	211	13.31	137	9.77	348	11.65
4	HSC or equivalent	138	8.71	75	5.35	213	7.13
5	BA or equivalent	81	5.11	22	1.57	103	3.45
6	MA or equivalent	41	2.59	5	0.36	46	1.54
7	Never attended a school	56	3.53	81	5.78	137	4.59
	Total	**1,585**	**100**	**1,402**	**100**	**2,987**	**100**

Source: Socioeconomic survey of affected persons, September-October 2018

203. Children receive their education from multiple educational institutions such as kindergartens, primary schools, middle schools, high schools and colleges, English medium schools, vocational training institutions, polytechnic institutions, medical colleges and universities. There are some good universities in the project influenced areas such as Islami University, Kushtia; Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Gopalganj; Jashore University of Science and Technology, Jashore; Hajee Mohammad Danesh Science and Technology University, Dinajpur; Khulna University of Engineering Technology, Khulna; Khulna Agricultural University, Khulna; and Barishal University, Barishal. Families would encourage their children irrespective of gender to pursue education and almost all the children are admitted to a school at the age of 5 years. Many families are unable to sustain their aspirations to educate the children primarily because of the household poverty. The number of children who drop out of school at primary level is rather negligible compared to the drop-out rates at secondary level. The boys would drop-out primarily to find employment preferably as an immigrant worker either in a major city like Dhaka or else in a foreign country. Or else they would engage in agricultural work or in daily paid labour work which are locally available. The factors that trigger girls to drop-out of school includes household poverty (equally applies to boys as well), long distances to schools and early/child marriages arranged by the families. Girls are keener to pursue education compared to boys.

4.5.3 Housing Infrastructure

204. The majority of the households live in tin shed and katcha (temporary structure made of mud, bamboo, and iron sheets) houses. The occupants of such tin shed and katcha houses account for 44% and 11% respectively. Another one-third of the households (29%) live in semi-pucca (semi-permanent structure where some walls/flooring is cemented) houses. The households that live in pucca (permanent structure, with brick walls/ roofs of concrete) houses comprise 15%.

205. The majority, 99% of the households claimed singular ownership to the house they live in which belonged to the head of the household. Households that live in a house belonging to their parents or children are only 1%.

4.5.4 Household Amenities

206. Households are not dependent on a single source of water for their domestic purposes and collect water from multiple sources. A private tube well is the main source of water for 85% of the households. Another, 25% of the households collected their water from a well or public tube well installed by the government. Water from rivers and streams has been accessed by another 25%. Pipe borne water from a government water scheme or from a neighbour's well is used by another 8%. Electricity is available for 89% of the households. The rest 11% are not connected to electricity. Of them, 6% use solar power and 5% use kerosene for household lighting. Individual toilets are available for 96% of the households. Of them, 78% have water seal toilets followed by another 14% who use flush toilets with commodes. Pit toilets are used by 3%. The households that share a toilet with another household or use a public toilet account for 5%. Mobile telephones are available for 62.3% of the households whereas 0.45% has fixed land telephones.

4.5.5 Household Assets

207. The movable assets available in a household are limited only to a few items. Almost one-fourth of the households (24.23%) have a push bicycle. Motor bicycles are available in 7.32% of the households. Water motors that are used for pumping water from deep and shallow tube wells are available in 2.62% of the households respectively. The rest of household assets include rickshaws (1.72%), cars (1.45%), and CNG/auto rickshaws (0.18%). The electrical appliances used in households include televisions in 27%; electric fans in 38.36%; refrigerators in 12.16%; rice cookers in 1.71%; and electric irons in 0.68% of the households. Air conditioners, washing machines, computers and electricity operated water pumps are available only in 1.08% of the households. However, a significant number of households (18.38%) have other electricity operated kitchen appliances.

4.5.6 Land Ownership

208. Of the 766 households, 460 reside either within the clearing width of the RoW or in the remaining portion of the land earmarked for acquisition for substations. Households have a combination of user rights to the land on which they either live or cultivate. The land occupied by 95.7% of the households or cultivated is claimed as private property. Analysis of the extents of land owned by the 460 households pointed to the following: 13% own less than 0.1 acres; 10% between 0.11-0.2 acres; 11.3% between 0.21-0.3 acres; 18.3% between 0.31-0.5 acres; 23% between 0.51-1.0 acre; and 25% with more than 1 acre. The majority of the households (89%) claimed singular ownership to the land they live/cultivate which belonged to the head of the household. Co-owners of the land comprise another 9%. The rest 2% are leaseholders of government or private land, sharecroppers and encroachers.

209. The rest 306 households reside either within the broader RoW or the immediate vicinity of the clearing width or in the adjacent village. Among the 306 households, 80% claimed owning paddy land, with each individual household having more than 0.8 acres of land. The extents of land owned by the rest 20% are less than 0.5 acres. Despite having their own land, a significant proportion of the population exceeding 1,000 persons are engaged in sharecropping. Households interviewed for the survey believed that the project would contribute to improving their livelihoods by providing an uninterrupted supply of electricity to their villages so that they would be able to irrigate their crop cultivations to provide a stable supply of water. Some households are contented

with the project as they expected a rise in land values with improvements in electricity supplies. Land use in the project impact areas is largely the agricultural fields covering 78% to 81% of the total area whereas the homesteads are confined to around 11%. The average homestead size is 0.2 acres which figure is nearer to the national average. The other important land uses are the orchards, bamboo plantations and livestock farming e.g. poultry and dairy farms.

4.5.7 Livelihoods

210. Households in the subproject impact areas are dependent on multiple sources of livelihoods. Households have more than a singular source of livelihood. They l include agriculture, marine fishing, labour work, employment in government and private sector, business activities and foreign employment. The economically active population in the 766 households is reported as 1,066, of whom women constitute only 3%. Of the female labour force, women are significantly represented among the professionals (41.7%) working in government and private sector followed by 19.4% of manual workers and 16.7% equally in agriculture and skilled/semi-skilled sectors. Women who are engaged in business activities are around 6%.

211. Agricultural activities are the main source of livelihood for 32.9% of the labour force followed by 22.9% in small and medium scale business activities. Professionals working in the government and private sector jobs represent 16.2%. Various forms of labour-based work provide a source of livelihood for 12.4%. Skilled and semi-skilled workers such as drivers, carpenters, masons etc. constitute 8.5%. Those engaged in fishery related activities are insignificant and limited to only 0.3% of the labour force. People who are employed in foreign countries represent 6.7% of the active labour force.

4.5.8 Household Income and Expenditure

212. The average monthly incomes of 10.57% households are less than Tk8,000. Another 10.18% have monthly incomes ranging from Tk8,000 to Tk10,000. Households receiving monthly incomes between Tk10,001 toTk20,000 are 49.09%. Monthly incomes of the rest one-third (30.16%) are within Tk30,001 to Tk165,000 (Table 4-26). The average monthly income of a household is estimated at Tk20,975. As per the official poverty line of Bangladesh, households earning an annual income of less than Tk96,000 are considered those living below the poverty line. Accordingly, 81 households (11%) out of 766 will be considered as poor households.

Table 4-26: Monthly Household Income

Monthly Household Income (Tk)	Frequency	Percentage (%)
< 8,000	81	10.57
8,000–10,000	78	10.18
10,001–20,000	376	49.09
20,001–30 ,000	143	18.67
30,001–40,000	41	5.35
>40,000	47	6.14
Total	**766**	**100.00**

Source: Socioeconomic survey of affected persons, September-October 2018

213. More than half the households (53%) spend Tk5,000 to Tk10,000 of their monthly incomes for food consumption followed by another 25% spending less than Tk5,000. The monthly expenditure of 99% of the households on electricity, water, gas, telephone and transport is less than Tk5,000. Household monthly expenditure on children’s education, family healthcare, clothing

and entertainment for 88% is less than Tk 5,000 whereas another 11% spend Tk5,000 to 10,000 a month (Table 4-27). The average monthly expenditure of a household is estimated at Tk13,043.

Table 4-27: Monthly Household Expenditure

Expenditure	Tk<5,000	Tk 5,000 – 10,000	Tk 10,000 – 15,000	Tk 15,000 – 20,000	Tk 20,000 - 25,000	Tk>25,000
Food consumption	190	406	123	34	6	7
%	24.8	53.0	16.1	4.4	0.8	0.9
Electricity, water, gas, telephone & transport	758	6	1	1	-	-
%	99.0	0.8	0.1	0.1	-	-
Children's education, healthcare, clothing & entertainment	673	85	7	-	1	-
%	87.9	11.1	0.9	-	0.1	-

Source: Socioeconomic survey of affected persons, September-October 2018

4.5.9 Government Assistance and Foreign Remittance for Households

214. Government's special assistance is received by 88 households (11.5%). Government assistance is delivered in various forms such as food for work (for those providing 40 days of manual labour work per year), old age allowance amounting to Tk500 per month, freedom fighters' allowance of Tk10,000 a month etc. In addition, vulnerable households are able to buy their rice at Tk10/- per kilogram. However, single household will not be eligible to receive more than one government's assistance. Another 63 households (8.2%) reported that they receive foreign remittance from family members working outside Bangladesh. Foreign remittance received by 35% of the households is in the range of Tk10,000 to 15,000 a month (approx. $122-183) whereas another 24% received monthly remittance of Tk5,000 to 10,000 (approx. $61-122). Another 28% received remittance exceeding Tk15,000 a month. Households that received less than Tk5,000 foreign remittance account for 13%.

4.5.10 Indebtedness

215. Loans have been obtained by 229 or 30% of households during the past 12 months. The source of loans for the majority of households (67.25%) was an NGO or a CBO followed by 17.5% from family members or neighbors, and 11.4% from a moneylender or a bank. The widespread operations of micro-credit institutions in Bangladesh such as BRAC, Grameen Bank etc. may be one of the reasons for rural communities to access loans from NGOs and CBOs. The annual interest rates charged on the loans varied from 10% to 25% with an average of 17%. The loans have been accessed by 36.2% to invest in agricultural activities; 33.6% for family emergencies; 10% each for the educational purposes of their children and house building; 6% for investments in businesses; and 5% for a variety of purposes such as for repaying past debts, land purchases, and getting gas connections. The loans taken by 74% of the households had been repaid while another 26% has been able to repay the loans partially.

4.5.11 Unemployment

216. The number of persons in the sample reported as unemployed is relatively small and represented only 1.5% of the household population. Of them, 36% are females. Low rates of unemployment may be due to engagement of many household members in a variety of seasonal and casual employment such as in daily paid labour work. Employment opportunities in the project impact areas are rather negligible as there are no industrial or commercial ventures that can absorb the unemployed. Due to a lack of employment opportunities in the surrounding areas,

most of the unemployed people find work in seasonal agricultural activities or in daily paid casual labour work as a source of livelihood to support their families. Some unemployed persons will operate as tenant farmers, cultivating the land belonging to another party and sharing part of the produce with the landowner. Some others engage in small businesses, rickshaw pulling, driving vans or auto rickshaws or jobs in the service sector. Women are mostly housewives. But some women are engaged in household labour and in agriculture, livestock farming, tailoring and manufacture of handicrafts to earn supplementary incomes for their families. A fair number of children also work in various factories to find extra incomes for their families despite child labour being illegal. In some communities, women would also engage in casual daily paid labour work whereas in other communities they would not go for such labour work. Many rural women are deprived of working outside due to customary and social beliefs and taboos. Many youths aspire to find employment in a foreign country.

4.5.12 Health and Services

217. No major chronic illnesses are reported from the subproject impact areas. However, incidence of water borne diseases and skin ailments were frequently reported during consultations. People approach multiple institutions for medical care and treatment. Government hospitals or university hospitals are accessed by 51% for their medical and health needs followed by 42% reaching the private hospitals or private physicians. Medication from pharmacies is sought by 7%. Despite the presence of several health and medical service institutions, access to them from rural areas is rather remote. Distance from the households to such institutions varied from 2 km to 7 km across the project impact areas. Medical services at private clinics are expensive and unaffordable to many families. Government hospitals in local areas lack sufficient medicine, diagnostic facilities and staff. Patients have to wait in long queues. For serious illnesses, people have to go to Dhaka for treatment. People sometimes travel more than 100 km to get their medical tests done.

4.5.13 Energy Use

218. Electricity is the main source of lighting for 89%grid connected households. The non-connected households (11%) use kerosene (5%) and the solar power (6%). Households use multiple and combined energy sources for domestic purposes. Firewood is the main source of energy used by a majority of the households (51.8 %) for cooking and boiling purposes followed by 1.84% using LP gas, particularly by people living closer to urban areas. Electricity is also used by 41.6% in combination with firewood and kerosene. Kerosene is used by 29.2% which is very harmful for the health and environment.

219. The electrified households, apart from household lighting, use electricity for a variety of other purposes. Electricity is used by 38.36% for operating fans, 27% for operating televisions, 12.16% for refrigerators, and 1.71% for rice cookers as they cook rice using rice cookers, 0.68% for electric irons and 18.38% for operating a variety of other kitchen appliances. Electricity use by households for operating air conditioners, computers and water pumps is only 0.4%. Moreover, 62.3% households own mobile phones, and all of them use electricity for charging.

220. Solar power and dry batteries are also used by 20% households for operating various electrical appliances. The majority of the solar users also use solar power for lighting.

221. Households in the project impact areas experience frequent load shedding which deprives them regular supply of electricity throughout the day. Daily power-cuts are extensive and continue for several hours both day time and night. Load shedding adversely affect the farmers in irrigating

their cultivation fields and providing a regular supply of water, children's studies at night time, and women in watching television programs during their leisure time. Households are unable to have good sleep at night after day's hard work as they cannot operate fans particularly during warm seasons. Despite irregular and limited power supply, households lament over having to pay high electricity bills.

4.5.14 Role of Women and Gender Issues

222. Women in the project impact areas are engaged in multiple activities. Apart from their household roles such as household cooking, cleaning, fetching water, feeding children, helping in children's studies and looking after the in-laws (particularly those living in extended families), women across the project areas also make a significant contribution to the household economy. Despite strong pressures from the families to dissuade women finding employment, they take a lead role in livestock farming and take care of the feeding of their cattle, goats and poultry. Home gardening is another important economic activity of women, produce of which is used for both household consumption and marketing. Other forms of economic activities conducted by women include agricultural labour work, dressmaking, handicraft-making, employment in apparel industries etc. Educated women are employed in both government and private sector jobs. Women's earnings are mainly used for children's education and clothing, to supplement the households' consumption needs, and to repay the past debts. Some women would also save some money to be used in emergencies or for their children's future. In some communities, however, it has been reported that women have to hand over their earnings to husbands or else get prior consent of the husband to spend their earnings. Women also participate in the activities of NGOs like BRAC and Grameen Bank to access micro-credit which they would use to buy cattle, goats and poultry.

223. Women who engage in daily paid labour work are paid less compared to their counterpart men. For example, when a man is paid Tk300 a day, a woman would get only Tk150 or Tk200 though there is not much difference in the work load that both groups carry out and the duration of work. Excess of labour available and social attitudes towards women are also reported as factors that influence to pay lower salaries for women. Women working outside the home suffer from lack of access to private and suitable sanitary services.

224. Household level decision-making is largely vested with the husband. A few instances of joint decision making by both men and women were reported. Women also perform a significant role in managing household assets despite the key immovable assets like land and house are owned by men. Physical assets such as land and jewellery received by women as part of their dowry remain in her possession but in some occasions, they are transferred to the ownership of men as part of matrimonial agreements. Women are discouraged from participating in social and political activities mostly by their male counterparts. However, many women struggle to change this situation.

225. During consultations, women expressed concerns over the loss of their fruit-bearing trees, livestock farming activities, household incomes and their social networks as a result of their potential displacements from the project impact areas. The project will address these concerns of women by minimizing physical displacements and helping them to continue to live in the remaining portion of their land or in the immediate vicinity while engaging in their routine activities. The project will also pay compensation for all their economic losses and will encourage their participation in livelihood restoration activities such as in tree planting programs. Female headed vulnerable households will receive additional cash allowances to re-establish their livelihoods. Consultations with women will continue throughout the project lifecycle.

226. A key gender challenge in the context of Bangladesh and project area is that while there is a high demand for technical people in the energy sector, the number of women in these jobs is limited, and the sector has been traditionally male dominated. Education in science and technology is generally not promoted for women and girls, and the environment for technical work is not conducive to women. In project areas, women participate in the workforce generally in areas that are deemed an extension of their gender roles. This results in less interest of families in sending girls to technical schools, and in limited opportunities for further training for those women already in the sector.

227. On the other hand, vulnerability of women in their economic and social lives is manifested in different forms such as household food insecurity, restricted social and economic mobility, limited amounts of freedom due to strict religious and moral codes and harmful practices such as child marriage and dowry.

228. Lack of access to reliable, affordable and clean energy sources can adversely affect the women. Extensive use of biomass for cooking can cause health complications among women. Their mobility in public places during night time would be restricted due to safety issues. They will be deprived of engaging in productive activities such as home-based enterprises and contributing to household economy. Their access to information via electronic means of communication such as radio and television can be curtailed.

4.5.15 Awareness on HIV

229. Not all men and women in the communities across the subproject areas are equally aware of the root causes of HIV, how the disease is communicated and the preventive measures that people should adopt to avoid the spread of HIV. In a few communities, awareness has been raised through educational programs conducted by NGOs over a period of almost two decades. However, not all the villagers have participated in those programs. People who claimed to have some knowledge on HIV acquired such awareness through media such as television, newspapers and the brochures and leaflets distributed by NGOs. It is the estimation of the villagers that around 50% to 70% of the villagers in their respective communities are not knowledgeable of the disease.

230. At consultations, people expressed concerns over the influx of migrant labourers for project's construction work and their possible engagement in illicit sexual relationships with women and children. They thought that such instances can cause the spread of sexually transmitted diseases. Addressing this concern, both PGCB and the contractors will ensure that awareness raising programs on sexually transmitted diseases are conducted for all local and migrant labourers as well as local communities prior to the commencement of civil works. Furthermore, it will be also a mandatory requirement on the part of contractors to enforce a strict code of conduct for their labour teams.

4.5.16 Indigenous Peoples

231. There are no indigenous peoples settlements in the impact area of the project DWZTGEP. Therefore, no permanent or temporary and direct or indirect impacts on indigenous peoples communities are anticipated. The project has taken necessary steps to avoid the indigenous peoples communities and their properties and other social and cultural activities from the areas identified for project implementation.

5. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1 Introduction

232. Based on the environmental baseline data and environmental screening, impact assessment for the selected subprojects (substations, overhead and underground transmission lines and LILO lines) was carried out. Potential impacts have been assessed by means of field surveys, consultations with local authorities and other stakeholders, use of secondary sources of information such as similar projects elsewhere. This section summarizes the potential environmental impacts and required mitigation, which is incorporated into the Environmental Management Plan.

233. Typical transmission line and substation impacts have been characterized as, construction site waste generation; Soil erosion and sediment control from materials sourcing areas, access roads, and site preparation activities; Fugitive dust and other emissions (e.g. from vehicle traffic, land clearing activities, and materials stockpiles); Noise from heavy equipment and truck traffic; Potential for hazardous materials and oil spills associated with heavy equipment operation and fuelling activities. Potential presence of polychlorinated biphenyl (PCB) and other pollutants in old transformers; Terrestrial, avian and aquatic habitat alteration, Health and Safety issues, including electric and magnetic fields (EMF).

5.2 Analysis of the Impacts

5.2.1 Impact Assessment Methodology

234. Potential environmental and social impacts were identified based on field surveys, interviews with affected persons, stakeholder engagement, relevant and available secondary data, review of relevant project documents such as the DPP, survey reports, etc. The significance of potential impacts was assessed using the criteria and methodology described below.

5.2.2 Impact Magnitude

235. The potential impacts have been categorized as major, moderate, minor or minimal, based on consideration of parameters such as: (i) duration of the impact; (ii) spatial extent of the impact; (iii) reversibility; (iv) likelihood; and (v) legal standards and established professional criteria. The magnitude of potential impacts has been identified according to the categories outlined in Table 5-1.

Table 5-1: Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Minimal
Duration	Long-term (more than 15 years)	Medium-term Lifespan of the project (5 to 15 years)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries, with no detectable potential impact
Reversibility	Potential impact is effectively	Potential impact requires a year or so	Baseline returns	Baseline remains almost constant

Parameter	Major	Moderate	Minor	Minimal
	permanent, requiring considerable intervention to return to baseline	for recovering with some interventions to return to baseline	naturally or with limited intervention within a few months	
Legal standards and established professional criteria	Breaches national standards and/or international guidelines/ obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of occurrence	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (Occasional)	Unlikely occur

5.2.2.1 *Sensitivity of Receptor*

236. The sensitivity of an environmental receptor (a parameter that may be affected by the project) has been determined based on review of the local population (including proximity/numbers/vulnerability) and presence of features at the project sites or the surrounding area. Criteria for determining receptor sensitivity are given in Table 5-2.

Table 5-2: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very High	Vulnerable receptor with no capacity to absorb proposed changes or minimal opportunities for mitigation.
High	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Medium	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low	Vulnerable receptor with good capacity to absorb proposed changes and/or good opportunities for mitigation

5.2.2.2 *Assigning Significance*

237. Following the assessment of magnitude provided by DoE guidance, and the quality and sensitivity of the receiving environment or potential receptor has been determined, the significance of each potential impact is established using the impact significance matrix shown in Table 5-3.

Table 5-3: Significance of Impact Criteria

Magnitude of Impact	Sensitivity of Receptors			
	Very High	High	Medium	Low
Major	Critical	Major	Moderate	Minor
Moderate	Major	Major	Moderate	Minor
Minor	Moderate	Moderate	Minor	Minimal

Magnitude of Impact	Sensitivity of Receptors			
	Very High	High	Medium	Low
Minimal	Minimal	Minimal	Minimal	Minimal

5.2.3 Impact Matrix

238. Potential environmental impacts on the Important Environmental and Social Components (IESCs) during the pre-construction, construction, and operation phases of the project are presented in a matrix form in Tables 5.4. Environmental components likely to be impacted by the project are referred to as important environmental components (IECs) and important social components (ISCs). The IECs and ISCs likely to be impacted by the pre-construction, construction, and operation are noted below.

5.2.3.1 *Important Environmental Components*

239. Important Environmental Components (IECs) for the physical and water resources and their rationale are described in Table 5.4.

5.2.4 Selection of IECs and their Rationale

Table 5-4: IECs-Physical Environment

IEC	Rationale for selection
Ambient air quality	• Construction of the project will generate a minor amount of air pollutants, such as particulate matter (PM), hydrocarbons, nitrous oxides (NOx), carbon monoxide (CO), and sulphur dioxide (SO_2) from the operation of trucks, heavy equipment and from activities such as excavation of foundation for the bases of the transmission line towers. These may impact air ambient quality.
Ambient noise quality	• Noise pollution during the construction phase may come from the operation of construction equipment, vehicular movements, construction works and other noise-generating activities at labourer settlements. Elevated noise levels may cause some inconvenience and annoyance in adjacent communities. • Corona during operation.

Surface and Groundwater Water Quality	• During construction, the construction wastes, leaks or spills of fuel, oil, chemicals may pollute the water of the adjacent tube well, canals and river. As a result, water quality (like pH, temperature, salinity, turbidity, etc.) may be changed. • During operation, groundwater may be a source of domestic water supply, which may be contaminated with wastes coming from the drainage of the substation areas. The wastes may include used mineral oil disposed from the electrical equipment (such as transformers).
Soil	• Construction of towers will involve excavation of soil, which may affect soil quality. The valuable topsoil and subsoil may be disturbed and likely to be displaced due to the construction of the substation. However, to mitigate, it is likely that all soil within the project footprint will be required to elevate the site prior to construction of substation facilities. • Where the transmission lines will cross rivers, construction activity and the foundations themselves could alter river banks and lead to scouring and erosion, unless protection works are undertaken. • Construction wastes at the project site may create hazards to the surroundings. Such activity may impact the environmental quality in and around the project area. • During operation of the substations, used insulating mineral oil from electrical equipment (such as transformers), if not disposed properly, may cause land contamination. The mineral oil to be used should be free from PCBs. There can also be soil/land contamination due to improper solid waste disposal from the construction and operation phases of the transmission lines.

PCB = polychlorinated biphenyl

Table 5-5: IECs-Land and Agriculture Resources

IEC	Rationale for selection
Land type change	• There will be permanent land loss due to construction of substations and base of the transmission towers.
Change in surface topography or terrain	• During construction and operation, there may be continuous soil erosion in unavoidable slope areas near the transmission towers that may cause permanent changes in landform, topography, and slope.
Loss of crop production	• During construction, standing crops in the area might be affected with a possibility of change in crop production (due to dust; use of heavy equipment and movement of vehicles).
Intercropping	• Intercropping may be affected due to the installation of towers.
Impairment of visual aesthetics	• Aesthetics and urban landscape may be affected by the presence of the transmission towers.

Table 5-6: IECs-Fisheries Resources

IEC	Rationale for selection
Fish habitat area	• The project site contains fish habitats such as waterbody. Raising the land for the substations will alter this.
Fish disease and mortality	• Potential discharge from substations may contaminate the waterbody and affect the culture of fish species.

IEC	Rationale for selection
Fish production	• Fish production is around Tk 10,000/acre/year. Alteration to land use will change the fish production potential.

Table 5-7: IECs-Ecological Resources

IEC	Rationale for selection
Terrestrial vegetation	• Terrestrial vegetation provides food and shelter to local birds and various animals. Construction activities will require clearing of terrestrial vegetation and the operation phase will require vegetation management along the RoW and restriction of vegetation height below the transmission lines.
Wildlife habitat and their disturbance	• Movement of local wildlife may be disturbed due to construction activities and vegetation management along the RoW during the operation phase. • Bird collision risk.

Table 5-8: ISCs-Socio-economic Aspects

ISC	Rationale for selection
PCRs	• Encountering physical and cultural resources in construction related excavations is a distinct possibility. Thus, it is important that any chance findings during excavations for project activities be protected.
Land Acquisition	• Fifteen new substations and 408 km transmission lines would be constructed under the DWZTGEP project. Due to the implementation of the project it would be required to acquire land. People affected by the project urged the authority for adequate compensation whenever they lose their crops for the construction activities. • Land affected by the tower footings may be devalued. Land development between transmission towers and below the transmission lines will be restricted, possibly affecting land value.
Land price	• The value of land would be affected because of the establishment of towers. On the other hand, buildings cannot be raised which are situated between two towers. The construction of towers will affect land price and hence it has been taken as an ISC.
Employment opportunities	• Employment opportunities for poor people in the vicinity of the proposed project area and outside the proposed project area will be created during the construction and operation phases. Furthermore, extension of industrialization will provide extra employment opportunities for the local people.
Human health and safety	• The safety and health of the public may be impacted due to the hazards created during the construction and operation period. It is anticipated that the risk of accidents during the construction period is moderate due to the operation and movement of heavy equipment, vehicles and machineries. Working at heights and other construction activities may pose occupational and safety risks. Exposure of workers who maintain the transmission lines may also pose health risks.

ISC	Rationale for selection
PCRs	• Encountering physical and cultural resources in construction related excavations is a distinct possibility. Thus, it is important that any chance findings during excavations for project activities be protected.
Regional and national development	• Economic development largely depends on the availability of a reliable power supply. Uninterrupted power supply is expected to improve productivity and development.

5.2.5 Impact Matrix

240. Potential environmental impacts on the IECs during the pre-construction, construction, and operation phases of the project are presented in a matrix form in Table 5-9.

Table 5-10: Impact Matrix

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation
Pre-construction Stage				
Physical-Chemical Environment				
Ambient air quality	Vehicular emissions; dust from excavation works, land clearing, and material stockyards may affect ambient air quality.	Medium	Minor	Minor Adverse
Ambient noise	Noise level may increase due to mobilization of vehicles and unloading of materials.	Medium	Minor	Minor Adverse
Quality of surface and groundwater	The quality of surface water of the water bodies close to the project construction sites may deteriorate if erosion products and silt reach water bodies, especially during rains	Medium	Moderate	Moderate Adverse
Soil	During the pre-construction period, site clearance work will be done accordingly. Site clearance will impact the fertile top soils that are enriched with nutrients	Low	Minor	Minimal Adverse
Land and Agricultural Resources				
Land use	Would be partially impacted in RoW	Low	Minor	Minimal Adverse
Crop production	Would be highly impacted, at tower foundation areas and substation lands	Medium	Moderate	Moderate Adverse
Fisheries Resources				
Fish habitat	Fish habitat quantity and quality will be changed.	Medium	Moderate	Moderate Adverse
Fish production	Production reduced due to waterbody loss	Low	Minor	Minimal Adverse
Socioeconomic Resources				
Land price	Reduced near RoW and substation lands, increase away from	Low	Minor	Minimal Adverse

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation
	transmission lines and substations due to availability of electricity			
Employment opportunities	Temporary or minimal opportunities at this stage.	Medium	Moderate	Moderate Beneficial
Human health and safety	Ensure proper Health and safety for workers involved for site clearance. Road traffic safety with number of trucks for fill import.	Low	Minor	Minimal Adverse
Road/ river/ canal/ water body crossings	Minimal impacts	Low	Minor	Minimal adverse
PCRs	Proper chance find procedures will also be implemented in case of a chance find.	Low	Minor	Minimal Adverse
Construction Stage				
Physical-Chemical Environment				
Ambient air quality	Suspended particulate matter from excavation works and land clearing, including vehicular emissions, may affect workers and community.	Medium	Moderate	Moderate Adverse
Ambient noise	Mobilization of heavy equipment and machinery, use of construction vehicles, transport of materials, pile driving and construction activities may increase ambient noise level. Exposure to high level ambient noise may cause anxiety and disturbance to workers and community.	Medium	Moderate	Moderate Adverse
Quality of surface and groundwater	Potential for siltation due to construction works near pond or river.	Medium	Moderate	Moderate Adverse
Riverbank erosion	Potential erosion due to ground movements along the riverbank.	Medium	Major	Moderate Adverse
Soil	During construction, top soil at the tower footings may be eroded during excavation. Construction wastes like metal scraps and wooden packing material, and polythene may create a disturbance to the surrounding land, settlements, and the communities; Domestic wastes from labor camp.	Medium	Major	Moderate Adverse
Land and Agricultural Resources				
Land use	Would be partially impacted as agricultural land may be permanently lost due to the tower footings.	Medium	Moderate	Moderate Adverse
Crop production	May be moderately affected due to crop loss at the tower footings and in the clearing for RoW.	Medium	Moderate	Moderate Adverse
Intercropping	Maybe affected due to the erection of towers	Low	Minor	Minimal Adverse

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation
Change in topography/terrain	Excavation and erection works for the transmission towers may affect topography.	Low	Minor	Minimal Adverse
Impairment of visual aesthetics	Transmission towers partially visible on the skyline.	Low	Minor	Minimal Adverse
Fisheries Resources				
Fish habitat	Few lands selected for substations having water bodies, permanent loss of fish habitats in substation lands. Construction activities may temporarily affect nearby fish habitats.	Medium	Minor	Minor Adverse
Fish production	Lands earmarked for 2 substations contain 3-acre waterbodies. These waterbodies might be filled for the construction of substations. This will affect the fish production.	Medium	Moderate	Moderate Adverse
Terrestrial Resources (Flora and Fauna)				
Terrestrial vegetation	Vegetation clearing/ tree cutting is required at the tower footings and RoW.	Medium	Moderate	Medium Adverse
Wildlife habitat and their disturbance	Route will be mainly in urban or peri-urban areas. Habitat in the areas affected may not host wildlife.	Medium	Moderate	Medium Adverse
Socioeconomic Resources				
Compensation for crop damage	Standing crops at the tower footings and RoW may be damaged.	Medium	Moderate	Moderate Adverse
Land price	Value of land may be temporarily affected.	Medium	Moderate	Moderate Adverse
Temporary employment opportunity	Both technical and non-technical laborers will be required	Medium	Moderate	Moderate Beneficial
Human health and safety	The safety and health of the public may be impacted due to the hazards created during the construction period, e.g. movement of heavy equipment, vehicles, and machineries. Damages to structure within RoW. Workers may be exposed to occupational health risks and safety hazards, mostly working with electricity and working at height.	Medium	Minor	Minor Adverse
Road/ river/ canal/ water body crossings	Road use for construction activities as haulage of construction materials, spoil, and equipment, river bank and Soil erosion	Medium	Moderate	Moderate Adverse
PCRs	Proper chance find procedures will also be implemented in case of a chance find.	Low	Minor	Minimal Adverse

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation
Regional and national development	May create development opportunities in anticipation of stable power supply.	Medium	Moderate	Moderate Beneficial
Operation Stage				
Physical-Chemical Environment				
Ambient air quality	Climate change from fugitive emission (negligible) of SF_6	Low	Minor	Minimal Adverse[26]
Ambient noise	Noise in the form of buzzing or humming can often be heard around transformers or power lines producing corona. Outside of RoW will be negligible.	Low	Minor	Minimal Adverse
Quality of surface and groundwater	Transformer oil spill and leakage	Low	Minor	Minimal Adverse
Riverbank erosion	No or minimal impact	Low	Minor	Minimal Adverse
Soil/Land contamination	Potential for spill or improper disposal of mineral oil used as insulating oil in transformers. No use of PCB or PCB-containing material will be allowed.	Low	Minor	Minimal Adverse
Land and Agricultural Resources				
Land use	No impact (changes will have occurred in construction phase).	Low	Minor	Minimal Adverse
Crop production	Tower footings may have minor impact on crop production due to permanent loss of agricultural land.	Medium	Minor	Minor Adverse
Change in surface topography/ terrain	Transmission towers will have minimal impact on topography.	Low	Minor	Minimal Adverse
Impairment of visual aesthetics	Transmission towers visible on the skyline.	Low	Minor	Minimal Adverse
Fisheries Resources				
Fish habitat	No change expected	Low	Minor	Minimal Adverse
Fish production	No change expected	Low	Minor	Minimal Adverse
Terrestrial Resources (Flora and Fauna)				
Terrestrial vegetation	Restriction of vegetation height below the transmission line.	Low	Minimal	Minimal Adverse
Wildlife habitat and their disturbance	Natural forest, Protected areas or ecologically sensitive areas are not present in the proposed substation lands or along the transmission line routes	Low	Minimal	Minimal Adverse
Socioeconomic Resources				

[26] Due to high global warming potential, SF_6 may contribute to the man-made greenhouse-effect, if it is released into the atmosphere. However in electrical switchgear the SF_6 gas is always used in gas-tight compartments, greatly minimizing leakage. This make the real impact on greenhouse effect negligible. As per ECOFYS, Sina Wartmann, Dr. Jochen Harnisch, June 2005, “Reductions of SF6 Emissions from High and Medium Voltage Equipment in Europe” study, the contribution to the greenhouse effect in Europe is estimated to 0.05 %.

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation
Compensation	Ongoing permanent loss of land at the tower footings (but occurred at the construction stage).	Medium	Moderate	Moderate Adverse
Land price	No land value at the tower footings (compensation already paid); development restrictions below the transmission line and between towers may affect land value.	Medium	Moderate	Moderate Adverse
Employment opportunity	Jobs will be created directly due to the project and indirectly through businesses and development resulting from the availability of power supply.	Medium	Minor	Minor Beneficial
Human health and safety	Occupational and community safety risks (project maintenance)	Medium	Minor	Moderate Adverse
Road/ river/ canal/ water body crossings	No disturbances to vehicular traffic	Low	Minor	Minimal Adverse
Regional and national development	Availability of a stable and reliable power supply may improve productivity and national development.	Medium	Moderate	Moderate Beneficial

5.3 Impact Assessment and Mitigation Measures

241. Potential environmental impacts and Mitigations on different IEC and ISC during the pre-construction, construction, and operation phases of the project are discussed in detail as below.

5.3.1 Physical-Chemical Environment

5.3.1.1 *Air and Dust Pollution from Project Implementation*

242. **Pre-construction Stage.** Exhaust from vehicles usually operating for earthwork within the area may contribute to impairment of ambient air quality. Fugitive dust emissions from the material stockyards may also affect ambient air quality. Regular maintenance of vehicles may improve combustion efficiency of engines.

243. **Construction Stage.** Activities would involve excavation, movement of vehicles carrying the construction materials. Exhaust emissions are likely to be generated by the construction equipment during construction. Motor vehicles that will be used to carry construction materials would cause air quality impact by emitting pollutants through exhaust emissions. All these activities would give rise to emission of dust particles thereby affecting air quality marginally at the site. But the impacts will not be significant, i.e., sporadic and temporary.

244. **Operation Stage.** SF_6 is a non-toxic greenhouse gas used in substations as a dielectric in circuit breakers, switch gear, and other electrical equipment. Very high-grade sealing system and erection methodology is followed to keep the loss of SF_6 within 0.1% every year. SF_6 handling is part of each contract technical specifications and required design and routine test are done after manufacturing of the circuit breaker and gas insulated switchgear. SF_6 handling system for evacuation and storage is always used for the maintenance of the circuit breaker and gas insulated switchgear.

245. **Mitigation.** Water can be sprayed to unpaved roads and stockyards can be covered to contain dust or generation of suspended particulates. Area allocated as stockyard for construction materials will be enclosed to minimize dispersion of dusts and located at least 500 m from any residential properties. Covering of stockpiles, minimizing double handling and drop loads as well as sprinkling of water during excavation will reduce the dust emission to a great extent. There is no movement of loose soil at base of transmission tower, however, if any loose soil is removed from substation site, it will be done using covered trucks to reduce dust[27]. Water will be sprayed on roads, and temporary fencing will be used at construction sites, and camps. Workers will require face masks to avoid dust inhalation. SF_6 leakage records will be maintained in each substation. This allows tracking of any release of SF_6 to the atmosphere. SF_6 emergency response plan should be prepared.

5.3.1.2 *Noise*

246. The proposed project areas are in relatively rural locations. Generation of noise pollution will occur, due to construction of the tower foundations, but these will be sporadic and temporary activities over the landscape. Noise will be generated during the preconstruction phase of the project with removal and/or cutting of vegetation in the RoW and during the movement of trucks or other required vehicles.

247. Transmission tower foundations and pads are constructed using a standard drill rig to bore to required depth, depending on geology. If water is encountered, pumps will be used to remove the water to either adjacent defined areas without disposal to surface water or to waiting tanker trucks for proper disposal. After the construction is completed, clearing and grading will happen. The agricultural soils are compacted, and the RoW is cleaned up. All these activities might create noise impacts for short periods at each location. Noise levels should not exceed 55 dBA (day time) and 45 dBA (night time) in residential, institutional and educational settings and 70 dBA in both day and night time in industrial and commercial areas (Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.). BAN standards which are more stringent in some locations will be referred to.

248. Noise impacts should not exceed the levels mentioned before or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site. A noise and dust control plan will be developed along with community and safety plans[28]. All vehicles will carry valid fitness certificates issued by Bangladesh Road Traffic Authority and renewed annually under the Motor Vehicles Ordinance 1983, Section 48, Chapter IV and the associated rules. Considering the noise from the vehicles' movement near locations with sensitive receptors, the transport of construction materials will be limited to daytime without hooting. Construction activity (particularly piling[29] for towers) will take place during acceptable hours (between 6 am to 9 pm). Residents will be informed in advance of the construction.

5.3.1.3 *Surface and Groundwater*

249. The construction and operation of the subprojects will not have major impacts on the surface and groundwater quality in the area. Contamination of water bodies may result due to

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[27] Importing fill material must be covered and all trucks should be serviced and meet BAN emission standards, any belching black smoke should be prohibited.

[28] Contractor will measure the distance from the infrastructure to the receptor when the design is finalized to conduct the noise impact assessment and develop the site-specific management plan.

[29] EPC contractor will decide type of piling with recommendations from PGCB.

construction of access road to the substation site, spilling of construction materials and surface runoff from the construction site joining the waterbody.

250. **Hydrology/Drainage Congestion.** Given the small footprint of the tower foundations and their scattered location over the landscape, it is not expected that the construction works will result in any disruption of hydrology or drainage.

251. **River Course.** Transmission tower platforms alongside the wider rivers such as Rupsha, Katcha and Teesta will be placed such that single wire spans will cross the river (no foundations required in the rivers). While there is a risk of some erosion if works are too close to the river, this risk is expected to be small as the minimum distance from the river bank to the tower footing would be 150 m.

252. **Drainage Congestion.** It is not expected that the tower foundations will impede drainage, given their relatively small size and location mostly away from watercourses.

253. **Irrigation Channels.** The proposed transmission and LILO lines will have 1,156 towers, most of which will occur in areas of intensely used agricultural land (mainly paddy), with potential to cause disturbance of irrigation channels which are used in the dry months to irrigate crops, particularly rice, using river or tube well water. Any temporary interference with irrigation activities and associated destruction /loss of crops will be identified and compensated for as part of the RP.

254. **Tube Wells and Groundwater.** A tube well is found in the paddy land earmarked for the construction of Maheshpur substation. It will be decommissioned to prevent the contamination of groundwater. Proper well decommissioning consists of removing pump, fittings, pipes and debris from tube well casing. The tube well is then filled from the bottom up with sealant materials. Sealing materials are used to prevent water from migrating into or between aquifers. They are commonly less permeable to water than the soil or rock on site. Bentonite chips or pellets, neat cement, concrete grout, and high solids bentonite slurry are approved for tube well decommissioning.

255. A new tube well within a 500 m radius from the existing tube well will be constructed. The same volume of water will be provided as this area consists of the same aquifer. No additional impacts will be expected due to the tube well relocation. PGCB will support the groundwater test for free to the tube owner to ensure the water quality in the new location will not be worse than the original one.

256. Care shall be taken to locate the temporary day-time construction worker sheds or toilets 500m away from waterbody. Drinking water facilities[30], enclosed sanitary facilities, septic tank (with soak pit) and drainage in the temporary sheds of construction workers should be provided to avoid the surface water pollution. Provision of washing[31] and toilet facilities in numbers and facility should be made obligatory.

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[30] Drinking water must meet national drinking water standards (should be tested/certificates available).

[31] Toilet connected to septic tanks, washing facilities of hot and cold water, male and female, separate area for preparation of food away from toilet area, provision of gas for cooking etc. Numbers to be decided by EPC contractors based on number of workers. EBRD guidance note on workers' accomodation can be referred to. https://www.ebrd.com/documents/environment/workers-accommodation-guidance-note.pdf?blobnocache=true

5.3.1.4 *Soil*

257. **Loss of Top Soil.** About 1 acres of land will be impacted for the construction of tower footings of transmission lines and 80.92 acres for substations. Works near watercourses will require protection to guard against loss of soil that result in turbidity of water. Top and sub-soils will be affected when the land is disturbed to make foundations for the transmission towers. On the other hand, these soils will be pushed back around the foundations, so will remain in a contained area. Proper handling of wastes will reduce the risk of soil contamination during construction.

258. **Pollution due to Wastes.** Generation of construction wastes (such as solid wastes: electric wire, pipes, stones, woods, rods etc., and liquid waste: paint, oil, bitumen, etc.) from the construction camp and general wastes (solid wastes: papers, containers, residues of food, fruits etc., and liquid waste: waste water from bathroom and kitchen, etc.) from workers' camps (if needed) could impact on the health and safety of the local community and workers, as well as on the aesthetic beauty of the area. Proper arrangement, e.g. disposal to existing licensed sanitary landfill etc. will be made for waste management, fuel oil and chemical storage at all work sites.

259. **Waste.** During the operation phase substances and oily waste might get leached through soil by precipitation of water and percolate to the groundwater table, due to handling, disposal and oil spills in substation sites. This results in groundwater pollution in nearby area. This situation will increase during the rainy season and have a critical impact on soil, surface and groundwater. PCB is not used in substation transformers or other project facilities or equipment. Battery, transformer oils, and SF_6 should be stored at substation sites with appropriate care, e.g. impermeable surface bunded to 110% capacity etc.

5.3.2 Land and Agricultural Resources

5.3.2.1 *Land Loss*

260. A substantial loss of agricultural lands, waterbodies, 80.92 acres is anticipated for the proposed fifteen and one existing substations (Satkhira) in Dhaka and Western zone transmission networks. Natural habitats are not found in any of the sites proposed for the construction of substations. Waste management and site drainage will be important during operation of the substations, to prevent soil and water pollution. All sites will also require secure fencing to maintain local community safety (no entry possible).

261. About one acre of land will be required for the footings of 1,156 towers. Once the towers are constructed paddy and other seasonal crops would be planted between the footings of the tower, therefore no land loss is anticipated. In addition, a small quantity of land will be required temporarily for the construction camps nearby the tower sites. A Resettlement Plan (RP) has been prepared in conjunction with the IEE to determine the land ownership, affected structures, trees, and crops to determine the compensation. A large number of households were originally identified within the chosen alignments and deviations to the routes were selected to reduce the number of affected houses (see Table 6.1-3).

262. The Electricity Rule 1910 of the Power Division, Bangladesh does not provide provisions for compensation for the land required for the foundations and platforms for transmission line towers. ADB's SPS 2009 requires compensation for loss of land at transmission tower sites. The RP provides compensation details. The Electricity Act, 1910 has been repealed on 12th February 2018 by re-enacting the Electricity Act 2018 for ensuring better supply as well as use and for meeting up the gradual accumulative demand of electrical energy all over the country.

5.3.2.2 *Crop Production*

263. Currently, rice crops are being cultivated on these lands. The standing crops will be affected during the construction of tower bases and stringing. Further, there will be a small change in land use with up to 1 acre lost for tower foundations, nearly all are on private lands. During construction, activities will be phased to allow farmers to harvest standing crops and for construction storage and vehicle activity, barren areas will be identified.

5.3.2.3 *Land Price*

264. The value of land may be affected by the proximity of overhead transmission lines. On the other hand, land values in the general area are likely to increase because of the availability of additional power supply resulting in changes in land use from agriculture to commercial and industrial use.

5.3.2.4 *Landscape*

265. The transmission lines, mostly in rural areas, will change the appearance of the natural landscape. This is unavoidable but can be minimised.

5.3.3 Fisheries Resources

5.3.3.1 *Fish Habitat*

266. During construction activities of substations and tower bases there will be some impacts on floodplain fish habitat which predominates in the study area. In most cases, this loss will only be temporary. However, there are two substation lands with a total extent of 3 acres waterbodies, including Rupsha (1 acre) and Phultala (2 acres). One acre of waterbody provides maximum income of Tka 10,000/year from fishing. As these waterbodies are open access, people normally do not spend any money for fish cultivation.

267. Three acres of waterbody loss if any will be fully restored as the compensation will enable waterbody owner to build similar water bodies within the paddy land they will buy. DC shall ensure the compensation is for restoration of lost waterbodies with restoration of new waterbodies at same size. The new waterbodies need to be installed before the old one is filled in to ensure continuation of subsistence fishing.

5.3.4 Terrestrial Resources (Flora and Fauna)

5.3.4.1 *Clearing of Vegetation*

268. Prior to starting construction, the tower sites need to be cleared and as a result, standing vegetation (e.g. crops, grass, bushes, trees etc.) will be lost. As mentioned earlier, a total of 22,790 trees will be partially or fully affected by trimming or cutting during construction of the transmission lines (Table 5-11). In addition, the proposed overhead transmission lines stretch approximately 394 km and require clearance of the RoW, resulting in temporary loss of vegetation. However, most of the trees in the RoW need to be trimmed rather than cut, and thus the impact will be only moderately significant. In general, vegetation destruction shall result in some loss of biodiversity, as valuable trees, such as those of medicinal importance or producing fruit may be adversely impacted. Trees also provide habitat for most birds, and some animals, so these may also be affected, as vegetation cover of the understory is reduced. On the other hand, most of the transmission alignment falls inside paddy fields/ floodplain areas, so tree felling will mostly be restricted to settlement areas. Some additional vegetation damage will occur at sites

required for storing construction materials, for construction activities, for labour camps, and for construction vehicle storage.

Table 5-12: Number of Trees (taller than 5 m) Affected by Different Sub Projects

SL	Subproject category	Total Affected Trees within 12 m RoW (Trees > 5 m in height)			Total
		Fruit trees	Non- Fruit	Medicinal	
1	Transmission lines	12,745	9,024	344	22,113
2	LILOs	118	138	09	265
3	Underground/ Partially overhead lines	192	164	0	356
4	New Substation	20	34	02	56
5	Existing substation with bay extensions	0	0	0	0
	Total	13,075	9,360	355	22,790

Table 5-13: Number of trees in the RoW of transmission lines (clearing width 12 m) and substations to be removed and their market value

Item	Fruit Trees		Wood/Timber Trees		Medicinal		Total Trees
	(> 10 m height)	(5-10 m height)	(> 10 m height)	(5-10 m height)	(> 10 m height)	(5-10 m height)	
Transmission Lines							
Trees	7054	5691	2525	6499	122	222	**22113**
Average Rate Tk	11783	9109	17588	12982	8000	6667	
Total Value, Tk	**83,114,522**	**51,837,587**	**44,410,294**	**84,372,312**	**976,000**	**1,480,000**	**266,190,715**
LILOs							
Trees	**59**	**59**	**45**	**93**	**4**	**5**	**265**
Average Rate	11783	9109	17588	12982	8000	6667	
Total Value	**695,174**	**537,413**	**791,471**	**1,207,359**	**32,000**	**33,333**	**3,296,750**
Underground/Partially Overhead Lines							
Trees	**0**	**192**	**0**	**164**	**0**	**0**	**356**
Average Rate	11783	9109	17588	12982	8000	6667	
Total Value	**0**	**1,748,870**	**-**	**2,129,106**	**0**	**0**	**3,877,975**
Total TLs							
Trees	**7113**	**5942**	**2570**	**6756**	**126**	**227**	**22734**
Average Rate	11783	9109	17588	12982	8000	6667	
Total Value	**83,809,696**	**54,123,870**	**45,201,765**	**87,708,776**	**1,008,000**	**1,513,333**	**273,365,440**
New Sub-stations							
Trees	**15**	**5**	**0**	**34**	**2**	**0**	**56**
Average Rate	11783	9109	17588	12982	8000	6667	
Total Value	**176,739**	**45,543**	**-**	**441,400**	**16,000**	**-**	**679,683**

Item	Fruit Trees		Wood/Timber Trees		Medicinal		Total Trees
	(> 10 m height)	(5-10 m height)	(> 10 m height)	(5-10 m height)	(> 10 m height)	(5-10 m height)	
Overall							
Trees	**7128**	**5947**	**2570**	**6790**	**128**	**227**	**22790**
Average Rate	11783	9109	17588	12982	8000	6667	
Total Value	**83,986,435**	**54,169,413**	**45,201,765**	**88,150,176**	**1,024,000**	**1,513,333**	**274,045,122**

269. Secondary vegetation damage will occur during the stringing of conductors. Trees will need to be lopped inside the RoW and at any settlement or farm areas falling inside the RoW. Existing crop field vegetation may be damaged during stringing activities.

270. After completing of construction works, all herbaceous plants are expected to re-generate within a few years. PGCB will pay compensation on trees that are cut during the project that include the replanting cost of trees. However, existing vegetation patterns under the proposed transmission line RoW will change to some extent as there will be a restriction for planting large trees in the RoW, and regular pruning of vegetation will be required.

5.3.4.2 *Disturbance of Wildlife*

271. Project activities such as earthworks for tower foundations, movement of project heavy equipment and transports (with noise especially during the night time) may disturb animals active in night. However, most of the alignment occurs in agricultural land with minimal natural habitat. Open areas under the lines could provide new browsing grounds for various animals. The presence of construction workers in the project area may induce poaching (more likely fish than anything else). Given that the alignment is mostly in agricultural land, few other animals would be affected. Tower foundation works could disturb habitats for smaller mammals, such as rodents (rats and mice).

272. The proposed transmission lines are not located close to the key breeding areas of birds. Therefore, regular migratory bird movements are not expected in the project area. However, further studies will take place prior to the construction. Bird deflectors are only likely to be needed in areas with high bird movement, e.g. along ridge lines and across wetlands. On the other hand, transmission towers and conductors may be supportive to local birds as resting, roosting and look-out locations, so they will be positively impacted. All vegetation layers (emergent, canopy and understory) allow for bird habitat and nesting, and therefore the removal of vegetation may impact negatively on these activities.

5.3.5 Socioeconomic Resources

5.3.5.1 *Objects of Cultural or Archaeological Importance*

273. Bangladesh is a country where civilization has existed for thousands of years and encountering physical and cultural monuments in construction related excavations is a distinct possibility. During construction, with many small construction sites along the line alignment, there is potential to unearth or discover objects of a cultural nature that will need to be protected. While there is no evidence of such sites within the study area, there are various tombs, temples and other sites in the country. It is, therefore, important to have a procedure in place to ensure that there is a mechanism in place to handle any material culture finds.

274. To protect cultural resources from accidental damage from construction, existing cultural property will be treated as sensitive receptors. They will be avoided where possible and subject to the control on air pollution and noise. Implement Chance Find Protocols as soon as historical/cultural monuments are encountered during construction activities. Stop work and inform the relevant authorities including the Ministry of Cultural Affairs, Bangladesh. The Ministry would implement measures to avoid damage to monuments and valuable features which the contractor is bound to follow.

5.3.5.2 *Health and Safety*

275. **EMF (electromagnetic field).** Overhead lines produce both electric and magnetic fields. Electric fields are created by differences in voltage. The strength of the electric field is measured in kilovolts per meter (kV/m). Any electrical wire that is charged will produce an associated electric field. This field exists even when there is no current flowing. The higher the voltage, the stronger the electric field at a given distance from the wire. Magnetic fields are created when electric current flows; the greater the current, the stronger the magnetic field. Electric fields are strongest close to a charge or charged conductor, and their strength rapidly diminishes with distance from it. Magnetic fields arise from the motion of electric charges. The strength of the magnetic field is measured in micro tesla, µT.

276. Health concerns over exposure to EMF are often raised when a new transmission line or substation is proposed. However, in spite of all the studies that have been carried out over the past 30 years, there is still no persuasive evidence that the fields pose any health risks. Rehabilitation of existing power lines is unlikely to increase EMF, but new lines may induce EMF. The transmission and LILO lines will traverse some populated areas. Therefore, inspection of existing EMF along the selected routes of existing and new transmission lines in populated areas would be important.

277. WHO (June 2007) recommends using exposure guidelines published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP (2010) has set the limits at 50 HZ for the public exposure as: (1) electric field strength (kV per meter) is 5 kV/m, and (2) magnetic field strength (micro tesla) is 200 µT (equivalent to 160 A/m); while for the occupational exposure as: (1) electric field strength is 10 kV/m and (2) magnetic field strength is 1000 µT.

278. Based on the literature review[32, 33], the maximum electrical field generated by the 400kV double circuit line is estimated at 5 kV/m, around the distance of 11 m from axis of line, equivalent to the 5 kV/m safe limit for public specified by ICNIRP. The maximum magnetic field generated by the proposed new lines is estimated to be 81.942 µT at the nearest distance from the line, below the 200 µT limit specified by ICNIRP. Thus, in the future any residents living underneath or very close to the proposed transmission lines are not expected to be exposed to an environment above EMF limits. Community health and safety, placement of safety signages within the vicinity, awareness training will be provided to the people in the vicinity.

279. **Occupational Health and Safety.** Construction workers are more likely to face occupational health hazards such as minor or major injuries due to lack of general safety requirements and precautions applicable while working at construction sites, and handling machines and equipment, use of equipment and driving vehicles and so on. Poorly designed

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[32] Extremely Low Frequency (ELF) Fields (http://www.inchem.org/documents/ehc/ehc/ehc35.htm) published by WHO 1984.

[33] Abu Izzeddin Salma, Berbari Kamal and Obeid Hiba. 2006. *Electromagnetic Field from Power Lines*. American University of Beirut.

temporary labour camp and sanitation facilities may pose a health threat and nuisance to the workers. Uncontrolled vending of food and drinking water at work sites may also pose a risk with respect to the transmission of contagious diseases like typhoid, diarrhoea, malaria, and dengue in particular. Although presently the total ratio of affected people in Bangladesh with HIV/AIDS is far less than 0.1%, this percentage is slowly being increased due to injection drug users and overseas migrant workers returning to Bangladesh. Only trained workers are permitted to work at height. Construction workers will be required to handle materials such as cement, bitumen, chemicals, fuels, and so on which will increase health risks if personal protective equipment is not used (as noted above).

280. One of the phenomena associated with all energized electrical devices, including high-voltage transmission lines, is corona. The localized electric field near a conductor can be sufficiently concentrated to ionize air close to the conductors. This can result in a partial discharge of electrical energy called a corona discharge, or corona. Several factors, including conductor voltage, shape, and diameter, and surface irregularities such as scratches, nicks, dust, or water drops, can affect a conductor's electrical surface gradient and its corona performance. Corona is the physical manifestation of energy loss and can transform discharged energy into very small amounts of sound, radio noise, heat, and chemical reactions with the air components.

281. During corona activity[34], transmission lines (primarily those rated at 345 kV and above) can generate a small amount of sound energy. This audible noise can increase during bad weather conditions. Water drops may collect on the surface of the conductors and increase corona activity so that a crackling or humming sound may be heard near a transmission line. Transmission line audible noise is measured in decibels using a special weighting scale, the "A" scale, that responds to different sound characteristics similar to the response of the human ear. Audible noise levels on typical 230 kV lines are very low and are usually not noticeable. For example, the calculated rainy weather audible noise for a 230 kV transmission line at the right-of-way edge is about 25 dBA, which is less than ambient levels in a library and much less than background noise for wind and rain.

282. Overhead transmission lines do not, as a general rule, interfere with radio or TV reception. There are two potential sources for interference: corona and gap discharges. The corona discharges can sometimes generate unwanted electrical signals. Corona-generated electrical noise decreases with distance from a transmission line and also decreases with higher frequencies (when it is a problem, it is usually for AM radio and not the higher frequencies associated with TV signals). Corona interference to radio and television reception is usually not a design problem for transmission lines rated at 230 kV and lower. Calculated radio and TV interference levels in fair weather and in rain are extremely low at the edge of RoW for a 230 kV transmission line.

283. **Community Health and Safety.** Improper health policies at work sites may lead to an outbreak of different diseases in the surrounding communities/public, if construction workers are

[34] Deno, D. W. and J. M. Silva. 1985. "Probability and Consequence of Gasoline Ignition Under HVAC Transmission Lines." IEEE Transactions on Power Apparatus and Systems. Vol. PAS104, No. 11. November. Electric Power Research Institute. 1997. Susceptibility of Implanted Pacemakers and Defibrillators to Interference by Power-Frequency Electric and Magnetic Fields. August. Electric Power Research Institute. 1982. Transmission Line Reference Book: 345 kV and Above. Second Edition. Institute of Electrical and Electronics Engineers. 1980. "Review of Technical Considerations on limits to Interference from Power Lines and Stations." IEEE Transactions on Power Apparatus and Systems. Vol. PAS-99, No. 1. January/February. Institute of Electrical and Electronics Engineers. 1976. The Location, Correction, and Prevention of RI and TVI Sources from Overhead Power Lines. IEEE Tutorial Document. No. 76-CH1163-5-PWR. Miller, L. N. 1978. "Sound Levels of Rain and Wind in the Trees." Noise Control Engineering. Vol. 11, No. 3. November. Silva, Mike. Personal Communication with Karin Noack. August 6, 1999.

sick. Further, construction vehicles will pose a risk to local communities. Collapse of towers (possibly during a cyclone or earthquake) and broken lines could pose a risk to local communities. The transmission lines should not pose a hazard to local communities, as long as they do not climb them, or fly kites or drive tall items into the lines. The awareness raising of the risk will be provided from pre-construction to operation. Substation will be fenced with authorized access. Information and public awareness programs, as well as placement of safety signages within the vicinity can reduce this risk. Traffic management will be required with special care in project sites adjacent to public or project components requiring large number of trucks to transport the construction materials.

284. **Mitigations.** The work force for construction will be sourced locally, as much as possible. Camps will not be necessary for the transmission line construction, but there may be small camps at the locations of proposed grid substations. These sites are away from any settlements; any small camps for laborers will be provided with water supply and sanitation facilities. The whole project work site will be fenced off and signs regarding potential hazards posted in conspicuous locations. Access to the construction site will be under traffic controls when trucks enter and exit (traffic managers with appropriate signs). Local communities will continue to be informed about project construction activities, schedules, and possible health and safety risks. Given the risk of damage to structures within right of way during construction, the contractor will prepare a construction method statement for installation of transmission lines above structures including community health and safety risk assessment and management plan, and provide compensation for any damage caused. The project will ensure that Bangladesh Labor Code regulations and the World Bank/IFC OHS standards are followed, including provision of safe working conditions and all appropriate personal protection equipment (PPEs). The Contractor will establish a mechanism for receiving and handling complaints about unfair treatment or unsafe living or working conditions (without reprisal). Health/accident insurance for employees/contractor staff will be provided for the duration of their contracts. A Health and Safety Officer (HSE tasks) will be designated and will provide regular briefing on worksite risks and the need to protect local communities. An accident reporting system will also be put in place, including notifications to ADB and Government of Bangladesh, and annotation of situation remedies. Special consideration will be given to risks associated with working at height and with electrical components (workers will be suitably trained for these tasks and fitted with safety equipment).

285. **Traffic Congestion/Road Accidents.** Heavy construction vehicles will be required for carrying of construction materials and equipment. Local vehicles (such as trucks, buses, jeeps, microbuses, cars, rickshaw vans, motorbikes, bicycles), as well as students and local people walking on the roads could result in traffic jams, especially during morning and evening times, as observed during field survey. The construction vehicles will add more traffic and as a result, traffic congestion and road accidents could increase. Traffic congestion may also occur if the stock piling of construction materials will be at the road sides.

286. **Interference with Road Crossing.** The transmission lines will cross various major roads in twenty districts and there are some minor roads to be crossed as well. The selected transmission line alignment is never far from the local road network and various roads and access tracks will be used during the construction of lines. Some access roads and road crossing locations will be temporarily impacted during the process of accessing transmission tower locations for erection of towers and stringing conductors between towers at the end of the construction phase.

287. Traffic management plans will be put in place with public awareness programs and warning signs at designated sites. Scaffolding will be placed over road crossing points while

stringing of conductors takes place. A detailed traffic plan will be prepared by EPC contractor after consultation with relevant authorities.

5.3.5.3 Employment Generation/Income

288. During construction, considerable quantities of workers (both male & female) may be required at various work sites. Some local people may also involve themselves in small businesses (e.g. tea stall, grocery shop, etc.). Local people can be involved in the project construction work as per their skills.

289. **Employment Opportunities and Income Generation.** During the 56-month construction phase, there will be a need for both skilled and non-skilled labour to build the tower pads, erect towers, and string conductors. Employment opportunities will be created for people in the immediate area, as well as in the country. Contractors will be encouraged to provide opportunities to local people. Jobs in construction and supporting industries will result in increased productivity and capital income of the people.

5.3.5.4 *Improvement of Social and Economic Life*

290. Due to an increase of power transmission capacity and reliability of power supply, the social life and economic condition of the people will be improved.

291. Community infrastructure. There is a risk of damage to existing access roads due to the heavy load from trucks for transporting construction materials. The damages to the road or road surface will be restored or improved after the construction phase by the contractors.

6. ANALYSIS OF ALTERNATIVES

292. At the planning stage itself, one of the factors that decides the location of the transmission lines and substation sub-projects is the possible infringement of populated, forested and cultivated lands. Wherever such infringements are substantial, different alternative options are to be considered. During the route alignment, all possible efforts are made to avoid populated, forested and cultivated areas (completely, if possible, or to keep infringement at a minimum). Wherever it becomes unavoidable due to the geography or terrain, mitigation costs required to handle the issue need to be worked out. While identifying the transmission system for Greater Dhaka and Western zone, preliminary route selection was done by PGCB, based on the interpretation of topographical and Google maps of the area.

293. Activities like construction of transmission lines and substations, subsequent operations and maintenance are generally non-polluting in nature; environmental impacts are usually minimal, generally restricted to RoW only, and further, usually only confined to the tower foundations. Another feature which is also very crucial in making this statement is the inherent flexibility available in alignment of transmission lines and locating substations, which helps in avoiding environmentally sensitive areas such as fragile ecosystems with their inherent biodiversity, and also dense human areas and areas of cultural significance.

294. All the potential environmental impacts of transmission lines and substations can be avoided or mitigated through careful route and site selection as explained above. Keeping this aspect in mind, due consideration has been provided in deciding the route alignment, including study of different alternatives for the proposed transmission lines under the scope of the project.

6.1 Transmission and LILO Lines

295. PGCB usually undertakes route selection in close consultation with representatives from government agencies and the local community. Although under national law PGCB has the RoW, yet it considers alternative alignments during site selection, with minor alterations often added to avoid environmentally sensitive areas and settlements at the implementation stage. For selection of the optimal route, the following points are taken into consideration:

i) As a principle, alignments are generally sited at least 500 m away from major towns, whenever possible, to account for future urban expansion and at least 50 m away from any houses or structures;

ii) The route of the proposed transmission lines avoids human habitation as far as possible. Also, the proposed route of a transmission line does not create any threat to the survival of any community with special reference to indigenous/ tribal communities;

iii) Similarly, plantations/natural forests are avoided to the maximum extent possible. When it is not possible, a route is selected in consultation with the Forest Department that causes minimum damage to existing plantation/forest resources; and

iv) Care is taken to avoid/minimize any protected areas (national parks, sanctuaries, and other declared protected areas/ecologically sensitive areas rich in biodiversity).

6.2 Grid Substations

296. For selection of appropriate sites and optimization of safeguards for substations, the following points are taken into consideration:

i) Construction activities do not adversely affect the population living near the proposed substations and do not create any threat to the survival of any community with special reference to indigenous, tribal community etc.;

ii) The location of the substation does not affect any PCRs;

iii) No resettlement of households by the substation site, no loss of livelihoods, siting of transformers away from schools, hospitals and other sensitive receptors, with due consultation with the community and local government units concerned;

iv) Transformers and other equipment specifications compliant with government rules/regulations and International Electro-Technical Commission standards shall be followed;

v) Construction techniques and machinery selection shall be made with a view to minimize ground disturbance;

vi) While planning for substations, drainage lines shall also be marked and studied to avoid seepage/leakages and pollution of water sources;

vii) Substation location/design to ensure that noise will not be a nuisance to neighbouring properties. Provision of noise barriers near substation sites will be made;

viii) Substation design will comply with the limits of electromagnetic interference within the floor area. Security fences will be erected around substations. Warning signs shall be displayed;

ix) PGCB shall adopt good practices and shall always strive for a high standard of housekeeping for its substations and ancillary facilities;

x) PGCB shall incorporate the best technical practices to deal with environmental issues in its workings;

xi) Site selection should consider seismicity and geography of the local area; the area should not be prone to flooding, landslides or be unstable; and

xii) Design of substations shall be made to include modern fire control systems/ firewalls. Provision of fire-fighting equipment would be made to be located close to transformers, switchgears etc.

6.3 Evaluation of Alternatives

6.3.1 Evaluation of Alternative Route Alignments of transmission lines

297. Firstly, PGCB provided proposed routes of the transmission lines and LILO connections in Keyhole Mark-up language Zipped (KMZ) format which provides satellite images of the earth. After marking clearing widths of routes, structures inside the clearing width were pointed on the map by conducting a desk study using the Google Earth software while identifying deviations for

high impact areas. Secondly, selection of best deviations was based on the objective of minimizing the number of structures within the clearing width of the line (12 m) and in the RoW. After obtaining the concurrence of PGCB, deviations were merged into the PGCB proposed routes which were dispatched to the safeguard survey team to conduct walk through surveys. The survey team identified structures which aren't visible on satellite images and proposed additional deviations considering actual situation on the ground. Lastly, the final routes were prepared by merging all deviations identified using satellite images and walk through surveys.

298. The three-stage alternatives status are listed below (Table 6.1). The detailed field survey (stage 3) of six transmission line routes (T-1, T-3, T-5, T-7, T-9 and T-10) showed that the number of structures was not different from Google Earth survey (stage 2).Therefore, the deviations to the six transmission lines carried out in stage 2 were accepted as the final. Only the four transmission lines (T-2, T-4, T-6, and T-8) had the deviations after the detailed field investigation (stage 3). These deviations increased the length of transmission lines as well as number of angle towers, to avoid structures that were recorded within the RoWs. The deviations were carried out to avoid structures as there were no ecologically or environmentally sensitive areas in the RoW of proposed line routes. River crossing of transmission lines cannot be avoided due to a large number of rivers, canals and water bodies found in the project area. The comparisons of the alternative studies are presented in Table 6.2 and Table 6.3.

Table 6-1: Final route selection through three stages

	Transmission Line/LILO	**Stage 1**	**Stage 2**	**Stage 3**
		PGCB Route	**RMA Route (based on satellite images & field surveys)**	**Final Route (Detailed Field surveys)**
T-1	Kaliganj (Gazipur)-Purbachal	Yes	Yes	No
T-2	Rupsha-Satkhira	Yes	Yes	Yes
T-3	Domar-Purba Sadipur	Yes	Yes	No
T-4	Domar -Hatibanda	Yes	Yes	Yes
T-5	Kaliganj-Maheshpur	Yes	Yes	No
T-6	Manirampur-Satkhira	Yes	Yes	Yes
T-7	Kushtia-Meherpur	Yes	Yes	No
T-8	Bagerhat-Pirojpur-Bhandaria	Yes	Yes	Yes
T-9	Gopalganj (N) – Shibchar	Yes	Yes	No
T-10	Niamatpur-Patnitola	Yes	Yes	No
L-1	LILO of Bagerhat-Goalpara 132 kV double circuit line at Rupsha	Yes	Yes	No
L-2	LILO of Barishal-Bhandaria 132 kV double circuit line at Jhalokati	Yes	No	No
L-3	LILO of Faridpur-Madaripur 132 kV double circuit line at Bhanga	Yes	No	No
L-4	LILO of Gallamari-Gopalganj 132 kV double circuit line at Rupsha	Yes	No	No
L-5	LILO of Khulna Central-Noapara 132 kV double circuit line at Phultala	Yes	Yes	No

L-6	LILO of Barishal-Bhola-Borhanuddin 230 kV double circuit line at Bhola	Yes	No	No
L-7	LILO of Ghorashal-Tongi 230 kV double circuit line at Kaliganj (Gazipur)	Yes	Yes	No
L-8	LILO of Khulna (S)-Rupsha Power Plant 230 kV double circuit line at Rupsha Substation	Lines Run Over Rupsha Substation		
L-9	LILO of Bhulta-Kaliakair 400 kV double circuit line at Kaliganj (Gazipur)	Lines Run Over Kaliganj Substation		
L-10	LILO of Ghorashal-Tongi 400 kV double circuit at Kaliganj (Gazipur)	Yes	Yes	No
U-1	Purbachal-Purbachal 2 **(Overhead Section)**	Yes	Yes	No
	Purbachal-Purbachal 2 **(Underground Section)**	Yes	No	No
U-2	Bashundhara - Rampura **(Underground)**	Yes	No	No

6.3.2 No-Action Alternative for a 132 kV single circuit line

299. A proposed single circuit 132 kV line would traverse the Choto Raghunathpur High School's premises in the original project scope. The safeguards consultation mission had a discussion, on 9th April 2019, with the teachers from the school. It is learned as follows:

300. This school was established in 1972. Currently, the school has 460 children and 13 staff (3 female), including 216 boys and 244 girls. Classes are conducted from grades 6-10. They informed that the line route should be changed to move it outside the school premises as they are responsible to ensure the safety of children. The team informed them that it is a 132 kV line and safety can be ensured according to WHO guidelines. Construction could take place during school break to avoid disturbance. Then the school authorities said that they would be happy if safety can be ensured. However, they requested changing the line route away from the school. When asked whether school has had any adverse impacts from the distribution line which is traversing closer to the school during its construction, they said that there was no disturbance.

301. Considering the concerns raised, the component was dropped off in the end as a No-Action alternative chosen.

Table 6-2: The details of PGCB proposed routes, alternative routes based on satellite images and final alternatives.

No.	Transmission line (Overhead line without LILO)	PGCB (km)	AT	ST/CW (G)	ST/CW-RoW (G)	ALT/ RMA (km)	AT	ST/ CW (G)	ST/CW-RoW (G)	ST/ CW (F)	ST/ CW-RoW (F)	ALT/ RMA/ Field (km) FINAL	AT	ST/ CW (F)	ST/ CW-RoW (F)
1	Kaliganj (Gazipur)-Purbachal	17.8	15	14	16	17.7	15	2	8	1	0	18	15	1	0
2	Rupsha-Satkhira	57.5	32	57	121	58.3	68	5	29	31	4	62	80	21	4
3	Domar-Purba Sadipur	44.3	25	28	55	46.0	46	0	4	3	0	46.5	46	3	0
4	Domar - Hatibanda	33.2	17	53	69	34.8	53	2	12	12	2	35	56	10	2
5	Kaliganj-Maheshpur	25.3	8	14	11	27.9	12	0	0	1	0	28	12	1	0
6	Manirampur-Satkhira	31.9	18	25	30	33.0	26	1	6	10	1	33	33	3	1
7	Kushtia-Meherpur	46.2	19	38	42	48.0	30	1	6	9	4	48	30	9	4
8	Bagerhat-Pirojpur-Bhandaria	48.3	43	55	62	49.6	55	0	12	48	1	49.5	55	43	1
9	Gopalganj (N) – Shibchar	21.7	12	20	23	24.6	21	0	3	15	6	25	21	15	6
10	Niamatpur-Patnitola	33.3	27	11	12	32.2	23	0	6	0	0	32.5	23	0	0
Subtotal		**360**	**216**	**315**	**441**	**372**	**349**	**11**	**86**	**130**	**18**	**378**	**371**	**107**	**18**

PGCB- Original line route and length given by the PGCB; **AT**- Angle tower; **ST/CW (G)**- Number of structures (houses/ buildings) found inside the Clearing Width (CW) of the transmission line (12 m) using Google Earth; **ST/CW-RoW (G)**- Structures found outside CW but inside the RoW; **ALT/RMA**- Deviations of original PGCB line done by RMA; **ST/ CW (G)**- Structures in CW, counted using Google Earth, **ST/G, CW-RoW (G)**- Structures found outside CW but inside RoW; **ALT/RMA/Field**- **Final** route of transmission line after field survey; **ST/CW (F)**- Number of structures found during the field surveys of RMA line; **ST/F CW-RoW (F)**- Number of structure found outside the CW but inside the RoW (**RoW of 132 kV line 28 m, 230 kV line 40 m and 400 kV line 46 m**)

Table 6-3: Length, number of households and primary structures found in the PGCB route, alternative routes (based on satellite images and field surveys)

Transmission Line component including LILO	PGCB Line Route			Alternative Route (based on satellite images)			Alternative (Final) Route (based on survey results)		
	Length (Km)	No. Entities/HHs	No. Primary structures inside the clearing width	Length (Km)	No. Entities/HHs	No. Primary structures inside the clearing width	Length (Km)	No. Entities/HHs	No. Primary structures inside the clearing width
Transmission Lines	360	315	625	372	130	267	378	107	239
Line-in-Line Out	13	16	33	13	9	21	16	9	18
Underground and Partially Overhead Transmission Lines*	37.1	2	3	28.2	3	6	14	3	3
Total	**410.1**	**333**	**661**	**413.2**	**142**	**294**	**408**	**119**	**260**

*Turag river is next to the Purbachal 400/230 kV substation land. All lines starting from this substation have to cross this river. Overhead sections are used to cross the river. After crossing overhead coverts to underground.

6.3.3 Analyses of Alternatives for Selection of Substations

302. For the fifteen proposed substation site selection, initially PGCB selected one or two alternative sites, based on environmental and social aspects and technical requirements. Such analysis considers various site-specific parameters that include availability of infrastructure facilities such as access roads, water, distance from railways, type of land (government/private land), and social impacts, such as number of families affected, common property resources, including feasibility of acquisition.

303. By considering certain issues during project formulation, it is often possible to reduce or eliminate some of the possible negative environmental impacts during both the construction and operational phases of a project. For example, efforts to avoid, where possible, critical homestead areas or crossing of rivers/hills/bamboo groves with the substation subprojects could greatly reduce negative impacts during construction and operational phases. Such considerations at the project formulation stage greatly reduce the possible negative impacts and facilitate proper environmental management of a project. Many such environmental and social issues to be considered for substation subprojects were identified as below and these issues were addressed during the project formulation stage, as a part of overall environmental management.

- Use of government-owned land or vacant/ fallow (non-productive) land for construction of substation, where possible;
- Use of land located at proximity to existing power lines/load centers, and road network (for easier transportation of material and equipment), where available;
- Avoiding lands that are susceptible to inundation/ storm surge;
- Avoiding government declared ecologically and environmentally critical areas while selecting land for substations;
- Use of Gas Insulated Switchgear (GIS) instead of Air Insulated Switchgear (AIS), to reduce the land requirement for a substation and avoid possible generation of toxic fumes

in the control building, due to flashover inside the AIS (especially under high humidity and saline conditions);

- Ensuring purchase and installation of polychlorinated biphenyl (PCB)-free new transformers;
- In some existing substations that are going to augment under the project, treating PCB contained in old transformers using available technologies; namely, super critical oxidation, electro-chemical oxidation, solvated electron technology, chemical reduction method, dehalogenation process, and thermal desorption using pyrolysis, catalyzed dehalogenation and vitrification before disposal; and
- Designing substations considering maximum flood level and considering wind speed and earthquake load suggested in the Bangladesh National Building Code.

304. Considering the above issues and site inspection/verification, the proposed substation subproject land has been selected and finalized. The selected location for the substation subprojects is given below. The social aspects were provided due weightage after technical requirements in decision making for selection/finalization of land for substation. The details of the selected sites for proposed substations are given in Table 6.4

Table 6-4: Extent, coordinates and land use of sites selected for proposed substations

No.	Substation	Extent (Acres)[35]	Location: Latitude / Longitude	Existing Land use
1	Bhanga GIS	2.03	23.41919/ 89.96184	Agriculture, Paddy & Jute
2	Domar GIS	5	26.105169/ 88.803787	Agriculture, mainly paddy, irrigated
3	Hatibanda GIS	3.04	26.20759/ 89.09256	Agriculture with different crop patterns
4	Jhalokati GIS	5	22.67789/ 90.1975	Agriculture, Paddy, irrigated
5	Maheshpur GIS	3.03	23.79119/ 88.6796798	Agriculture, paddy, irrigated
6	Manirampur GIS	3	22.97617/ 89.22928	Paddy and other seasonal crops, such as, coriander, sugarcane etc.
7	Meherpur GIS	3	23.79119/ 88.6796798	Paddy, Jute, irrigated land
8	Phultala GIS	2	22.92388 89.48595	Waterbody, Water lily cultivation in the waterbody and vegetables at the boundary of the waterbody
9	Pirojpur GIS	3	22.63538/ 89.95208	Agriculture and marshy land, Paddy, Coriander, sugarcane
10	Shibchar GIS	5	23.3552513/ 90.1847076	Agriculture, Paddy, irrigated
11	Bhola GIS	5	22.57811/ 90.66592	Agriculture, Paddy, irrigated
12	Purbachal-2 GIS	1.32	23.85394/ 90.52116	Highland, barren land
13	Rupsha GIS	5.35	22.77076/ 89.61685	Agriculture & waterbody, Paddy in the field, seasonal vegetables (pumpkin, cucumber, papaya) at the boundary of the waterbody.

[35] Access road will require 0.6-acre land.

No.	Substation	Extent (Acres)[35]	Location: Latitude / Longitude	Existing Land use
14	Kaliganj (Gazipur) GIS Future 132 kV Provision	18.05	23.587122/ 90.325799	Agriculture and marshy land, Paddy
15	Purbachal GIS	14.10	23.853916/ 90.521263	Agriculture and marshy land, Paddy
Total		77.92		

6.3.4 Reasons for the Final Selection

305. Considering the various reasons above, the alternatives selected were found to be the most suitable as they involved lesser populated area, few homesteads in the RoW and in the immediate surroundings[36]. The alternatives will not have any infringement of environmentally sensitive area, forest reserves, wildlife reserves, or Important Bird Areas. Maps of the transmission lines are given in the Annex 1 to show the PGCB alignment and deviations to original routes in 10 transmission lines.

[36] Installation of transmission lines directly above to residential properties or other locations intended for highly frequent human occupancy (e.g. schools or offices) should be avoided.

7. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

306. Information disclosure and public consultations were undertaken during the preparation of the IEE to provide information on the concept of the Project, environmental issues or inconveniences associated with the Project during the implementation stage and to obtain the views of members of the immediate community and interested and project affected persons (PAPs) within the sites and immediate areas of influence. The consultations were done with people in the neighbourhood of the proposed sites and involved use of a semi-structured public participation form.

307. ADB's SPS 2009 specifies that "The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Meaningful consultation is a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;1 (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues. Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results are to be documented and reflected in the environmental assessment report."

308. The public consultation was conducted in September and October 2018 through stakeholder consultations, and individual meetings during the environmental study of the proposed project in conformity with the DoE's environmental guidelines to achieve the following objectives:

- To share information on the subprojects (substations, transmission lines) of the proposed project;
- To understand stakeholders, including PAPs, concerns regarding various aspects of the proposed project including existing power supply facilities/system and expected potential environmental impacts along with possible mitigation measures during the construction and operation stages of the proposed project;
- To identify the conflict issues in advance and to find acceptable solutions; and,
- To gather local knowledge before decision making on the proposed project.

7.1 Consultations with Stakeholders

309. The stakeholder consultations followed a participatory planning process in order to gain local inputs in decision-making and policy development regarding compensation and social development in the Project area. This chapter also focuses on plans for future consultations during the project implementation stage, including information sharing and disclosure meetings among the stakeholders.

7.2 Project Stakeholders

310. Prior to the consultation meetings, a mapping of the relevant stakeholders was conducted to identify both primary and secondary stakeholders of the project (Figure 7-1).

Figure 7-1: Stakeholder Mapping

311. The primary stakeholders for consultations include all directly affected persons such as HH's that will be displaced due to the construction of transmission lines, title owners losing land for 15 substations and squatters cultivate on proposed substation land or residing under the proposed lines, as well as indirectly affected persons and communities'/host villages. Women, children, physically handicapped or disabled are especially vulnerable and were therefore consulted separately through FGDs. The section on the socio-economic baseline highlights their status and the need for additional support. Secondary stakeholders pertain to those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on project aspects. A summary description of primary and secondary stakeholders is presented in Table 7-1.

Table 7-1: Description of Primary and Secondary Stakeholders

A. Project Owner	**B. Government of Bangladesh**
The Project Director, The Project Team	-Bangladesh Planning Commission, Executive Committee of the National Economic Council, -Ministry of Power, Energy and Mineral Resources (MPEMR), Power Division of the MPEMR, - Ministry of Environment, Forest & Climate Change, (MEFCC) Department of Environment (DoE), Forest Department (FD).
C. Affected Persons (Directly/Indirectly Affected)	**D. Financiers/Development Partners**
- Land owners on the right-of-way for transmission lines and sub-stations - Households living within RoW who are non-titled, vulnerable groups, poor and female-headed households - Host area villagers	ADB, the Consultants, other development partners with past, current or future projects in the area, related infrastructure Development Partners with interest in the area.
E. Local Administration	**G. Implementing NGOs and Contractors**
Deputy Commissioner of districts where substations/ transmission line/ LILOs are located Upazila level land offices, Union level revenue offices, Local union parishad	Implementing NGO, other local partner NGOs in health, microfinance and education or safety net, Rights and Activist NGOs, and contractors of different packages

H. Media
Local media, National media

7.3 Methodology

7.3.1 Approach

312. A systematic stepwise approach guided the consultation meetings starting from disclosing the project interventions to the understanding of the area and the perceptions of the people in the project area.

- First, conducted consultation meeting with the potential affected households due to construction of transmission lines and households those will be affected due to the substation land acquisition;
- Second, the team made efforts to understand the baseline conditions including the history of energy consumption as well as the development of the transmission lines and substation construction;
- Third, the listing of the key issues related to project impacts and mitigations became the focus of the consultation meetings;
- Fourth, attention was paid to the women and the very poor through separate focus groups discussions; and
- Finally, the consultation team assessed the responses and attitudes of the people to the Project impacts and planned mitigation measures.

7.4 Tools and Process Used

313. Multiple tools and methods have been used during the consultation meetings. These include: Key Informant Interviews; FGDs with various occupational/interest groups; Stakeholder Consultation Meetings, Issue Specific Consultation Meetings; and Information and Communication Meetings.

314. The use of a wide range of methods helped to fully involve all types of stakeholders and engage them in meaningful consultations. Some of the participatory rural appraisal tools used during community consultation meetings included group discussion, participatory mapping and seasonality (Table 7-2).

315. The team carried out open meetings and FGDs in each substation location and conducted consultations with potential affected households under proposed transmission lines. FGDs were conducted with identified community groups, occupational groups as well as vulnerable groups. The location and number of participants at public consultations and gender consultations are given in Table 7-3 to 7-6.

Table 7-2: Tools Used in Consultation Meetings

Tools	Methods
Group Discussion and Data Analysis	Project data review
	Identification of impacts – checklist
	Local history, stories, local knowledge, social classification
	Direct and participants' observations
	Analysis of group discussion and ranking of issues
Participatory Mapping	Village/social mapping
	Resource mapping

	Historical and future vision mapping
	Mobility mapping, including women
	Gender relations and work matrix
Seasonality	Village profile
	Seasonal activity and timeline
	Livelihood analysis
	Impacts of grid lines construction
	Positive impacts
	Negative impacts
	Potential mitigation measures
	Community/social network analysis

Table 7-3: Location and number of participants at FGDs (Transmission Line - Environment)

SL. NO.	Name of Transmission line	Venue	Sub-district	District	No. of Male(M)/ Female(F)		Total Participants	Date
					M	F		
1.	Domar-Hatibandha	Doani	Hatibanda	Lalmonirhat	19	0	19	25/09/2018
2.	Domar-Hatibandha	Melapanga	Domar	Nilphamari	16	8	24	22/09/2018
3.	Kaliganj-Maheshpur	Moheshpur	Moheshpur	Jhenaidah	4	3	7	25/09/2018
4.	Kaliganj-Maheshpur	Sundarpur	Moheshpur	Jhenaidah	12	2	14	25/09/2018
5.	Kaliganj - Purbachal	Borkaw	Kaliganj	Gazipur	9	0	09	09/10/2018
6.	Kaliganj - Purbachal	Pipulia	Kaliganj	Gazipur	5	3	08	08/10/2018
7.	Meherpur-Kushtia	Khuksha	Meherpur Sadar	Meherpur	13	2	15	27/09/2018
8.	Purbasadipur- Domar	Gormollikpur	Kaharol	Dinajpur	12	5	17	19/09/2018
9.	Purbasadipur- Domar	Purbokathuria	Domar	Nilphamari	7	15	22	26/09/2018
10.	Shibchar-Gopalganj	Gopalpur	Shibchar	Madaripur	14	1	15	19/09/2018

Table 7-4: Locations and Number of Participants at FGDs (Substation -Environment)

SL. NO.	Name of Substation	Venue	Sub-district	District	No. of Male(M)/ Female(F)		Total Participants	Date
					M	F		
1.	Manirampur	Lauri Bazaar	Manirampur	Jashore	38	0	38	18/09/2018
2.	Phultala	Mamun's shop	Phultala	Khulna	25	0	25	29/09/2018
3.	Rupsha	Alam's shop	Fakirhat	Bagerhat	26	0	26	02/10/2018

SL. NO.	Name of Substation	Venue	Sub-district	District	No. of Male(M)/ Female(F)		Total Participants	Date
					M	F		
4.	Satkhira	Taltola Eidgah Intersection	Satkhira Sadar	Satkhira	30	0	30	22/09/2018
5.	Bhanga (LILO)	Madobpur	Bhanga	Faridpur	6	1	7	21/09/2018
6.	Domar	Paschim Chikonmati	Domar	Nilphamari	21	13	34	20/09/2018
7.	Hatibandha	Romniganj	Hatibanda	Lalmonirhat	21	4	25	25/09/2018
8.	Kaliganj	Fuldi	Kaliganj	Gazipur	11	0	11	13/10/2018
9.	Meherpur	Meherpur	Meherpur Sadar	Meherpur	5	3	08	27/09/2018
10.	Purbachal	Fuldi	Kaliganj	Gazipur	7	0	07	11/10/2018
11.	Shibchar	Maler Kandi	Shibchar	Madaripur	4	4	08	17/09/2018

Table 7-5: Location and Number of Participants at Gender Consultations for Substations

SL. NO.	Name of Substation/ TL	Venue	Sub-district	District	No. of Male(M)/ Female(F)		Total participants	Date
					M	F		
1.	Phultala	Kawsar's resident	Phultala	Khulna	0	12	12	29/09/2018
2.	Manirampur	Borhan's resident	Manirampur	Jashore	0	12	12	18/09/2018
3.	Bhola	Farid's resident	Dawlatkhan	Bhola	0	13	13	15/10/2018
4.	Domar	Paschim Chikonmati	Domar	Nilphamari	0	13	13	26/09/2018
5.	Hatibandha	Romniganj	Hatibandha	Lalmonir	0	12	12	25/09/2018
6.	Satkhira	Ibdul Islam's resident	Satkhira Sadar	Satkhira	0	13	13	25/09/2018
7.	Rupsha	Humayun Kabir's resident	Fakirhat	Bagerhat	0	12	12	01/10/2018
8.	Pirojpur	Shanti Ranjan Saha's resident	Pirojpur Sadar	Pirojpur	0	12	12	12/10/2018
9.	Jhalokathi	Hanif's resident	Jhalokathi Sadar	Jhalokathi	0	10	10	14/10/2018
10.	Bhanga	Rafiqudin Talukdar's resident	Bhanga	Faridpur	0	11	11	21/09/2018
11.	Kaliganj	Abdul Awal's resident	Kaliganj	Gazipur	0	12	12	10/10/2018

12.	Meherpur	Salma Begum's resident	Meherpur Sadar	Meherpur	0	14	14	26/09/2018
13.	Maheshpur	Abdul Baten's resident	Moheshpur	Jhenaidah	0	9	09	25/09/2018
14.	Shibchar	Muslem Howladar's resident	Shibchar	Madaripur	1	15	16	18/09/2018

Table 7-6: Location and Number of participants of Gender Consultation for Transmission Line

SL. NO.	Name of Transmission Line	Venue	Sub-district	District	No. of Male(M)/ Female(F)		Total participants	Date
					M	F		
1.	Pirojpur-Bagerhat	Bijoy Saha's resident	Kachua	Satkhira	0	12	12	07/10/2018
2.	Domar-Hatibandha	Baburhat	Dimla	Nilphamari	0	14	14	25/09/2018
3.	Meherpur-Kushtia	Md. Jibrail's resident	Meherpur Sadar	Meherpur	0	12	12	27/09/2018
4.	Niyamatpur-Patnitola	Monir's Mango Garden	Niyamatpur	Naogaon	0	13	13	30/09/2018
5.	Purbasadipur - Domar	Paschim Chikonmati	Domar	Nilphamari	0	8	8	26/09/2018
6.	Satkhira-Rupsha	Muktar's resident	Tala	Satkhira	0	11	11	23/09/2018

7.5 Summary of consultations on Environment

316. Ten FGDs on transmission line environment and eleven on substations were held in September and October 2018 during the field survey. Fourteen Gender Consultations for substations and six for transmission lines were held as well. Details of FGDs and gender consultations are given in the Annex 5, and the photographs are in Annex 4. The main points are summarized below:

- In most of the places people mentioned that they came to know about the project from the ADB consultants (RMA consulting firm) field team. After knowing that the objective of the Project is to increase the supply of electricity, majority appreciated;
- The proposed areas for 15 substations are currently using for cultivation. Therefore, most people of the community will lose cultivating lands which were a source of their yearly agricultural income. The survey team informed them that the compensation will be paid for lands three times of the market value;
- People concerned about some environmental impacts on the area due to the construction. The survey team explained those impacts will be temporary and can be mitigated to minor level;

- People requested proper compensation for the trees and structures, if affected. The survey team informed them that the funds have been allocated to pay compensation for structures and replanting of trees.
- They have also raised the issue of cutting a large number of trees which will have an impact on environment. These trees save them during the cyclone and natural disasters. Therefore, the project should provide them additional compensation to plant trees. The survey team informed that cutting of trees will be confined to about 12 m width. If one tree is removed, the project should provide funds to plant 3 trees. This can be considered as a livelihood restoration plan; and
- People wanted to make sure that tower construction does not create any negative impacts on river flow or fish migration. The survey team informed that the distance between the tower foundation and the river bank would be minimum 150 m. Therefore, soil erosion to river would not take place.

317. Awareness of child labour issues and the contractors’ obligation to adhere to core labour standards will be further strengthened through trainings together with HIV/AIDS awareness improvement trainings.

8. GRIEVANCE REDRESS MECHANISM

8.1 Introduction

318. A Grievance Redress Mechanism (GRM), consistent with the requirements of ADB's SPS 2009 will be established to prevent and address community concerns, reduce risks, and assist the project to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the GRM has been designed to help achieve the following objectives: (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the project; (ii) demonstrate concerns about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations. The GRM is accessible to diverse members of the community, including more vulnerable groups such as women and youth. Opportunities for confidentiality and privacy for complainants are to be honoured where this is seen as important.

319. Unforeseen problems and issues may arise due to construction and operational impacts. The impacts of the project may raise numerous grievances and complaints on the part of affected persons. These are land related or several other non-land acquisition-based grievances and complaints. Therefore, to resolve these issues, PGCB will establish a mechanism to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the project's environmental performance. The clearance of standing trees and way-leaves within the RoW of the transmission lines can adversely affect the livelihoods and incomes of households; civil construction works can cause destructions to standing crops; stringing of transmission lines over private properties can lead to property devaluation and raise people's concerns over their personal safety; and construction work of the project could also result in various inconveniences to the general public such as access difficulties, restrictions to public places, damages to privately owned built structures and common property resources, disturbances causing from noise and dust, and issues related to labour influx etc.

320. However, the legal framework of the country may not have all-inclusive provisions nor the institutional mechanisms to effectively address all the grievances mentioned above. The Deputy Commissioner in a district may not have the legal provisions to resolve all the issues arising from land acquisitions. On the other hand, not all the project affected parties will be able to resort to legal action which is costly, time consuming and non-affordable to the poor segments of the population.

321. Therefore, the project will establish a project-based grievance redress mechanism (GRM) which is easily accessible to the aggrieved parties, transparent and accountable in grievance handling and responding both effectively and efficiently to the grievances reported by the affected parties while winning the confidence of the complainants. A well-established and well-functioning GRM would be able to resolve the grievances locally, and avoid lengthy court procedures which on the other hand could generate adverse implications on the timely implementation of the project together with reputational risks to key stakeholders.

322. PGCB will ensure that local people can express their legitimate grievance or file a complaint about the project by establishing a process to address issues raised. This can be achieved by careful implementation of the EMP, continuing consultation and communication with stakeholders during implementation by PGCB, through the project management unit (PMU) of

PGCB, various contractor(s), and local government authorities. Contact details of the PMU for filing complaints will be posted in each village in the project area.

8.2 Objectives of Grievance Redress Mechanism

323. GRM is a locally based, project-specific extra-legal way to deal with and resolve complaints and grievances faster and thus enhance project performance standards in terms of environmental, social and resettlement management. The fundamental objectives of the GRM, implemented through a Grievance Redress Committee (GRC) serving as a para-legal body, are to resolve any environmental and resettlement related grievances in consultation with the aggrieved party to facilitate smooth implementation of environmental and resettlement plans and establish accountability of the affected people.

8.3 Guidelines to Redress Grievances

324. PGCB will establish a procedure to deal with and resolve queries as well as address complaints and grievances. A policy and/or guideline will be prepared and adopted for assessing and mitigating potential social and environmental impacts through the GRM. A GRC will be formed to receive and resolve complaints as well as grievances from aggrieved persons from the local stakeholders including the Project-affected persons. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly, saving the aggrieved persons from having to resort to expensive, time-consuming legal actions. The procedure will, however, not prevent a person’s right to go to the courts of law. The GRC will be established through a gazette notification from the Ministry of Power, Energy and Mineral Resources; therefore, the GRC will be a legally constituted body.

8.4 Complaints and Grievance Mechanism

325. Affected persons may appeal any disagreeable decision, practice or activity arising from project related activities to the GRC. Affected persons will be fully informed of their rights and of the procedures for addressing complaints, either verbally or in writing during consultation, survey, and time of compensation.

8.5 Grievances Redress Committees

326. The project will establish a three-tier GRM, which will function throughout the life cycle of the project implementation and PGCB will ensure its accessibility to affected parties, and transparency and efficiency in grievance resolution. However, it will not deal or interfere with any matters which are already placed before the country’s courts of law. The Project will provide wider publicity for the GRM established using a variety of media such as brochures and leaflets printed in Bengali, and through community level awareness raising programs. The roles and functions of the GRM and its different tiers, specific locations where the different tires are established, grievance reporting procedures, time frames for grievance resolution at each level etc. will be disseminated to the affected persons as well as the general public using the above-mentioned modes of communication. Furthermore, the Project will provide orientation and training to the members of the GRM on effective grievance handling procedures.

327. **GRM – Level 1:** Level 1 of the GRM will be the project officers appointed by PGCB. The persons can be sub assistant engineers, or any other engineers appointed by PGCB to the sites.[37] Also, contractors on project sites can be windows for field level grievances. In case of grievances that are urgent and minor, aggrieved parties can easily approach PGCB's field officers and/or contractors. Contact phone numbers, mails and names of the focal persons will be posted at all construction sites at visible locations. Considering female complainants, a contact point of a female focal will be posted too. The field officers of PGCB and focal persons of the contractors will record the name of the complainants, the dates of complaints and the nature of the complaints. The field officers of PGCB and/or focal persons of contractors will communicate with the complainants to reach an amicable settlement within a period of two weeks.

328. **GRM – Level 2:** Level 2 of the GRM will be the Local Grievance Redress Committee (LGRC) chaired by one of the Executive Engineers. PGCB will establish five LGRCs, one for each Division under the project namely, Dhaka, Barishal, Khulna, Rajshai and Rangpur. The rest of the members of the GRC with special care of gender balance will include (i) the project officers from concerned project areas; (ii) the focal persons from the contractors; (iii) representatives of the concerned Unions; and (iv) representatives of the relevant government offices such as DC. Grievances that cannot be resolved at GRM-Level 1 or else if the affected persons were dissatisfied with the Level 1 resolution can submit their grievances to LGRC. The meetings of the LGRC will be held at the local office of PGCB or the union office in the area where the complaint originated. The LGRC can convene the affected person to explain his/her grievance at the meeting. The complainant can also send his/her nominee to the LGRC, if he/she is unable to physically participate in the LGRC. During the committee deliberations, LGRC will clarify the issues involved, and would try its best to reach a settlement acceptable to both the affected person and the project within a period of two weeks. The executive engineer can also consult the deputy project director (DPD) for advice and guidance if necessary. If an agreement or resolution is reached, the key points of the agreement/resolution will be summarized, documented and signed by both the affected person and the members of the GRC. The project officer of PGCB at site level from where the complaint is submitted to LGRC will assist in the documentation and record keeping, summaries of which will also be reported to ADB through monitoring reports.

329. **GRM – Level 3:** Level 3 of the GRM will be the Project Management Unit (PMU) of PGCB. The GRC at the PMU with special care of gender balance will be chaired by Project Director (PD) and comprise (i) External monitor for resettlement; (ii) dedicated safeguards specialist(s) under PMU/ESU; (iii) relevant technicians and engineers from PGCB and contractor; and (iv) representatives of the relevant government offices. The complainant and/or representative will be called to appear before the Level 3 GRC and explain his/her grievance. An officer from ESU/PMU will coordinate with the complainant. The complainant can send his/her nominee to the GRC, and in the event of both being unable to physically participate in the GRC, the ESU/PMU officer will explain the grievances on behalf of the complainant. If necessary, GRC members will undertake field inspections to verify the issues reported. Level 3 GRC will reach a settlement through consensus among its membership, failing which the decision may be taken on a majority vote. The GRC located at PMU will conclude its proceedings within a period of one month since the submission of the grievance and inform the complaint the conclusion. Any significant grievances which may pose a life-and-death scenario should be resolved immediately. Also, in the case of critical issues to be resolved, PD can also consult the managing director of PGCB for advice and guidance. The ESU/PMU officer will assist in the documentation and record keeping, and

[37] The DWZTGEP envisages recruiting 2 deputy project directors, 12 sub-divisional engineers and 42 assistant engineers. (DPP, April 2019)

summary outcomes will be reported to ADB through monitoring reports. Also, the external monitor will take a role as a liaison between the GRC and ADB.

330. Apart from the above described three levels of GRM, contractors will also establish GRM at site level which will exclusively address the issues and grievances of the labour teams. However, whenever necessary, the aggrieved laborers also have the choice of approaching the project based GRM.

331. The GRM does not impede access to the legal system. Affected persons can resort to legal action through the country's judiciary system at any time. They can also submit their grievances to ADB's Accountability Mechanism, which has both a problem-solving function to respond to concerns of project affected people and a compliance review function where there is discrepancy with implementation of ADBs operational policies.

332. The member secretary of GRCs will be regularly available and accessible for affected persons to address concerns and grievances. The legal advisor of the PGCB will support the GRCs in the regular process.

Table 8-1: Hierarchy of GRMs

Level	Members at Different Levels & Time Frame
Field Level	Project officers appointed by PGCB (Time frame is two weeks)
Local Community Level	1. Executive engineer of the project; 2. Contractor or his representative; 3. A male and a female member of the concerned Union; 4. A representative of the aggrieved party (the representative should be a female if the aggrieved party is a female). (Time frame is two weeks)
PMU Level	1. Project Director of the relevant subproject; 2. Resettlement Specialist of the environmental and social unit; 3.Team Leader of the contractor; 4. The one responsible for land acquisition; 5. A representative of the aggrieved party; 6. A representative of the civil society. (Time frame is one month)

8.6 Scope and Jurisdiction of GRC

333. The scope of work and jurisdiction of the GRC are:

i) The GRC shall evaluate, consider and resolve grievances, related to social/resettlement and environmental mitigations during implementation, received by the committee;

ii) Major grievances that might require mitigations include construction site waste disposal, soil erosion to agricultural lands, access roads, and site preparation activities; fugitive dust and other emissions (e.g. from vehicle traffic, land clearing activities, and materials stockpiles), noise from heavy equipment and traffic, materials and oil spills associated with heavy equipment operation and fuelling activities. Any grievances presented to the GRC should ideally be resolved on the first day of the hearing, and no more than a period of two weeks, in cases of complicated cases requiring additional investigations. Grievances of indirectly affected persons and/or persons affected during project implementation will also be reviewed by GRC;

iii) The GRC will not engage in any review of the legal standing of an “awardee” other than in direct losses or distribution of shares of acquired property among the legal owners and associated compensation or entitlement issues;

iv) GRC decisions should ideally be arrived at through consensus, failing which resolution will be based on majority vote. Any decision made by the GRC must be within the purview of social, resettlement and environmental policy framework;

v) The GRC will not deal with any matters pending in the court of law. However, if the parties agree through a written appeal, GRC can mediate. The parties will withdraw the litigation;

vi) A minimum of three members shall form the quorum for the meeting of the GRC; and

vii) The Legal Adviser will not play role as a member but will put his/her lawful advice/ suggestion during GRC sessions

8.7 Filing Grievance Cases and Documentation

334. Grievances will be filed without any fear and stress. The contractors will support the affected persons in drafting the grievances. All grievances must be submitted in writing to the Chair, GRC. The affected person himself/herself or appointed agent such as local elected officials/legal advisors are to represent the complainants. The judgment made by GRC will be communicated to the concerned affected person mainly in writing, also will be made allowances for those that are illiterate to be able to access. If dissatisfied, and with the agreement of the GRC, the affected person may request a further review of the judgment of GRC by the Project-level GRC. In such cases, the case will be forwarded to the Convener of the project-level GRC with all documentations. If he/she remains unsatisfied, he/she can go to the formal court of law or accountability mechanism for SPS related grievances.

335. Through community meetings, notices and pamphlets in the local language (Bangla) and the GRC procedures and operational rules will be publicized widely, so that APs are aware of their rights and obligations, and procedure of grievance redresses.

336. GRC meetings will be held as agreed by the Committee, in the respective field offices of the contractors/PGCB or other location(s). If required, GRC members may carry out field visits to verify and review the issues at dispute, including titles/shares, the reason for any delay in payments or other relevant matters. Through the process described below the affected persons will address the complaints and grievances.

Table 8-2: Grievance Resolution Process

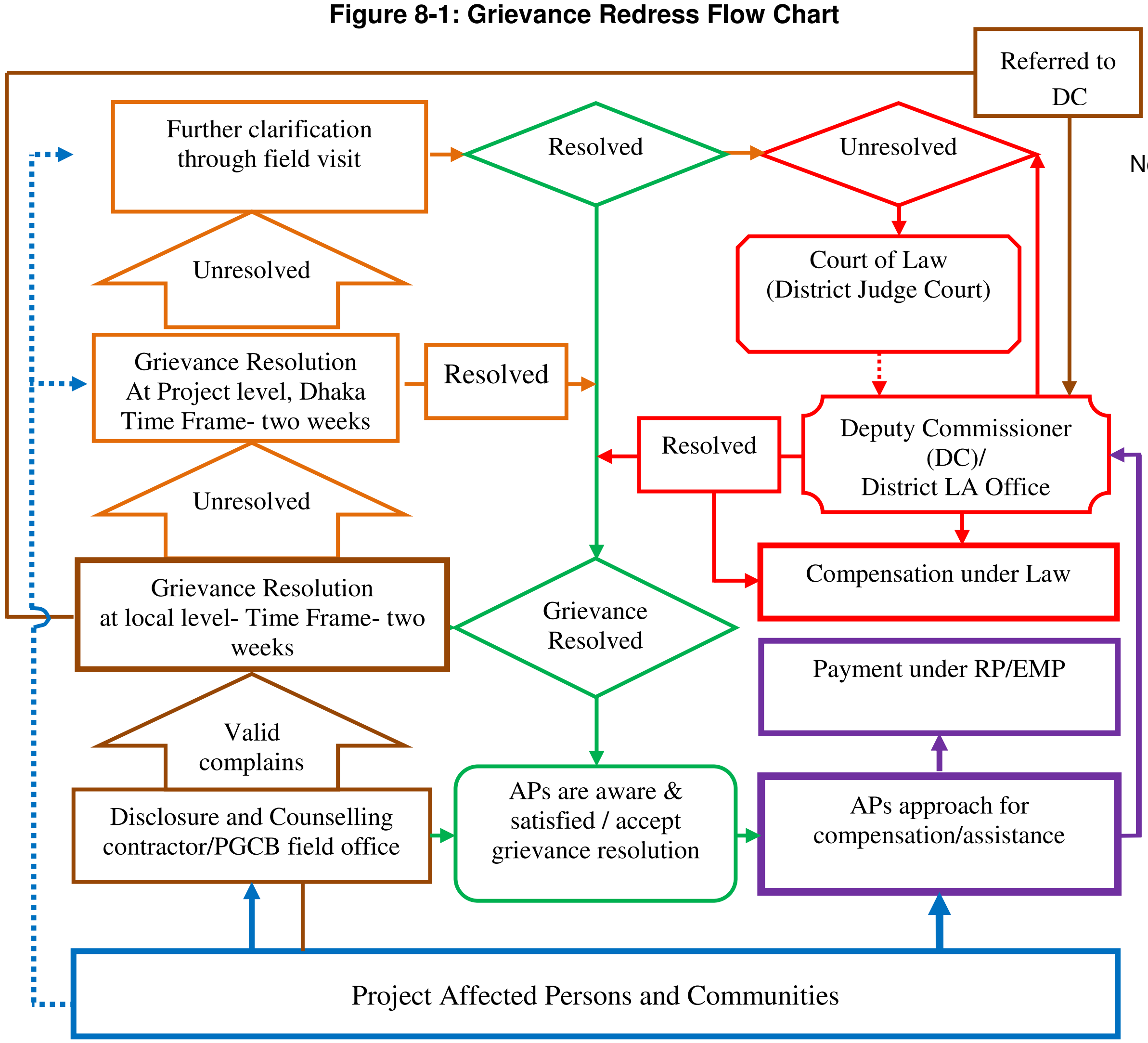
Step 1	• Complaint relating to the environmental impacts such as construction site waste disposal, soil erosion to agricultural lands, access roads, and site preparation activities, fugitive dust and other emissions (e.g. from vehicle traffic, land clearing activities, and materials stockpiles), noise from heavy equipment and traffic, materials and oil spills associated with heavy equipment operation and fuelling activities will be entertained by the GRC
Step 2	• The contractor assists the aggrieved affected persons to produce a written complaint to the convener of GRC with stories and expectations.[38] The contractor counsels the aggrieved persons on the mandate and procedure of grievance resolution.

[38] Contractor should solve minor grievances if they can resolve at once, with documentation to show responsiveness.

	• GRC scrutinize the case records and sort out cases to be referred to the Deputy Commissioner or the court of law and those to be resolved in GRC. • Hearing is organized on cases with merit at the GRC secretariat or at Union Parishad/Municipality Offices at local level and resolution is given by the GRC in one month of receiving the complaints. • Aggrieved APs satisfied with the resolution approach the executing agency for assistance under the provision of the EMP/ RP. The agreed resolution is forward to PGCB for approval by the Project Director. • In case the resolution is not acceptable to the aggrieved person, he/she approaches the Project Director through the GRC convener with assistance from the contractor for further review. • Aggrieved APs may opt to approach to the Court of Law, if the resolution at PGCB is not acceptable to him/her.
Step 3	• The resolution accepted by the aggrieved persons at any level (local, PMU) is approved by the Project Director and forwarded back to the Conveners' office keeping records at his/her office.

EA = executing agency, DP = Displaced Person, GRC = grievance redress committee, NGO = non-governmental organization, PGCB = Power Grid Company of Bangladesh, PMU = Project Management Unit.

Figure 8-1: Grievance Redress Flow Chart



Note: the ongoing issues which pose a life- and – death scenario shall be resolved immediately.

337. The project level GRC at headquarters will keep records of complaints received for its use, as well as for use by ADB during regular supervisions. The GRM does not impede access to the legal system. Affected persons can resort to legal action through the country's judiciary system at any time. They can also submit their grievances to ADB's Accountability Mechanism.

8.8 Approval of GRCs and Entitlements of GRC Members

338. All the decisions and proceedings of GRC meetings at any level will be finally approved by the contractor and PGCB.

339. All GRC members will attend a training and orientation meeting earlier, before commencement of their work. Project staff and consultants/environment specialists will conduct the training.

340. Grievances will be heard once a month by GRC. Before starting project work, the resettlement process must be completed, the GRC may meet more than once in every 30 days depending upon the number of such cases. Within two weeks of the hearing of the grievances the LGRC will inform the concerned aggrieved persons of their decision. If necessary, GRC will conclude its proceedings based on field inspection within a period of one month since the submission of grievances.

8.9 Grievance Redress Monitoring

341. The Project Directors of PMU will keep records of all the grievances and their redress in monthly cumulative formats, which will be provided by the contractor and to be signed by the convener of the GRC. The format will contain information on the number of grievances received with nature, those resolved, and the number of unresolved grievances.

9. ENVIRONMENTAL MANAGEMENT PLAN

342. ADB's SPS 2009 requires that an Environmental Management Plan (EMP) be prepared as part of an IEE report. This EMP aims to (i) comply with ADB requirements and guidance, (ii) comply with applicable environmental requirements of the Government of Bangladesh, which requires an EMP to be part of an IEE or EIA, (iii) achieve sustainable and environmentally and socially acceptable development interventions for transmission line and substation development, and (iv) inform the Government of Bangladesh involved agencies and the future contractors on environmental management strategies.

343. The EMP has been prepared for the substation and transmission line subprojects. It describes the anticipated impacts, monitoring requirements, and development of mitigation measures with respect to the following stages: (i) pre-construction, (ii) construction, and (iii) operation and maintenance. Detailed, mitigation measures and monitoring plans are developed and will be implemented during the project implementation phase.

344. The EMP for the project identifies feasible and cost-effective mitigation and remediation measures to be taken to reduce potential significant, adverse impacts to acceptable levels. Here, proper mitigation measures are proposed for each potential impact, including details of responsible parties for implementation of the mitigation measures and the associated monitoring program.

345. Table 9-1 to Table 9-5 show the EMP and Environmental Monitoring Plan (EMoP) and the costs for supporting the activities. Environmental monitoring reports will be submitted to ADB on a semi-annual basis by the Design and Supervision Consultant (DSC) & PGCB. If any of the safeguard requirements that are covenanted in the legal agreements are found not to be satisfactorily complied, an appropriate corrective action plan (CAP) will be developed and implemented as agreed upon with ADB to rectify unsatisfactory safeguard compliance. The environment monitoring reports, the CAP and the updated IEE if any, submitted by PGCB during project implementation are disclosed locally and on the ADB website upon receipt.

Table 9-1: Environmental Management Plan[39] for the Impacts of the Substation Subprojects in Components 1 and 2

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Super-vision Agency
(a) Preconstruction/Construction Stage				
Land acquisition/ requisition	Loss of 80.92 acres of land for the construction of 15 substations and one existing (Satkhira) substation (mainly agricultural/ paddy, waterbody, marsh) permanently at substation sites. Temporary loss of land (requisition) for construction camps etc.	Prior to commencement of construction activities, the owners of the affected lands must be notified and provided proper compensation in time as per the government and ADB guidelines. As per the government and ADB guidelines, RP should be prepared for land acquisition/ requisition/ compensation and follow it. Use GIS instead of AIS, in order to reduce land requirement.	DC	DSC/ PGCB
Top soil	As the lands, except Purbachal 2, are paddy fields removal of top soil might not be required before the land filling.	Site specific mitigation measures will be required in 14 substation lands, except at Purbachal -2 GSS site	Contractor	DSC/ PGCB
Cutting of trees/ Clearing of vegetation	Lands selected for the construction of 15 substations are paddy fields, including small extents of marshy lands and waterbodies. Only the land earmarked for Purbachal-2 substation (Dhaka) is a highland. Fifty-six trees (> 5 m in height) to be removed from these lands. Loss of standing crops (if any), grass and bushes at substation sites and construction camp sites is anticipated.	Prior to the start of removal of trees/ clearing of vegetation, provide adequate compensation to the owners.	Contractor	DSC/ PGCB
Fauna (Wildlife)	Possible 3-acre waterbody loss. Disturbance of wildlife due to project activities such as earthworks, moving of project equipment and transports, especially during night time.	3 acres of waterbody loss might be fully restored as the compensation will enable waterbody owner to build similar water bodies within the paddy land they will buy. DC shall ensure the compensation is for restoration of lost waterbodies with restoration of new waterbodies at same size prior to the old waterbodies to be filled up.	DC Contractor	DSC/ PGCB

[39] Site-specific environmental management plans with quantified impacts and their mitigations will be prepared by contractors and endorsed by PGCB prior to access to the sites permitted.

		Prepare construction management plan (CMP, by the contractor) to be approved by PGCB before access to site is permitted and follow it properly. Follow the government rules and regulations, EHS guidelines and WHO noise guidance whichever is more stringent on noise. Project workers should not disturb or kill any wildlife. Fishing is not allowed.		
Construction Waste	Generation of construction wastes from the construction materials.	Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time. Provision of facilities for handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements. Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials. Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste. Use of construction materials containing recycled content when possible and in accordance with accepted standards. Adequate collection, separation, and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated, licensed, engineered and sanitary landfills shall be provided.	Contractor	DSC/ PGCB
Drainage congestion and flooding	Reducing floodplain storage area and increase local flooding, due to earth filling of substation sites and access roads above highest flood level (HFL). This will be a major environment impact as the 14 lands selected for construction of substations consist of paddy lands, marshes and waterbodies. Drainage congestion if the surrounding sites are blocked by the earth embankment.	Provide culverts enough for accommodating flood flows in the access road of the substation. Ensure timely monitoring, especially if construction works are carried out during the monsoon period. Provision for pumping of congested water, if needed. No discharge to the surface water. Consideration of the HFL during design of substations, to avoid inundation. Substation civil designs will include drainage and flood control measures to avoid adverse impacts by	Contractor	DSC/ PGCB

		land filling in new substation lands and also specify that the soil/sand shall be sourced only from existing licensed suppliers who are authorised by the government to supply soil/sand for land filling.		
Noise level	Noise pollution due to construction activities, generators and construction vehicle movement.	Use of noise reducers in heavy construction equipment. It is required that no construction should be allowed during night time (9 PM to 6 AM). As per EHS guidelines, avoid prolonged exposure to noise (produced by equipment) by workers. Regulate use of horns and avoid use of hydraulic horns in project vehicles. Generators should be placed within rooms (concrete walls with roof). Noise levels will continue to be monitored in pre-construction and construction, and if there is exceedance at the village edges, noise baffles will be constructed.	Contractor	DSC/ PGCB
Air quality and dust	Air pollution and dust generation due to construction activities especially due to the underground cabling, generators and construction vehicle movements.	All vehicles (e.g., trucks, equipment, and other vehicles that support construction works) shall be well maintained and not emit dark or smoky emissions in excess of the limits described in the EQS. Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines. Dust suppression facilities (water sprayer) shall be available where earth and cement works are required. Spray water on dry and loose surfaces of the construction sites regularly. Maintain adequate moisture content of soil to minimize dust during transportation, compaction and handling. Construction materials (sand, gravel, and rocks) and spoil materials will be transported in trucks covered with tarpaulins.	Contractor	DSC/ PGCB

		Sprinkle and cover stockpiles of loose construction materials (e.g., fine aggregates, sand). Avoid use of equipment such as stone crushers at the sites, which produce significant amount of particulate matter. N95 masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction.		
Soil quality	Soil pollution	Laboratory analysis of the river bed materials to be confirmed prior to starting collection from the river by existing licensed suppliers. Prevention of spillage and leakage of liquids at construction sites and camp. Ensure no use of transformers containing PCB to avoid soil and air pollution. Oil storage in drums stored on impermeable surface with 110% bunded capacity.	Contractor	DSC/ PGCB
Siting of construction camps	Removal of vegetation such as grass, standing crops (if any) shrubs and trees. Environmental pollution (such as air/dust, noise, water, wastes, excess soil) affecting nearby the settlements.	Prior to the start of clearing of vegetation, provide adequate compensation to the owners in time. Locate construction camps away from residential settlements, cultural sites, water bodies, etc. (minimum 0.5 km). Try to use fallow land to avoid crop damage. Just after completion of the construction, hand over the camp sites to the owners as in earlier condition.	Contractor	DSC/ PGCB
Traffic congestion/ road accident	Traffic congestion and road accidents due to movement of construction vehicles.	Follow Bangladesh Road Traffic Authority (BRTA) traffic rules and regulations to develop a traffic plan. Schedule deliveries of materials/ equipment during off-peak hours. Engage flagmen especially at the entry of the substation sites and construction camps for traffic control. Engage experienced drivers to drive project vehicles. Arrange for signal lights at night. Prepare and follow proper traffic management to be approved by PGCB before the access to site granted.	Contractor	DSC/ PGCB

		Avoid stockpiling of materials, especially at the road sides, that could disturb traffic movement.		
Pollution due to wastes	Pollution due to wastes (construction wastes from construction activities and general wastes from workers' camps)	Solid wastes collection system will be essential, which should include separation and collection of solid wastes in the dustbins/waste containers throughout the work sites, construction yard/ labour camps. Wastes such as pieces of rods and wood, newspapers, containers etc. can be sold to the vendors and the rest of the waste must be taken to the licensed, engineered sanitary landfill by the contractor or licensed third party. A log of the disposal of toxic and other waste materials is to be kept by the Contractors. Prior to the start of construction, contractor should prepare waste management plan (WMP) based on the EMP, for approval by PGCB before access to site reflecting national and EHS guideline requirements.	Contractor	DSC/ PGCB
Community health and safety (H&S)	Community H&S nearby the substation site could be affected.	Safety barriers and warning signs surrounding the construction site. Generators should be placed in closed rooms. Formulate and implement an emergency risk management plan, for approval by PGCB before access to site reflecting national and EHS Guideline requirements.	Contractor	DSC/ PGCB
Occupationa l health and safety (H&S)	Health and safety risks of construction workers.	An experienced Health & Safety (H&S) Manager must be engaged on each works package with appropriate qualifications and experience and not doubling up on any other job by the contractor prior to start of construction. Before access to site granted, contractor to prepare H&S plan based on risk assessment for approval by PGCB following national and EHS guideline requirements. Only permit trained and certified workers to work with any electrical equipment. Safety induction by the H&S Manager should be provided for the workers and visitors before they will be allowed to access the site.	Contractor	DSC/ PGCB

		Prior to starting work, a tool box meeting should be arranged by the H&S Manager for the workers. First Aid Box and personal protective equipment, PPE (such as safety helmets, safety shoes, eye protection glasses, ear plugs/muffs, waist belts, masks, hand gloves, body protective aprons and insulating boots) must be provided to the workers and ensure their use by the workers. Safety signs, health signs, prohibition signs, warning signs, mandatory signs, emergency escape signs, first-aid signs, information signs, signboards, supplementary signboards, safety collar, symbol, pictogram, illuminated signs, acoustic signals, verbal communication and hand signals must be fitted at the designated sites of the subproject areas.		
Physical Cultural Resources	Possibility of damage to Physical Cultural Resources.	Chance Find Procedure to be developed following the IFC Guidance Note 8 and BAN regulations	Contractor	DSC/ PGCB
Employment generation/ income	Employment opportunities for the local people, especially for PAPs.	Employ local people, especially PAPs, for the project activities (as much as possible).	Contractor	DSC/ PGCB
(b) Operation Stage				
Tree replantation	A total of 75,000 indigenous tree species (three times the number of affected trees from both substations and transmission line) can be planted in home gardens and govt. lands	Planting of 75,000 saplings to replace felled trees, on the side slopes of the access roads, during the monsoon period. The number of saplings which die within 3 years of planting should be replaced by new saplings. Nursing period of planted saplings should not less than 3 years.	FD	PGCB
Drainage congestion	Drainage congestion could occur in the surface drains within the substation area, if proper O&M is not done regularly.	Clean the drains, especially during the monsoon, regularly. Ensure adequate monitoring.	PGCB	PGCB
Community health and safety	Community H&S nearby the substation site.	Safety barriers and warning signs surrounding the substation sites with awareness raising programme. Generators should be placed in the closed rooms. operational H&S risk assessment to be undertaken.	PGCB	PGCB

Safety and security of workers	Risk to continuous power supply and even damage of substation.	Ensure security of substation in collaboration with law enforcement agencies. Keep complaint book in the substation for recording of people's complaints. Ensure availability of adequate safety gear for substation operations.	PGCB	PGCB
Power Supply	Due to adequate reliability of power supply, social life and economic condition of the people will be improved.	O&M of the substations should be done in time for adequate power generation.	PGCB	PGCB
Short Circuit/Accident	Due to a possible short circuit of the substation, disruption of power and accident could occur.	O&M of substations should be done in time by experienced personnel.	PGCB	PGCB

ADB = Asian Development Bank, BRTA= Bangladesh Road Traffic Authority, CMP = Construction Management Plan, DC = Deputy Commissioner, DSC = Design and Supervision Consultants, EMP = Environmental Management Plan, EQS = Environment Quality Standards, FD = Forest Department, GoB = Government of Bangladesh, H&S = health and safety, HFL = highest flood level, km = kilometre, m = meter, O&M = operations and maintenance, PAP = project affected person, PCB = polychlorinated biphenyl, PGCB = Power Grid Company of Bangladesh, PPE = personal protective equipment, RP = Resettlement Plan, WMP = waste management plan.

Table 9-2: Budget for Tree Planting and Environment Management Plan (EMP) implementation Cost

Item	Qty	Rate	Total Amount ($)
Tree planting (three times of trees removed for project interventions)	75,000 seedlings/ saplings to be planted in home gardens and govt. lands, maintenance for three years	Lump sum	50,000
Contractor's EMP implementation cost	1.5% of the contractor's civil cost	Lump sum	1,550,000*
Sub total			**1,600,000**
Environmental quality Monitoring (water, air, noise, soil etc.)			
Laboratory analysis (see Table 9.6)		Lump sum	200,000*
Sub Total			**200,000**
Total Cost			**1,800,000**
1,800,000			

*cost will be included in the contractor's turnkey price

Table 9-3: Mitigation Measures for the Impacts of Transmission Lines, LILO and underground cabling subprojects in Components 1 & 2[40]

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(a) Preconstruction/Construction Stage				
Tree felling, Clearing of vegetation	22,790 trees (>5 m in height) will be directly affected by cutting and trimming, as well as standing crops (if any) and bushes along the RoW will also be affected.	Prior to the start of clearing of vegetation, provide adequate compensation to the owners.	Contractor	DSC/ PGCB
Requisition of land (loss of 10.6 acres of land for the construction period of about 3- 4 years, and beyond)	Loss of 14.92 acres (6.0 ha) land permanently for 1,140 tower bases of the TL/LILO lines.	Prior to commencement of construction activities, the owners of the affected land must be notified and provided proper compensation as per GoB and ADB guidelines. As per GoB and ADB guidelines, RP should be prepared for land acquisition/requisition/compensation and follow it.	DC	DSC/ PGCB
Fauna (Wildlife)	Disturbance of wildlife, especially birds, due to project activities such as moving of project equipment and transports (especially during night time).	Preparation of construction management plan (approved by PGCB before access to site is permitted) by the contractor and follow it. Follow GoB rules and regulations on noise. Project workers should not disturb or kill birds or other animals.	Contractor	DSC/ PGCB
Construction Waste	Generation of construction wastes from the construction materials.	Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time. Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste. Use of construction materials containing recycled content when possible and in accordance with accepted standards.	Contractor	DSC/ PGCB

[40] Site-specific environmental management plans with quantified impacts and their mitigations will be prepared by contractors and endorsed by PGCB prior to access to the sites permitted.

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated, licensed, engineered and sanitary landfill shall be provided.		
Noise level	Noise pollution due to construction activities, generators, and construction vehicle movement.	It is recommended that no construction should be allowed during night time (9 PM to 6 AM). Avoid using of construction equipment producing excessive noise at any time. Avoid prolonged exposure to noise (produced by equipment) by workers. Regulate use of horns and avoid use of hydraulic horns in project vehicles. Follow the government rules and regulations, EHS guidelines and WHO noise guidance whoever is more stringent on noise.	Contractor	DSC/ PGCB
Air quality and dust	Air pollution and dust generation due to construction activities, especially during the underground cabling, generators and construction vehicle movement.	All vehicles (e.g., trucks, equipment, and other vehicles that support construction works) shall be well maintained and not emit dark or smoky emissions in excess of the limits described in the Environment Quality Standards (EQS). Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines. Dust suppression facilities (back pack water sprayer) shall be available where earth and cement works are required. Spray water on dry and loose surfaces of the construction sites regularly to minimize dust. Maintain adequate moisture content of soil during transportation, compaction and handling. Construction materials (sand, gravel, and rocks) and spoil materials will be transported in trucks covered with tarpaulins. Sprinkle and cover stockpiles of loose construction materials (e.g., fine aggregates, sand). Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction.	Contractor	DSC/ PGCB

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
Soil quality	Soil pollution.	Prevention of spillage and leakage of liquid at tower sites.	Contractor	DSC/ PGCB
Sitting of construction camps (if needed for tower construction)	Temporary loss of land for the construction camps for towers. Clearing of standing crops (if any), grass and bushes. Environmental pollution (such as air, noise, water, wastes and soil) affecting nearby the settlements.	Prior to commencement of construction activities, the owners of the affected land must be notified and provided proper compensation as per GoB and ADB guidelines. As per GoB and ADB guidelines, RP should be prepared for land acquisition/ requisition /compensation. Prior to the start of clearing of vegetation, provide adequate compensation to the owners in time. Locate construction camps away from residential settlements, cultural sites, water bodies etc. (minimum 0.5 km). Try to use fallow land and just after completion of construction, hand over camp sites to the owners as in earlier condition.	Contractor	DSC/ PGCB
Traffic congestion/road accident	Traffic congestion and road/railway accident due to movement of construction vehicles.	Follow Bangladesh Road Transport Authority (BRTA) traffic rules and regulations to develop a traffic plan. Schedule deliveries of material/ equipment during off-peak hours. Engage flagman where needed. Engage experienced drivers to drive project vehicles. Arrange for signal lights at night, for proper traffic management. Avoiding stockpiling of materials, especially at the roadsides, that could hamper traffic movement.	Contractor	DSC/ PGCB
Pollution due to wastes	Pollution due to wastes (construction wastes from construction activities and general wastes from workers' camps).	Solid wastes collection system will be essential, which should include separation and collection of solid wastes in the dustbins/waste containers throughout the tower work sites. Wastes, such as pieces of rods and wood, newspapers, containers etc. can be sold to vendors and the rest must be taken to the licensed, engineered sanitary landfill by the Contractors or licensed third party. A log of the disposal of toxic and other waste materials is to be kept by the Contractors. Contractor should prepare a waste management plan based on the EMP, for approval by PGCB before access to site reflecting national and EHS guideline requirements.	Contractor	DSC/ PGCB

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
Community health and safety (H&S)	Community H&S along the transmission line.	Safety barriers and warning signs surrounding the tower construction site. For structures remaining in the RoW a targeted consultation with residents will be undertaken prior to determining final alignment to discuss the health and safety implications, with education program for residents and communities on how to minimize the risks involved. Given the risk of damage to structures within RoW, during construction the contractor will prepare a construction method statement for installation of transmission lines above structures including community health and safety risk assessment and management plan, and provide compensation for any damage caused. Further, final alignment will be reviewed if structures can be relocated out of the right of way with particular emphasis on avoiding schools. Lightening conductor and earth wire will be installed on the transmission line. Resistance of turbine tower feet will be designed to limit lightning back voltage. Metallic components on structures located within the right of way will be grounded, where directly under transmission line. If there are structures with more than about 500m^2 of metal surface, provision for reconstruction in alternative materials. If there are structures used to store highly flammable materials, alternative storage arrangements will need to be provided. Formulate and implement an emergency risk management plan, for approval by PGCB before access to site reflecting national and EHS guideline requirements.	Contractor	DSC/ PGCB
Occupational health and safety (H&S)	Health and safety risks of construction workers.	An experienced H&S Manager must be engaged on each work package with appropriate qualifications and experience and not doubling up on any other jobs by the contractor prior to the start of construction of the towers. Only permitting trained and certified workers to work with any electrical equipment. Before access to site granted, contractor to prepare H$S plan based on risk assessment for approval by PGCB following national and EHS guideline requirements.	Contractor	DSC/ PGCB

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		Safety instruction by the E&H Manager should be provided for the workers and visitors before they will be allowed to access the site. First aid box and personal protective equipment, PPE (such as helmet, safety shoes, eye protection glass, ear plugs, waist belt, mask, hand gloves, body protective apron, ear muff and insulating boots, as needed) must be provided to the workers, and ensure their use by workers. Safety signs as needed at the tower sites.		
Employment generation/ income	Employment opportunities for the local people, especially for PAPs.	Employ local people, especially PAPs, for the tower construction activities as much as possible.	Contractor	DSC/ PGCB
(b) Operation Stage:				
Tree replantation	A total of 75,000 indigenous tree species (three times the number of affected trees from both substations and transmission line) can be planted in home gardens and govt. lands	Planting of 75,000 saplings to replace felled trees, on the side slopes of the access roads, during the monsoon period. The number of saplings which die within 3 years of planting should be replaced by new saplings. Nursing period of planted saplings should not less than 3 years.	FD	PGCB
Community health and safety	Community H&S along the transmission lines.	Safety barriers and warning signs at each tower with awareness raising programme. Operational H&S risk assessment to be undertaken.	PGCB	PGCB
Safety and security of workers	Risk to continuous power supply.	Ensure security of transmission towers in collaboration with law enforcing agencies. Ensure availability of adequate safety gear for tower maintenance workers.	PGCB	PGCB
Power Supply	Due to adequate reliability of power supply, social life and economic condition of the people will be improved	O&M of towers should be done in time to ensure their integrity.	PGCB	PGCB

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
EMF	Due to EMF, human health may be affected	For housing structures[41], clearance between the transmission line and roof tops should be 6.5 m - 8 m and for river crossings it will 14.6 m -15.9 m, warning signs of TL will be needed on the river for navigations/fishing. Note that no houses will be directly affected by the TL/LILO lines.	PGCB	PGCB

ADB = Asian Development Bank, BRTA= Bangladesh Road Traffic Authority, DC = Deputy Commissioner, DSC = Design and Supervision Consultants, EMF = electromagnetic field, EMP = Environmental Management Plan, EQS = Environment Quality Standards, GoB = Government of Bangladesh, H&S = health and safety, ha = hectare, km = kilometre, LILO = line-in line-out, m = meter, O&M = operations and maintenance, PAP = project affected person, PGCB = Power Grid Company of Bangladesh, PPE = personal protective equipment, RoW = right of way, RP = Resettlement Plan, TL = transmission line.

[41] Currently no housing or school structures directly underneath the lines, during the final alignment selection, PGCB will try every effort to avoid housing or school structures directly underneath the line. For structures remaining in the right of way a targeted consultation with residents will be undertaken prior to determining final alignment to discuss the health and safety implications, with education program for residents and communities on how to minimize the risks involved.

Table 9-4: Environmental Monitoring Plan for Substation Subprojects

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Preconstruction[42]/Construction Stage							
Clearing of vegetation	Checking whether proper compensation as mentioned in the RP is received by PAPs.	DoE/FD	Inspection	Regular frequency during site clearing operations.	Within the substation land and access road sites	Contractor/FD	DSC/PGCB
Fauna (Wildlife)	Checking whether wildlife is disturbed/ killed by the workers.	DoE/FD	Inspection	Weekly	Substation sites	Contractor/FD	DSC/PGCB
Drainage Congestion/ Flooding	Checking drainage congestion and top of substation site above HFL.	Hydrological/ Drainage study	Inspection	Regularly during earthworks	Substation sites	Contractor	DSC/PGCB
Noise Pollution	Ambient noise level	DoE Noise Pollution Control Rules, 2006	Measurement	Regularly during construction at the substation sites and during piling works Monitor noise of traffic movements at substation sites with exceptionally large volume of infills during peak movements	At construction sites, roadsides and camps	Contractor	DSC/PGCB
Dust Pollution	Dust should be controlled by water spraying regularly, especially during dry period.	DoE guidelines	Inspection	Regularly During land fill works should do quantitative dust monitoring at substation sites	Substation sites	Contractor	DSC/PGCB

[42] The EPC contractor will collect a set of baseline data prior to any civil work commencement.

Surface Water Quality	pH, BOD_5, COD, NH_3-N, Total Petroleum Hydrocarbons (TPH), coliforms, PO_4	DoE Standards	Sampling and Laboratory Analysis	Quarterly for substation sites	Nearby Waterbodies	Contractor	DSC/PGCB
Ground Water/Drinking Water Quality	pH, Mn, Fe, As, TC, FC, TPH	DoE Standards	Sampling and Laboratory Analysis	Quarterly at all tube wells within 500m	At construction camps	Contractor	DSC/PGCB
Pollution due to Wastes	Checking collection, storage, transportation, and disposal of waste. Waste from construction sites to be collected and disposed safely to the designated sites. Wastes from labor camp to be disposed properly at the designated sites.	DoE guidelines	Inspection	Regular	Construction camps	Contractor	DSC/PGCB
Traffic Congestion/ Road Accident	Checking meeting points of existing road and access road	BRTA	Inspection	Regular	Meeting point of existing road and access road	Contractor	DSC/PGCB
Occupational health and safety	Checking health, use of PPE and first aid facilities, DWQ, sanitation and accommodation. Record of all occupational H&S incidents, any people lost time or fatal must be reported to ADB within 48hrs with corrective action plan.	DoE/IFC guidelines	Inspection and testing of DWQ	Regular	At construction sites and camps	Contractor	DSC/PGCB
Community health and safety	Awareness of local people and staying safely away from the project activities Record of all community H&S incidents, any people	DoE/IFC guidelines	Inspection	Regular	At construction site and camps	Contractor	DSC/PGCB

	lost or fatal must be reported to ADB within 48hrs with corrective action plan.						
Physical Cultural Resources	Chance find procedure to be developed	DoE/IFC guidelines	Inspection	Regular	At construction site	Contractor	DSC/PGCB
Operation Stage							
Tree replantation	Replanting of saplings and checking replacement of dead saplings, and watering and fertilizing of saplings for 3 years	FD	Inspection	QuarterlyQuaterly	Access road side slopes	FD	PGCB
Drainage congestion	Checking drainage congestion in the substation sites during monsoon	Hydrological /Drainage study	Inspection	As and when required during monsoon	Substation sites	PGCB	PGCB
Community health and safety	Community H&S nearby the substation site. Record of all community H&S incidents, any people lost time or fatal must be reported to ADB within 48hrs with corrective action plan.	DoE/IFC guidelines	Inspection	Regular	Substation sites	PGCB	PGCB
Safety and security of substation and workers	Checking use of PPE and duties of security force. Record of all occupational H&S incidents, any people lost time or fatal must be reported to ADB within 48hrs with corrective action plan.	DoE/IFC guidelines	Inspection	Regular	Substation sites	PGCB	PGCB

As = arsenic, BRTA= Bangladesh Road Traffic Authority, COD = chemical oxygen demand, BOD5 = five-day biochemical oxygen demand, DoE = Department of Environment, DSC = Design and Supervision Consultants, DWQ = Drinking Water Quality, FC = Faecal Contamination , FD = Forest Department, Fe = iron, H&S = health and safety, HFL = highest flood level, IFC = International Finance Corporation, NH3-N = ammonia nitrogen, PAP = project affected person, PGCB = Power Grid Company of Bangladesh, PO_4 = phosphate, PPE = personal protective equipment, Mn = manganese, RP = Resettlement Plan, TC =Total Coliform .

Table 9-5: Environmental Monitoring Plan for TL/LILO Line Subprojects

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Preconstruction[43]/Construction Stage							
Requirement of land	Ensure that PAPs get compensation as per RP	As per RP	Inspection	As per RP	RoW of the TL/LILO lines	DC	DSC/PGCB
Trimming of trees within RoW and clearing vegetation from the tower bases of the TL/LILO lines.	Checking whether proper compensation as mentioned in RP is received by PAPs.	DoE/FD	Inspection	Regular during tree felling and site clearing operations	Trimming of trees within RoW and clearing vegetation from the tower bases of the TL/LILO lines.	FD	DSC/PGCB
Noise Pollution	Ambient noise level	DoE standards	Measurement	Regularly during construction at the locations with sensitive receptors and during piling works if any	At adjacent subproject cultural sites and construction camps	Contractor	DSC/PGCB
Pollution due to Wastes	Checking storage, transportation, handling, and disposal of wastes. Wastes from construction sites and camps to be disposed properly at the designated waste dumping sites.	DoE guidelines	Inspection	Regular	Construction sites and camps	Contractor	DSC/PGCB
Surface Water Quality	pH, BOD_5, COD, NH_3-N, PO_4, TPH and coliforms	DoE Standards	Sampling and Laboratory	At all river crossings within 500m	River Crossing Sites near towers	Contractor	DSC/PGCB

[43] The EPC contractor will collect a set of baseline data prior to any civil work commencement.

			Analysis	of waterbodies before and after works			
Groundwater /Drinking Water Quality	pH, Mn, Fe, As, TC, FC, TPH	DoE Standards	Sampling and Laboratory Analysis	Quarterly at all tube wells within 500m	At representative tower construction sites	Contractor	DSC/PGCB
Traffic congestion/ Road Accident	Checking road crossing points, roads adjacent to towers.	BRTA	Inspection	Regular	At road/railway. crossing points and roads adjacent to towers	Contractor	DSC/PGCB
Cultural sites (such as a mosque)	Checking whether cultural sites are affected by the project activities such as noise, wastes, etc.	DoE guidelines	Inspection	As and when required		Contractor	DSC/PGCB
Physical Cultural Resources	Chance find procedure to be developed	DoE/IFC guidelines	Inspection	Regular	At construction site	Contractor	DSC/PGCB
Occupational health and safety	Use of PPE, general health, water supply and sanitation. Record of all occupational H&S incidents, any people lost time or fatal must be reported to ADB within 48hrs with corrective action plan.	DoE/IFC guidelines	Inspection	Regular	At construction sites and camps	Contractor	DSC/PGCB
Community health and safety	Awareness of local people. Record of all community H&S incidents, any people lost time or fatal must be reported to ADB within 48hrs with corrective action plan.	DoE/IFC guidelines	Inspection	Regular	At tower construction sites and crossing of roads	Contractor	DSC/PGCB
Operation Stage							
Tree replantation	Replanting of saplings and checking replacement of dead saplings, and watering and fertilizing of saplings for 3 years	FD	Inspection	Quarterly	Access road side slopes	FD	PGCB

Tall trees	Trimming of tall trees under the transmission line	FD	Inspection	Once every year and as directed by the relevant engineer of PGCB	Along the TL/LILO Lines	PGCB	PGCB
EMF	Checking of clearance of transmission line and tops of houses (for housing structures) and for river crossing clearance from HFL to TL	Australian Standard for the safety of power lines (No BD standard and no device available in BD)	Inspection	As and when required	At populated /housing areas where TL/LILO lines pass over	PGCB	PGCB
Short circuit/ accident	Safety	DoE guidelines	Inspection	Regular	Along the TL/LILO lines	PGCB	PGCB
Occupational and Community Health and Safety	Use of PPE. Record of all occupational and community H&S incidents, any people lost time or fatal must be reported to ADB within 48hrs with corrective action plan.	As required	Inspection	Regular	Along the TL/LILO lines	PGCB	PGCB
Power Supply	Access to electricity in the rural area on priority basis.	DoE/PDB guidelines	Inspection	Whole project period	Along the TL/LILO lines	PGCB	PGCB

As = arsenic, BD = Bangladesh, BOD5 = five-day biochemical oxygen demand, BRTA= Bangladesh Road Traffic Authority, COD = chemical oxygen demand, DC = Deputy Commissioner, DoE = Department of Environment, DSC = Design and Supervision Consultants, EMF = electromagnetic field, FC = faecal coliform, Fe = iron, HFL = highest flood level, IFC = International Finance Corporation, LILO = line-in line-out, m = meter, Mn = manganese, NH3-N = ammonia nitrogen, OHS = Occupational Health and Safety, PAP = project affected person, PDB = Power Development Board , PGCB = Power Grid Company of Bangladesh, PO4 = phosphate, PPE = personal protective equipment, RoW = right of way, RP = Resettlement Plan, TC = total coliform, TL = transmission line.

Table 9-6: Cost of Laboratory-based Environmental Monitoring

Environmental Parameter	Monitoring Parameter	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementing Agency	Monitoring Agency	Cost (Tk)
Ambient Air Quality Parameters	SPM, PM_{10}, $PM_{2.5}$, SOx, NOx, Co & Pb- 24hr monitoring	EQS/ DOE	Sampling/ laboratory analysis	Before construction, then quarterly	Substation land and surroundings	Contractor	PGCB	50,000 ($600)/ location 15 x new substations (before construction & every six months/ 2 years Tk 3,000,000 ($35,545)
Noise level monitoring	Leq day and Leq night Ambient Noise Level	EQS/DOE Noise pollution control Rules, 2006	Measurement	Before construction & when required	Substation land and surroundings, near settlements where tower bases/ towers are constructed	Contractor	PGCB	5,000 ($60)/ location 15 x substations (before construction & every six months/ 2 years) Tower bases near settlements 20 locations x 2 measurements Tk500,000 ($5924)
Surface Water Quality Monitoring	pH, Turbidity, BOD5, COD, TDS, TSS, DO, Total Coliform, Ammonia-Nitrogen, Oil and grease PCB in existing substations with PCB contained transformers	EQS/DOE Standards	Sampling/ laboratory analysis	Before construction & when required	Substation land and surroundings, near settlements where tower bases/ towers are constructed	Contractor	PGCB	30,000 ($360)/ location 15 x substations (before construction & every six months/ 2 years) 20 locations in TLs x 2 measurements Tk3,000,000 ($35,545)
Groundwater/Drinking water Quality	pH, Turbidity, manganese, Iron, Arsenic, EC, Chloride	EQS/DOE Standards	Sampling/ laboratory analysis	Before construction & when required	Substation land and surroundings, near settlements	Contractor	PGCB	20,000 ($240)/ location 15 x substations

	PCB in existing substations with PCB contained transformers				where tower bases/ towers are constructed			(before construction & every six months/ 2 years) 20 locations in TLs x 2 measurements Tk 2,000,000 ($23,696)
Soil Pollution	pH, Texture, Organic content, Lead, Copper, Chromium, Cadmium PCB in existing substations with PCB contained transformers	EQS/DOE Standards	Sampling/ laboratory analysis	Before construction & when required	Substation land and surroundings, near settlements where tower bases/ towers are constructed	Contractor	PGCB	20,000 ($240)/ location 17 x substations (before construction & every six months) 20 locations in TLs x 2 measurements Tk 2,000,000 ($23,696)
Expenses to carry out sampling (traveling and other cost to do the sampling)								Tk,10,500,000 (= $ 124,406) + cost of sampling (Tk15,000 per location x 460) 6,900,000 (= 81,753)
							Total	$ 206,159*

* A round off value of this cost has been added in the total EMP implementation budget.

Laboratory analysis will be carried out at **Atomic Energy Commission, Bangladesh** (Air and Noise measurements); **Bangladesh Council of Scientific and Industrial Research** (Surface & Groundwater quality) and **Soil Research Development Institute** (soil parameters).

10. CONCLUSION AND RECOMMENDATION

346. The proposed DWZTGEP will ensure the capacity of electricity supply in Greater Dhaka area and the Western Bangladesh through improvements in the technical efficiency of the transmission system. It will also focus on expanding the local transmission network to deliver electricity to new and expanding load centres while meeting the network operating criteria. Development of transmission and distribution network in line with generation has been identified as a key element of the power sector strategy in the 'Bangladesh Seventh Five Year Plan FY2016 – FY2020'. Development of an inter-region transmission network is required due to the disparity in concentration of generation and demand, while local network expansions are required to cater the increasing demand at new load centres.

347. The proposed project is expected to provide support for the construction of 15 new substations, ten overhead transmission lines, ten LILOs, two underground (with overhead) transmission lines and construction of bay extensions in nine substations.

348. The DWZTGEP contains three (3) main components:

Component 1: Transmission system in Greater Dhaka expanded. The project will construct and commission substations with a total capacity of 4,450 MVA and 40 km of transmission lines in Greater Dhaka.

Component 2: Transmission system in Western Zone expanded. The project will construct and commission substations with a total capacity of 3,070 MVA and 368 km of transmission lines in western zone.

Component 3: Institutional Capacity of PGCB strengthened. The project will enhance capacity by (a) supporting installation and operation of an enterprise resource planning (ERP) system to assist PGCB in optimally managing its capital-intensive assets; (b) establishing a Drone Inspection Center within the operation and maintenance department of PGCB with some gender equality element.

349. The scope of the IEE included:

a. Legislation study;
b. Review of relevant information/data/documents from secondary sources, and identification of gaps to be filled, relevant to the environmental screening needs from primary surveys;
c. Provision of a description of the environment (such as baseline data on physical, biological/ecological and socio-economic characteristics of the subproject sites along with impact area);
d. Primary surveys where needed to include baseline data (trees in the clearing width of transmission lines, LILOs and substations) and proposed environmental quality monitoring at representative and sensitive locations, and identification of all macro-level environmental issues within the project influenced area;
e. Survey of the environmentally sensitive locations, if any, at and along the sub-projects and within the project influenced area;
f. Arrangement of stakeholder consultations/individual consultations with the local people from all professions to find out their opinions on the subprojects;
g. Analysis of alternatives to the proposed subproject;

h. Identification and assessment of potential environmental impacts due to implementation of the subprojects; and
i. Formulation of an EMP.

350. The 408 km of transmission lines follows low lying lands which is extensively farmed (mainly with paddy and seasonal crops), and terrestrial lands with homesteads. The proposed transmission lines will cross several rivers. There will be 1,156 towers (42 terminal towers, 387 angle towers, 727 suspension towers) to carry the transmission line conductors.

351. Alternatives for the ten transmission lines were studied. Environmental screening and assessment for these ten transmission lines were carried out to identify the potential impacts based on the collected baseline information/data by the safeguard survey team, during Sept. and October 2018. Lands in predominantly agricultural areas were selected for all substations and alternatives were not identified, as these areas avoid the resettlements, and individual homesteads. Only a few trees were found in most of lands chosen for construction of substations. These are away from ecologically sensitive areas, forest reserves, and protected areas in the country. Important Bird Areas (IBAs) are not found in the vicinity of any of the subproject sites.

352. About 80.92 acres of agricultural lands will be permanently changed by the construction of 15 substations and one bay extension in existing Satkhira substation. There are two substation lands with a total extent of 3 acres waterbodies. A total size of 1 acres for tower footings will be permanently changed for the tower construction. Land acquisition is not required for tower bases in transmission lines. Once the tower construction is completed the tower base area would be utilized for cultivation of crops including paddy. The total tower footings of 1-acre land will be permanently lost. There will be no loss of residential homes or property. Various project activities will, however, have adverse impacts during the construction phase of the project. There will be some damage to vegetation and standing crops in the fields to access each of the transmission tower locations. There will be further damage during stringing of conductors between the towers. Construction activities will affect crop production and there will be some crop loss and lopping of fruit and economically important trees. During the operation phase of the Project, there will be restriction for planting large trees and pruning in the transmission line RoW. The vegetation pattern will be changed in some locations within the transmission line RoW. At most tower locations, herbaceous plants will re-generate within a few years and agricultural practices will return to normal.

353. During the implementation of the project, measures will be undertaken to keep impacts to a minimum. The EMP included in this IEE defines mitigation measures and responsibility for implementation. Measures for mitigation will be included in construction contracts to ensure that materials are properly stored and proper disposal of waste materials. Work camps will be controlled and will be fully equipped with fire-fighting equipment. PPE and emergency rescue items will also be available.

354. A set of mitigation measures has been designed to protect community health and safety. These include, traffic control measures to ensure public safety, safety measures such as fences, signs, controlled entrances; training to communities (especially children) on the dangers of transmission lines, towers, and substations, include providing access of people to all community properties and facilities during the construction period; informing the public on the timing and duration of any disruption to water, electricity, roads, postal, telecommunications, or other services; avoiding damage to utilities by ensuring that vehicles and equipment are operated by trained personnel, that operations are adequately supervised, and that the construction of towers and other facilities does not cause damage to underground utilities; and avoiding conflicts with

local communities by providing resources for worker requirements at camp stores and regulating outside visits.

355. Crop and tree losses because of the project have been assessed and affected people will be compensated under the Resettlement Plan. EMP includes a budget for planting of seedlings, and it is recommended that 3 trees be planted for every tree that is removed, or as directed by the Bangladesh Forest Department.

356. Community level public consultations were conducted in 44 locations in the different project impact areas during September and October 2018. These included 25 at proposed sites for different transmission lines, and 19 at sites proposed for new substations and bay extensions to existing substations. Participants at consultations included persons to be potentially affected by the use of their land for transmission line corridors, owners/claimants of the lands to be acquired for substations and their dependents such as tenants and sharecroppers, vulnerable groups and members of local government authorities (Union Paishad) and civil society organizations. Participants at these consultations altogether comprised 1,208 community members of whom included 966 men and 242 women. Furthermore, separate consultations were conducted in the same 25 locations with women and men to specifically discuss their gender perspectives on the proposed project and its environmental and social impacts, understanding women's socioeconomic conditions, and the possibilities of how women could be involved in the project implementation and benefit sharing. These women's consultations were attended by 118 women and 25 men. Such consultations also led to identifying the special safeguard measures that need to be adopted to secure the rights of women and children during project construction and operation. The transmission line will not supply electricity directly to the people along the line route. However, during the public consultations people expressed keen interests/supports for implementation of the transmission line and substation subprojects. Their main reason is that overall development in the power sector would contribute to the national development from which they along with others can benefit.

357. Construction of the subprojects will require skilled and non-skilled laborers and thus will create employment opportunities for people in the area. The additional power supply made possible by the transmission line will impact positively on industrial development.

358. A three-tire GRM will be established to deal with and resolve complaints and grievances faster and thus enhance project performance standards in terms of environmental and social management. Health and safety risks exist at substations and transmission lines. These need to be addressed through detailed Health & Safety and Emergency Response Plans to be developed by the Contractor.

359. In conclusion, there will be some minor negative impacts caused by the Project during implementation. Compensation will be paid for loss of land, trees, and crops. There are no protected or environmentally sensitive areas impacted by the project. The impacts identified in the IEE can be mitigated with implementation of the EMP and monitoring measures included in the IEE. PGCB has formed a PMU and will strengthen its capacity to implement and monitor the DWZTGEP.

360. For implementing the EMP, a total amount of $ 1,800,000 has been budgeted. Assuming that mitigation measures and monitoring requirements in the EMP are effectively implemented, the DWZTGEP is not expected to have any significant adverse environmental impacts.

Annex 1 - Detailed project description of 46 subprojects in Greater Dhaka and Western zone

1. Names of 46 subprojects, sub-district, district and division under Component 1 and 2 of DWZTGEP are provided in Table 1. Distance to nearest property and distance to nearest waterbody and tube well will be measured during the pre-construction baseline collection.

Table 1: Location Details of 46 Subprojects in DWZTGEP

No.	Subproject	Upazila	Zila	Division
	Component 1. Transmission Network Development in Greater Dhaka			
1	Kaliganj (Gazipur) 400/230 kV indoor gas insulated switchgear (GIS) substation (18 acre + 0.05 acre for access road)	Kaliganj	Gazipur	Dhaka
2	Purbachal 400/230 kV indoor GIS substation (14 acre + 0.1 acre for access road)	Rupganj	Narayanganj	Dhaka
3	Purbachal-2 230/132 kV indoor GIS substation (1.32 acre)	Rupganj	Narayanganj	Dhaka
4	Kaliganj (Gazipur)-Purbachal 400 kV double circuit transmission line (18 km)	Gazipur Sadar Kaliganj	Gazipur	Dhaka
5	Purbachal-Purbachal-2 230 kV double circuit underground transmission cable with overhead transmission line section (5 km UG/0.5 km OHL)	Kaliganj	Gazipur	Dhaka
6	Basundhara-Rampura 132 kV double circuit underground transmission cable, 9 km	Basundara	Dhaka	Dhaka
7	Line-in line-out connection from Bhulta-Kaliakair 400 kV double circuit transmission line to Kaliganj (Gazipur) substation 0.5 km	Kaliganj	Gazipur	Dhaka
8	Line-in line-out connection from Ghorashal-Tongi 400 kV double circuit transmission line to Kaliganj (Gazipur) substation (3.5 km)	Kaliganj	Gazipur	Dhaka
9	Line-in line-out connection from Ghorashal-Tongi 230 kV double circuit transmission line to Kaliganj (Gazipur) substation (3.5 km)	Kaliganj	Gazipur	Dhaka
	Component 2. Transmission Network Development in Western Zone			
1	Bhola 230/33 kV indoor GIS substation (5 acre)	Daulat Khan	Bhola	Khulna
2	Rupsha 230/132/33 kV indoor GIS substation (5 acre)	Fakirhat	Bagerhat	Khulna
3	Bhanga 132/33 kV indoor GIS substation (2 acre)	Bhanga	Faridpur	Dhaka
4	Domar 132/33 kV outdoor GIS substation (5 acre)	Domar	Nilphamari	Rangpur
5	Hatibanda 132/33 kV outdoor GIS substation (3 acre)	Hatibanda	Lalmonirhat	Rangpur
6	Jhalokati 132/33 kV indoor GIS substation (5 acre)	Jhalokati Sadar	Jhalokati	Barishal
7	Maheshpur 132/33 kV indoor GIS substation (3 acre)	Maheshpur	Jhenaidah	Khulna
8	Manirampur 132/33 kV indoor GIS substation (3 acre)	Manirampur	Jashore	Khulna
9	Meherpur 132/33 kV indoor GIS substation (3 acre)	Meherpur Sadar	Meherpur	Khulna
10	Phultala 132/33 kV indoor GIS substation (2 acre)	Phultola	Khulna	Khulna
11	Pirojpur 132/33 kV indoor GIS substation (3 acre)	Pirojpur Sadar	Pirojpur	Barishal
12	Shibchar 132/33 kV indoor GIS substation (5 acre)	Shibchar	Madaripur	Dhaka
13	Rupsha-Satkhira 230 kV double circuit transmission line (62 km)	Fakirhat Batiaghata DumuriaSatkhira Sadar, Tala	Bagerhat, Khulna, Satkhira	Khulna
14	Domar-Purba Sadipur 230 kV double circuit transmission line (46.5 km)	Birganj Kaharole Khansama Domar Nilphamari Sadar	Dinajpur Niphamari	Rangpur

15	Domar-Hatibanda 132 kV double circuit transmission line (35 km)	Hatibanda Dimla Domar	Lalmonihat Nilphamari	Rangpur
16	Kaliganj-Maheshpur 132 kV double circuit transmission line (28 km)	Kaliganj Kotchandpur Maheshpur	Jenaidah	Khulna
17	Manirampur-Satkhira 132 kV double circuit transmission line (33 km)	Keshabpur Manirampur Patkelghata Satkhira Sadar, Tala	Jeshore Satkhira	Khulna
18	Kushtia-Meherpur 132 kV double circuit transmission line (48 km)	Kushtia Sadar Mirpur, Gangni	Kushtia Meherpur	Khulna
19	Bagerhat-Pirojpur-Bhandaria 132 kV double circuit transmission line (49.5 km)	Bagerhat Sadar Kachua Bhandaria Kawkhali Pirojpur	Bagerhat Pirojpur	Khulna Barishal
20	Gopalganj (North)-Shibchar 230 kV double circuit transmission line (25 km)	Bhanga Rajoir Shibchar	Faridpur Madaripur	Dhaka
21	Niamatpur-Patnitola 132 kV double circuit transmission line (32.5 km)	Mahadebpur Niamatpur Patnitala	Naogoan	Rajshahi
22	Line-in line-out connection from Barishal-Bhola-Burhanuddin 230 kV double circuit transmission line to Bhola substation (1 km)	Daulat Khan	Bhola	Barishal
23	Line-in line-out connection from Bagerhat-Goalpara 132 kV double circuit transmission line to Rupsha substation (3.5 km)	Rupsha	Khulna	Khulna
24	Line-in line-out connection from Gallamari-Gopalganj 132 kV double circuit transmission line to Rupsha substation (0.5 km)	Fakirhat	Bagerhat	Khulna
25	Line-in line-out connection from Khulna (South)-Rupsha power plant 230 kV double circuit transmission line to Rupsha substation (0.5km)	Rupsha	Rupsha	Khulna
26	Line-in line-out connection from Faridpur-Madaripur 132 kV double circuit transmission line to Bhanga substation (0.5 km)	Bangha	Faridpur	Dhaka
27	Line-in line-out connection from Barishal-Bhandaria 132 kV double circuit transmission line to Jhalokati substation (1.5 km)	Jhalokati Sadar	Jhalokati	Barishal
28	Line-in line-out connection from Khulna Central-Noapara 132 kV double circuit transmission line to Phultala substation (1 km)	Phultola	Khulna	Khulna
29	132 kV air insulated switchgear (AIS) bay extensions at Satkhira substation (3 acre)	Satkhira Sadar	Satkhira	Khulna
30	132 kV outdoor GIS bay extensions at Purba Sadipur substation	Sadipur	Dinajpur	Rangpur
31	132 kV AIS bay extensions at Kaliganj substation,	Kaliganj	Gazipur	Dhaka
32	132 kV outdoor GIS bay extensions at Kushtia substation	Kushtia Sadar	Kushtia	Khulna
33	132 kV outdoor GIS bay extensions at Bagerhat substation	Bagerhat Sadar	Bagerhat	Khulna
34	132 kV outdoor GIS bay extensions at Bhandaria substation	Bhandaria	Pirojpur	Barishal
35	132 kV AIS bay extensions at Gopalganj (North) substation	Mukshdpur	Gopalganj	Dhaka
36	32 kV AIS bay extensions at Niamatpur substation	Niamatpur	Naogaon	Rajshahi
37	32 kV AIS bay extensions at Patnitola substation	Patnitola	Naogaon	Rajshahi

Detailed Project Description

1. Component 1 – Transmission system development in Greater Dhaka

2. This component consists of fifteen subprojects; construction of three new substations, a transmission line, one underground transmission line, one underground transmission cables with overhead transmission line sections, and three LILOs. Details of these subprojects are given below.

Table 2: Land required for Substations (acres) - Component 1-Greater Dhaka Region

SL	Substation Name	Area required for Substations	Area required for access road	Total Required Land
New Substations				
1	Kaliganj GIS SS, (Gazipur) (Future 132 kV Provision)	18.00	0.05	18.05
2	Purbachal GIS SS 400/230 kV	14.00	0.10	14.10
3	Purbachal 2 GIS SS, 230/132 kV	1.32	0.00	1.32
	Total	**33.32**	**0.15**	**33.47**

(i) Kaliganj (Gazipur) 400/230 kV indoor gas insulated switchgear (GIS) substation (18 acres)

3. The site selected for the construction of Kaliganj substation is located in Baktarpur union, Fulldi mouza, Kaliganj sub-district in Gazipur district (Dhaka Division) (Figure 1). It is an eighteen-acre agricultural and marshy land with few isolated trees (fruit trees- 04, timber trees- 06). The coordinates of the proposed land are 23.587122N, 90.325799E. Farmers cultivate paddy in one season and participate in fish cultivation during the rainy season. There are no other structures on the land. Fulldi-jame mosque, Kapashia- Kaliganj road, local market, transmission and distribution lines, culvert and a canal are found within 500 m radius of the land. Number of owners of this land is one hundred and details of 71 owners found during the census survey. Remaining 29 landowners reside either abroad or in other cities. The land must be filled about 3-4 m before construction of the substation. The sand for landfilling will be provided by the government registered sand suppliers. Three LILO lines are proposed to be connected at proposed Kaliganj substation. These are (i) Line-in line-out connection from Bhulta-Kaliakair 400 kV double circuit transmission line, (ii) Line-in line-out connection from Ghorashal-Tongi 400 kV double circuit transmission line, (iii) Line-in line-out connection from Ghorashal-Tongi 230 kV double circuit transmission line.

Figure 1: Location of Kaliganj (Gazipur) GIS Substation

Table 3: Physical Features of proposed Kaliganj (Gazipur) Grid Substation (18.05 acres)

Features	Specification
Land ownership	Private Land
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	400/230 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Plate 3.1 Land identified for the construction of Kaliganj (Gazipur) substation

(ii) Purbachal 400/230 kV indoor GIS substation (14 acres)

4. The land selected for proposed Purbachal substation is located in Bokkaw and Talna mouza, Nagari union in Rupganj sub-district of Narayanganj district (Dhaka Division) (Figure 2). It is an irrigated agricultural land. Farmers cultivate paddy in this land in two seasons. There is also a marshy area in the 14-acre land earmarked for the construction of substation. The geographical coordinates are 23.86195N, 90.47150E. Farmers cultivate paddy in one season. Thirty-two landowners were recorded during the census survey. Turag river is about 100 m of the proposed substation land. Ulukhola- Khordi road, local market, Hordi bazar, Jame Mosque and power distribution lines are found within the 500 m radius of the land. The land filling must be carried out up to about 5-7 m, before commencing the construction activities of the substation. The sand for landfilling will be provided by the government registered sand suppliers.

Table 4: Physical Features of Proposed Purbachal Grid Substation (14.10 acres)

Features	Specification
Land ownership	Private Land
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	400/230 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 2: Location of Purbachal 400/230 Indoor GIS Substation

Plate 3.2 Land selected for the Purbachal substation, Turag river in the foreground

(iii) Purbachal-2 230/132 kV indoor GIS substation (1.32 acres)

5. The land identified for the construction of Purbachal- 2 substation is located in Daoutpur union in sub-district Rupganj of Narayanganj district (Figure 3). The extent of the land is 1.32 acres and coordinates are 23.85394N, 90.52116E. This is a RAJUK allocated land

to PGCB, at present it is a barren/degraded land having about 15 m elevation. Land filling is not required for the construction activities.

Figure 3: Location of Purbachal-2 230/132 kV Indoor GIS Substation

Table 5: Physical Features of Proposed Purbachal-2 Grid Substation (1.32 acres)

Features	Specification
Land ownership	Rajuk Land
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	230/132 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Plate 3.3 The RAJUK land earmarked for the Purbachal-2 substation

(iv) Kaliganj (Gazipur)-Purbachal 400 kV double circuit transmission line (18 km)

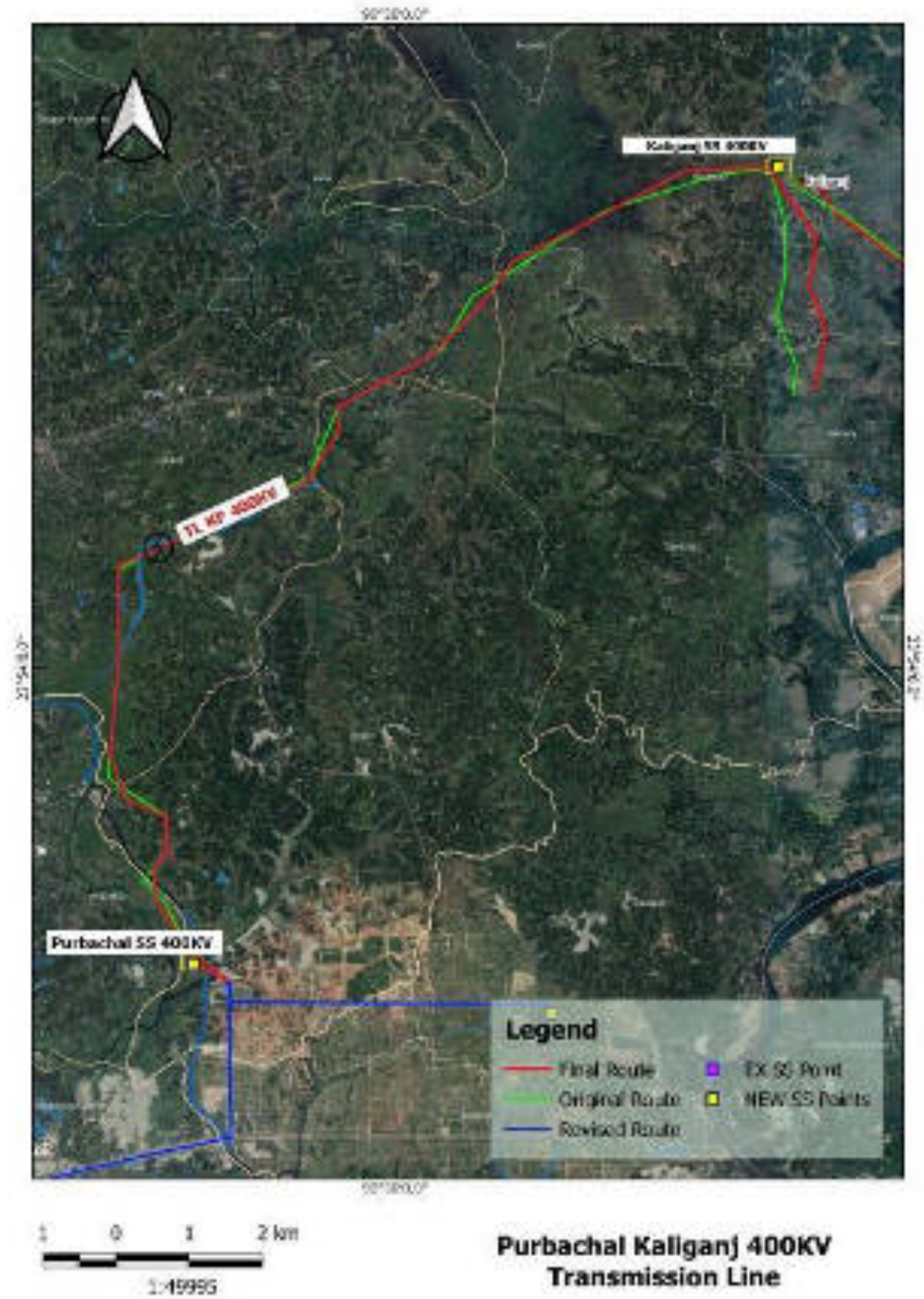
6. Kaliganj-Purbachal 400 kV transmission line, 18 km in length, is located in Gazipur Sadar and Kaliganj sub-districts of Gazipur in Dhaka Division (Figure 4). This line passes through paddy fields (10.6 km), agricultural lands, water bodies, marshy areas and home gardens (5.2 km). Turag river is found between angle points 5-6, 7-8, 10-11, 13-14, and 14-15. It crosses ponds and canals between angle points 7-8, 8-9 and 13-14. No forest or wildlife reserves along or the vicinity of the line. Two terminal towers, seventeen angle towers and 27 suspension towers are needed to cover the length of the line. The line is accessible through several roads; Bokterpur- Delanbazar, Sataripara-Sikulia, Dhaka bypass, Morkun- Bindar, Tongi- Ulokhula, Abdullahpur- Ulokhula, Klokhula- Hadibazar, Joyramber- Tumulia and Tongi- Kaliganj highway. The RoW is 46 m and the land under the clearing width of 12 m is 21.2 ha. This line crosses 230/132 kV existing line between 4-5 and 7-8 angle points and 33 kV line between 7-8. The proposed line crosses main roads in ten different locations and highways in three locations. Thirty-eight timber trees and 32 fruit trees (> 5 m in height) were recorded within the clearing width of the line. Banana and bamboo were also found within the RoW. Average elevation of the line is 10 m. Dhaka international airport is 16 km away from the line. Avian authority will be consulted to issue the clearance during domestic approval process. Bokterpur, Sumusingh, Harbaid, Bindar, Rayerdia, Taliya, Hatkhula, Borkaw, Madla, Joyramber, Boro Koir, Pipulia,Pipuliya,and Dimati are the villages found along the line.

Table 6: Physical Features of Proposed Kaliganj (Gazipur)-Purbachal 400 kV Double Circuit Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	400 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	46 m
4	No of transmission towers	42
5	Transmission towers heights	Standard towers: 50.52 meters
6	Transmission line clearances	11 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 400 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain

10	Type of connection	Kaliganj (Gazipur) and Purbachal Grid Substations
11	Duration of project implementation	Approximately 3 years

Figure 4: Kaliganj (Gazipur)-Purbachal 400 kV Double Circuit Transmission Line



(v) Purbachal-Purbachal-2 230 kV double circuit underground transmission cable with overhead transmission line section (5km UG +0.5 km OH)

7. The length of the overhead section of Purbachal-Purbachal-2 230 kV transmission line is 0.5 km. It crosses Balo river between angle towers 1 and 2 (Figure 5). This section is accessed through Hulokhula- Hordibazar road. Two angle towers and a single suspension tower is required for the overhead section. About 300 m of the line passes through paddy fields and marshy area. Dhaka International airport is about 34 km away from the line. The nearest village is Borkaw.

Figure 5: Underground Transmission Cable from Purbachal to Purbachal-2

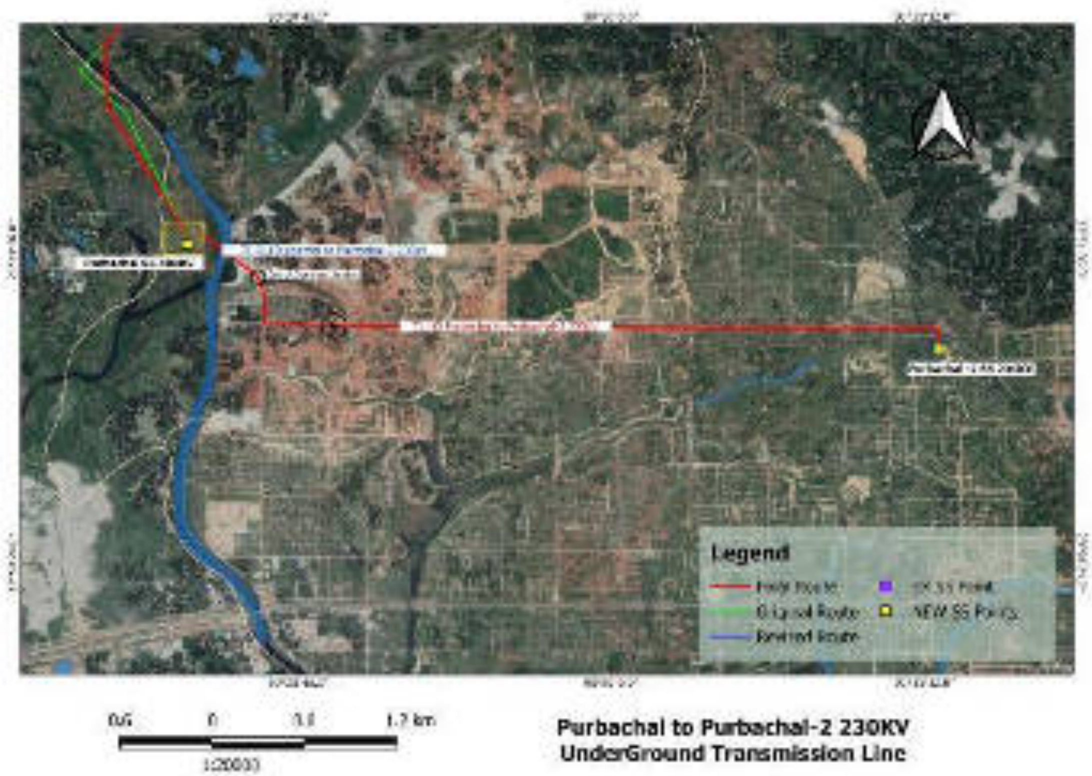


Table 7: Physical Features of Purbachal-Purbachal-2 230 kV Double Circuit Underground Transmission Cable with Overhead Transmission Line

Sl. No.	Physical Features	Attribute
Underground Section		
1	Voltage rating	230 kV
2	Type of transmission line	Double circuit
3	No of transmission towers	Underground cable
4	Conductor material	2,000 mm^2 Copper
5	Type of connection	Overhead section and Purbachal 2 substation
6	Duration of project implementation	Approximately 5 years
Overhead Section		
1	Voltage rating	230 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	40 m
4	No of transmission towers	2 AT
5	Transmission towers heights	Standard towers: 37 meters
6	Transmission line clearances	8 m (ground clearance measured from the highest flood level)

7	Type of line support	Steel 230 kV lattice
8	Conductor material	Aluminium Conductor Steel Reinforced
9	Line insulator	Disc type, porcelain
10	Type of connection	Purbachal substation and underground section
11	Duration of project implementation	Approximately 3 years

(vi) Basundhara-Rampura 132 kV double circuit underground transmission cable (9 km)

8. The proposed underground 132 kV transmission line is 9 km in length. It is located in Dhaka North City Corporation, Vatara and Badda sub-districts of Dhaka (Dhaka Division). The line traverses Bashundara Residential area (0- 3 km), Madani Avenue between 3 and 4 km, Notun Bazar (4-6 km), Badda Link road (6-7 km), Moddha Badda (7-8 km) and Merul Badda (8.-8.85 km). The road network of underground cabling as follows: Rampura substation- Jahirul Islam Avenue/Aftab Nagar main road - Bir Uttam Rafiqul Islam Avenue - Hatir Jeel link road - Bir Uttam Mir Shawkat Sarak - Shaheed Tajuddin Ahmed Avenue - Bir Uttam A K Khandakar Road - Gulshan Avenue - Road 34 - Gulshan Bridge -Road 19A - Kamal Ataturk Avenue - Madani Avenue - Pragati Avenue - Kuril-Bishwa Road – and Purbachal Express Highway.

9. Underground cabling affects 140 Coconut trees which are more than 5 m in height, between 1-3 km, about 160 Krishnachura (Delonix regia) trees between 3 to 5 km of the line and 50 Bakul (Mimusops elengi) trees in 8- 9 km.

Table 8: Physical Features of Basundhara-Rampura 132 kV Double Circuit Underground Transmission Cable

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	No of transmission towers	Underground cable
4	Conductor material	2,000 mm^2 Copper
5	Type of connection	Bashundhara and Rampura Grid Substations
6	Duration of project implementation	Approximately 3 years

Figure 6: Rampura Existing Substation and Underground Cable (proposed)

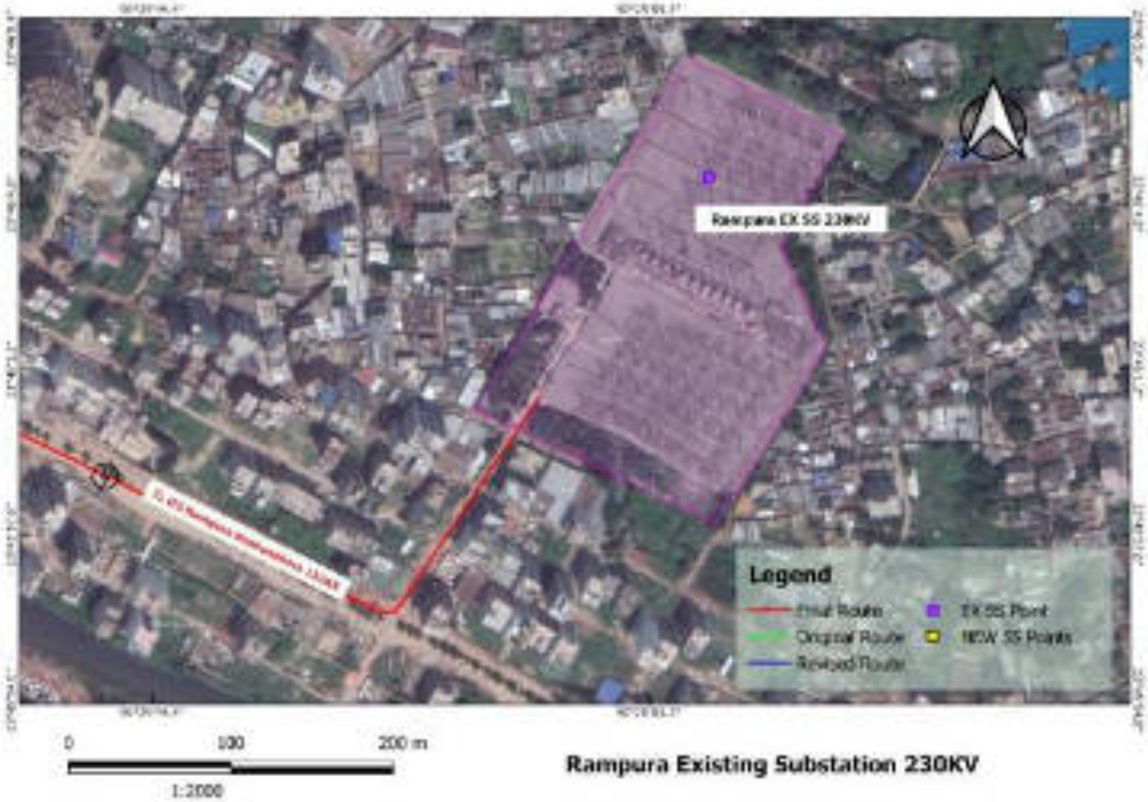
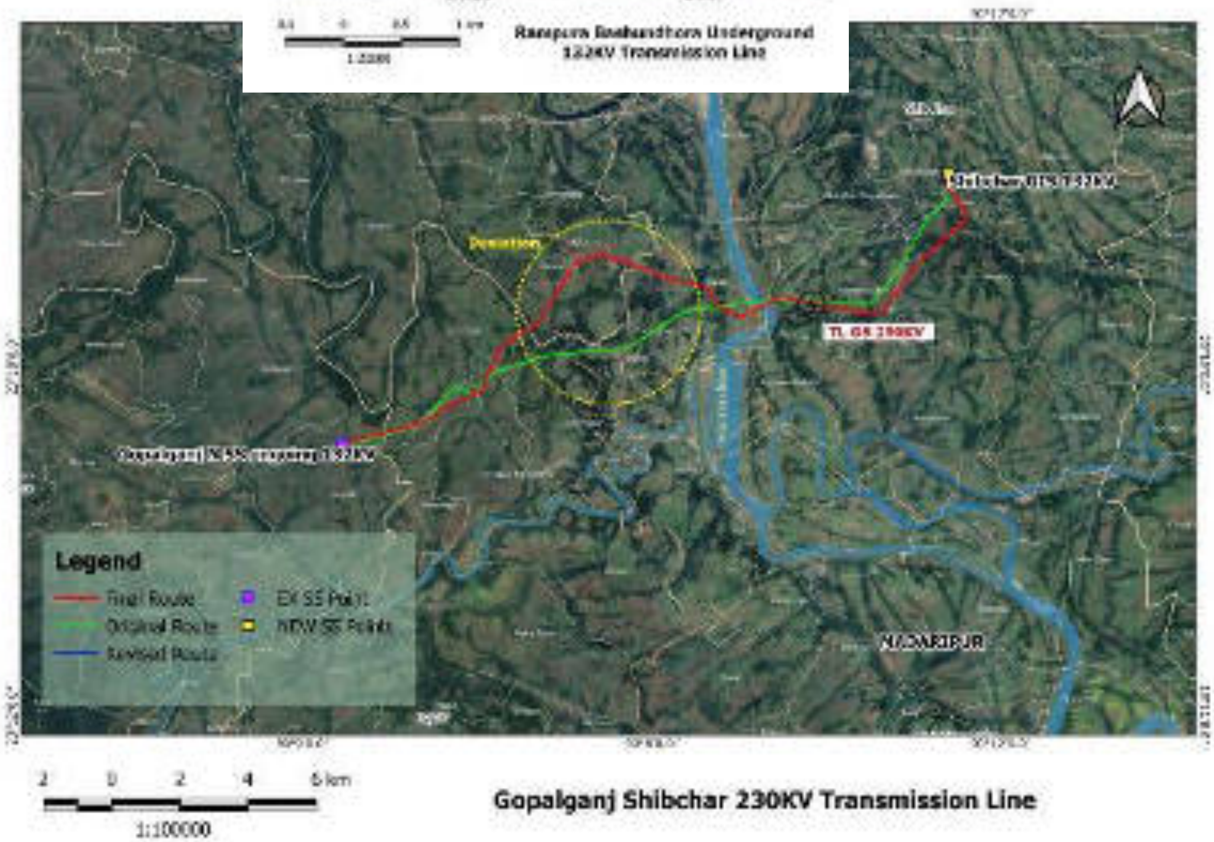


Figure 7: Rampura- Basundhara Underground 132 kV Transmission Cable



(vii) Line-in line-out connection from Bhulta-Kaliakair 400 kV double circuit transmission line to Kaliganj (Gazipur) substation

10. The proposed land for the construction of Kaliganj (Gazipur) substation is underneath the Bhulta-Kaliakair 400 kV line. Therefore, the length of LILO is not exceeding 0.5 km.

Table 9: Physical Features of LILO from Bhulta- Kaliakair Line to Kaliganj Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	400 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	46 m
4	No of transmission towers	Line over the substation
5	Transmission towers heights	Standard towers: 50.52 meters
6	Transmission line clearances	11 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 400 kV lattice
8	Conductor material	Aluminium Conductor Steel Reinforced
9	Line insulator	Disc type, porcelain
10	Type of connection	LILO connection to Kaliganj (Gazipur) substation from Bhulta-Kaliakair 400 kV transmission line
11	Duration of project implementation	Approximately 2 years

(viii) Line-in line-out connection from Ghorashal-Tongi 400 kV double circuit transmission line to Kaliganj (Gazipur) substation (3.5 km)

11. The proposed 3.5 km, overhead 400 kV transmission line is located in Kaliganj sub-district of Gazipur (Dhaka Division) (Figure 4). The line crosses marshy area and a canal between the terminal tower and the angle point No.1, pond between angle points 1 and 2. No forest area or wildlife reserves in the project area and distance to a forest or wildlife area is more than 50 km. Elevation at Ghorashal is 3 m and 16 m at Tongi. The line will have six angle/terminal towers and 4 suspension towers. RoW is 46 m and the land under the 12 m clearing width is 4.1 ha. About 2.0 km of the line passes through marshy lands and 160 m through home gardens. The line route is accessible through Mohani-Bokterpur road. The nearest villages are Fuldi, Boketpur and Durbati. The line is about 5 km away from Dhaka International Airport. Thirty-four timber and five fruit trees, >5m in height, in the clearing width will be affected.

Table 10: Physical Features of LILO from Ghorashal-Tongi 400 kV Line to Kaliganj Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	400 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	46 m
4	No of transmission towers	04 AT
5	Transmission towers heights	Standard towers: 50.52 meters
6	Transmission line clearances	11 m (ground clearance measured from the highest flood level)

7	Type of line support	Steel 400 kV lattice
8	Conductor material	Aluminum Conductor Steel Reinforced
9	Line insulator	Disc type, porcelain
10	Type of connection	LILO connection to Kaliganj (Gazipur) substation from Ghorashal-Tongi 400 kV transmission line
11	Duration of project implementation	Approximately 2 years

(ix) Line-in line-out connection from Ghorashal-Tongi 230 kV double circuit transmission line to Kaliganj (Gazipur) substation (3.5 km)

12. The proposed 3.5 km, 230 kV transmission line is located in Kaliganj sub-district of Gazipur (Dhaka Division) (Figure 4). The line crosses marshy area and a canal between the terminal tower and the angle point No.1, pond between angle points 1 and 2. No forest area or wildlife reserves in the project area and distance to a forest or wildlife area is more than 50 km. Elevation at Ghorashal is 3 m and 16 m at Tongi. The line will have six angle/terminal towers and 4 suspension towers. RoW is 40 m and the land under the 12 m clearing width is 4.0 ha. About 2.6 km of the line passes through paddy and agricultural lands. The line route is accessible through Dalanbazar- Kaliganj, Kaliganj- Kapasia and Batira- Boktepur roads. The nearest villages are Fuldi, Batira and Batiya. The line is about 5 km away from Dhaka International Airport. Only the seven trees in the clearing width will be affected.

Table 11: Physical Features of LILO from Ghorashal-Tongi 230 kV Line to Kaliganj Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	230 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	40 m
4	No of transmission towers	4 AT
5	Transmission towers heights	Standard towers: 37 meters
6	Transmission line clearances	8 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 230 kV lattice
8	Conductor material	Thermal-resistant Aluminium-alloy Conductor, Steel Reinforced (TACSR)
9	Line insulator	Disc type, porcelain
10	Type of connection	LILO connection to Kaliganj (Gazipur) substation from Ghorashal-Tongi 230 kV transmission line
11	Duration of project implementation	Approximately 5 years

2. Component 2: Transmission Network Development in the Western Zone

13. This component consists of thirty-seven subprojects; construction of twelve new substations, nine transmission line projects, seven LILOs, and nine bay extension projects. Details of these subprojects are given below.

Table 12: Total required Land for Substations (acres)- South & Northwest region

SL	Substation Name	Area required for Substations	Area required for access road	Total Required Land
New Substations				
1	Bhola GIS 230/33 kV	5.00	0.00	5.00
2	Rupsha GIS 230/132 kV + 132/33 kV	5.00	0.35	5.35
3	Bhanga GIS 132/33 kV	2.00	0.03	2.03
4	Domar GIS 132/33 kV	5.00	0.00	5.00
5	Hatibandha GIS 132/33 kV	3.00	0.04	3.04
6	Jhalokhati GIS 132/33 kV	5.00	0.00	5.00
7	Maheshpur GIS 132/33 kV	3.00	0.03	3.03
8	Manirampur GIS 132/33 kV	3.00	0.00	3.00
9	Meherpur GIS 132/33 kV	3.00	0.00	3.00
10	Phultala GIS 132/33 kV	2.00	0.00	2.00
11	Pirojpur GIS 132/33 kV	3.00	0.00	3.00
12	Shibchar GIS 132/33 kV	5.00	0.00	5.00
Sub-Total New Substation		**44.0**	**0.45**	**44.45**
Existing substations which will be augmented under the project				
1	Satkhira GIS	3	0.00	3.00
Total		**47.0**	**0.45**	**47.45**

Table 13: Name of substations, extent, area under waterbody in substation land and status of water body.

	Substation	Area (acre)	Waterbody (acre)
1	Rupsha	5.00	1-acre
2	Phultala	2.00	2-acre

(i) Bhola 230/33 kV indoor GIS substation

14. The proposed Bhola substation will be constructed in an irrigated paddy land which is under cultivation at present (3 harvest seasons annually). The extent of the land required for the substation is 5 acres. This land is found in Dakshin Joynagar union, Pashchim Joynagar and Madhya Jaynagar mouza in Daulat Khal sub district of Bhola (Barishal Division) (Figure 8). Coordinates are 22.57811 N and 90.66592 E. Charfashion-Bhola highway is located within 500 m of the substation land. There are no built structures on land at present, and the land filling (approx. 1.5 m) is required before the construction of substation.

Table 14: Physical Features of proposed Bhola Grid Substation

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	230/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 8: Location of the Bhola 230/33 kV Substation

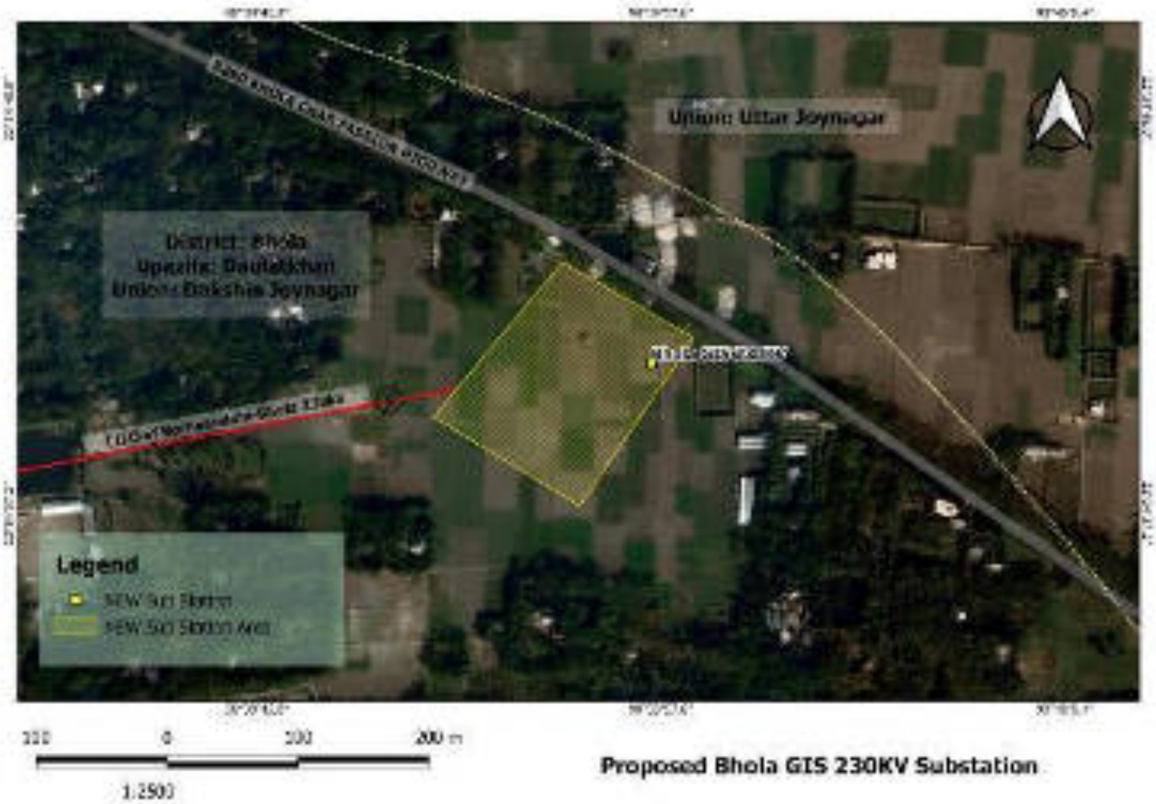


Plate 3.4 Land identified for the proposed Bhola substation

(ii) Rupsha 230/132/33 kV indoor GIS substation (5 acre)

15. The five-acre land selected for the construction of Rupsha Grid Substation is located in Lokhpur union, Khajura and Khajura mouza in Fakirhat subdistrict of Bagerhat district (Figure 9). The coordinates are 22.77076 N 89.61685 E. The type of land is agricultural and main crop is paddy. The owners cultivate paddy in 2 seasons and vegetables in one season. Pumpkin, cucumber, and papaya are cultivated on the bank of the waterbody. A 1-acre waterbody is found adjacent to the land. The filling of the land (1.5 m – 3 m) might be required before the construction of the substation. Khulna-Mongla highway is about 200 m from the centre of substation land. Three LILO connection are proposed at the Rupsha substation from (i) Bagerhat- Goalpara 132 double circuit line, (ii) Gallamari-Gopalganj 132 kV double circuit line and (iii) Khulna (South)- Ruphsha power plant 230 kV double circuit transmission line.

Table 15: Physical Features of Proposed Rupsha Grid Substation

Features	Specification
Land ownership	Private Land
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	230/132 kV + 132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 9: Location of Rupsha Grid Substation

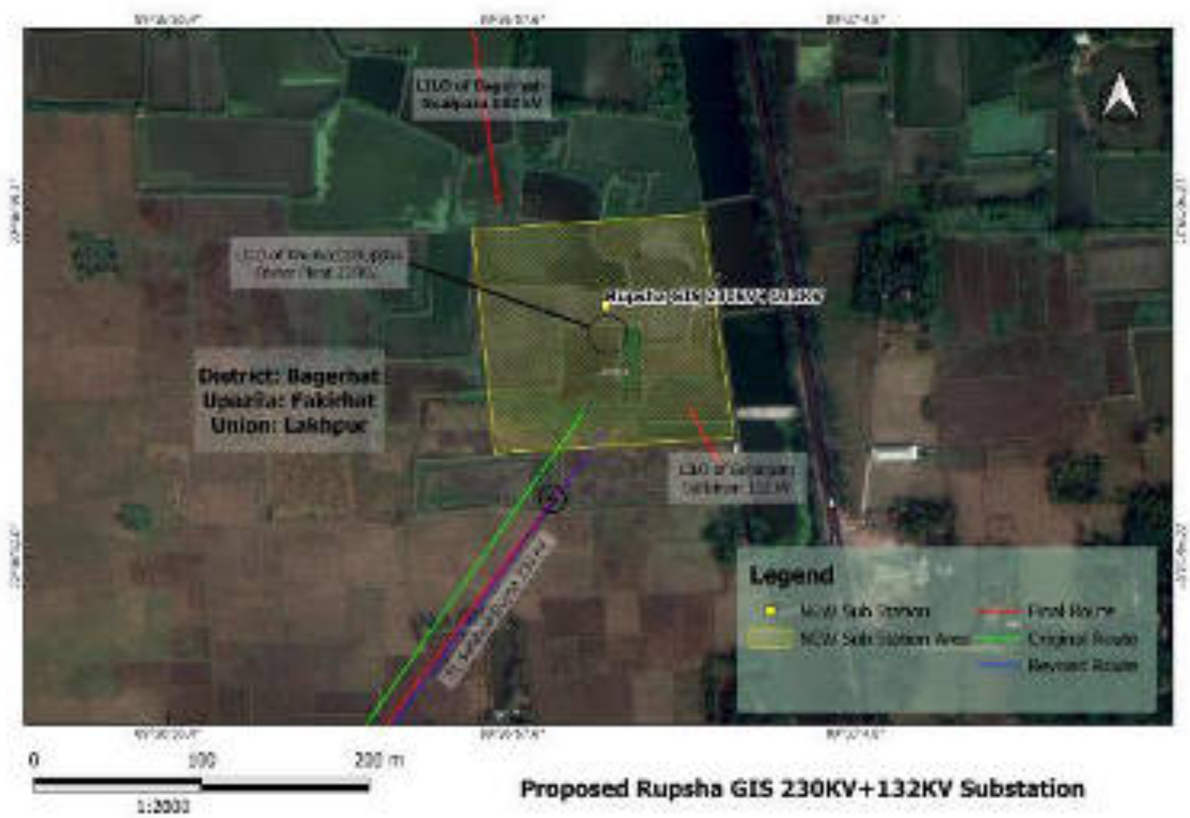



Plate 3.5 Agricultural land (5 acres) selected for the construction of Rupsha substation

(iii) Bhanga 132/33 kV indoor GIS substation (2 acres)

16. The land for proposed Bhanga Grid Substation is located in Madhabpur mouza in Bhanga sub district of Faridpur district (Figure 10). Two acres of land is required for the construction of substation and the geographical coordinates are 23.41919 N, 89.96184 E. The land is irrigated; paddy and jutes are cultivated in two seasons per year. Bangha-Faridpur highway, transmission line, distribution line, technical college, Madhabpur- Jame mosque and a local market are found within the 500 m radius of the substation land.

Table 16: Physical Features of Proposed Bhanga Grid Substation

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 10: Location of Bhanga Grid Substation

	
Plate 3.6 Land earmarked for the construction of Bhanga substation	

(iv) Domar 132/33 kV outdoor GIS substation (5 acres)

17. The total extent of land required for Domar substation is five acres. The selected land is located in Bara Rawta mouza in Domar sub-district of Nilphamari district (Rangpur

Division) (Figure 11). The geographical coordinates of the land are 26.105169N, 88.803787 E. The land is irrigated and at present it is under cultivation, mainly paddy and seasonal crops such as corn and potato. The proposed land border the Debiganj – Domar road (Z5003). Other structures found within the 500 m radius are Domar Union Parishad market (35 shops), Boro Ratwa primary school and Domar filling station. There are 23 timber trees and three fruit trees found in the land. One irrigation pump is used for commercial purposes and it is covered with thatched structure. The land belongs to four land owners and they are interested to sell the land to the project if and only they receive compensation according to current market price and if they are able to buy similar type of land in the vicinity. Land filling is required up to about 1.5 m.

Table 17: Physical Features of Proposed Domar Grid Substation (5 acres)

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 11: Location of Domar Grid Substation

	
Plate 3.7 The land earmarked for the construction of Domar substation	

(v) Hatibanda 132/33 kV outdoor GIS substation (3 acres)

18. The land selected for construction of Hatibanda substation is located in Romoniganj and Ramganj mouza in Hatibanda sub-district of Lalmonirhat district (Rangpur Division) (Figure 12). The construction of substation requires 3 acres of land and the geographic coordinates are 26.20759 N, 89.09256 E. This is an irrigated agricultural land with different crop patterns and at present it is under cultivation; three seasons annually. Dalia-Borokhata road is close to the land, within 500 m. The filling of land up to 3 m is required before the construction of substation.

Table 18: Physical Features of Proposed Hatibanda Grid Substation (3 acres)

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 12: Location of Hatibanda Grid Substation

Plate 3.8 The land identified for the construction of Hatibanda substations

(vi) Jhalokati 132/33 kV indoor GIS substation (5 acres)

19. The construction of Jhalokati substation requires five acres of land. The selected land is found in Kunihari and Uttar Piplita mouza in Jhalokati Sadar sub-district of Jhalokhati

district (Figure 13). The coordinates of the land are 22.67789N, 90.1975E. It is an irrigated agricultural land and at present under paddy cultivation. The land is cultivated with paddy and other seasonal crops in three seasons, annually. Kunihari Khal/Basanda river is west of the proposed land. Chamata bazar road, college intersection, electricity distribution lines, and brick kiln is found within 500 m radius. No trees or structures are found in the land. The land filling up to 1.5 m is required before the construction.

Table 19: Physical Features of Proposed Jhalokati Grid Substation (5 acres)

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 13: The Location of Proposed Jhalokati Grid Substation

Plate 3.9 The land earmarked for the Jhalokathi substation

(vii) Maheshpur 132/33 kV indoor GIS substation (3 acres)

20. The land identified for Maheshpur substation is located in Jalilpur mouza in Maheshpur sub-district of Jhenaidah (Khulna Division) (Figure 14). The total extent of the land required is three acres and the coordinates are 23.3422317N, 88.9123916E. This is an irrigated agricultural land and at present it is cultivated with paddy (2 seasons). Paurashava Mohila Degree College, Maheshpur High School, Maheshpur- Jadoppur road, Patibilapoura govt. primary school, Maheshpur bazar, and a mosque are found within the 500m radius of the land. A tube well is found in the land. Filing of the land up to 2-3 m is required.

Table 20: Physical Features of Proposed Maheshpur Grid Substation (3 acres)

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 14: Location of Maheshpur Grid Substation

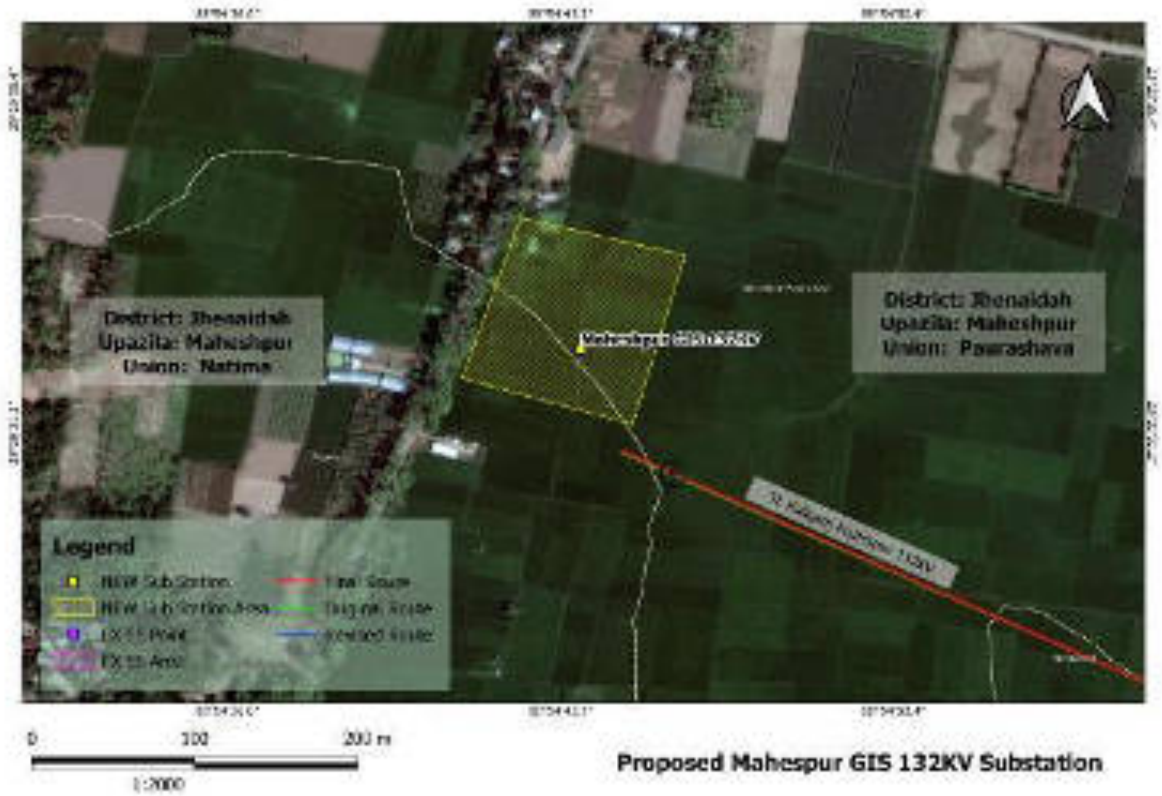


Plate 3.10 The land ideintified for the proposed Maheshpur substation.

(viii) Manirampur 132/33 kV indoor GIS substation (3 acre)

21. The proposed three-acre land for Manirampur grid substation is located in Jamla and Jamla mouza in Manirampur sub-district of Jashore (Khulna Division) (Figure 15). The geographical coordinates are 22.97617N, 89.22928E. This is an agricultural land; paddy and crops such as coriander, and sugar cane are cultivated. Trees are not found in the land. Land filling up to 1.5 m is required before the construction work of substation.

Table 21: Physical Features of Proposed Manirampur Grid Substation (3 acres)

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 15: The Location of Manirampur Indoor GIS Substation

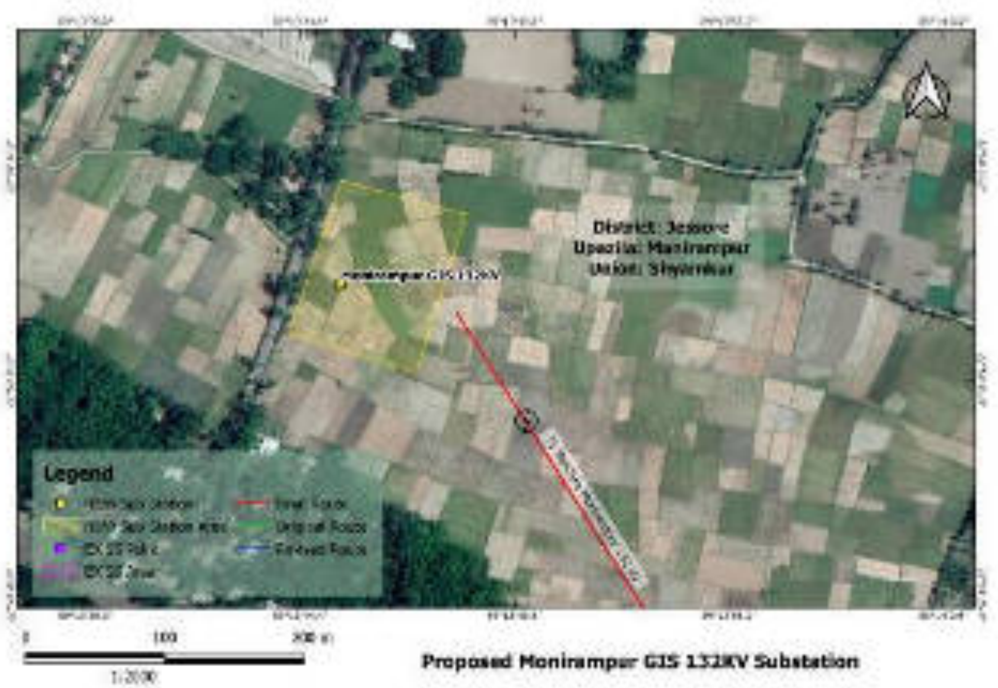



Plate 3.11 The land allocated for the construction of Manirampur substation

(ix) Meherpur 132/33 kV indoor GIS substation (3 acre)

22. A three-acre land for the proposed substation is assigned in Notun Modnadanga and Alampur mouza in Meherpur Sadar sub-district of Meherpur (Khulna Division) (Figure 16). Geographical coordinates are 23.79119N, 88.6796798 E. This is an irrigated agricultural land, paddy and jute are cultivated in two seasons annually. The structures such as Meherpur Upazila Mohila Degree College, Meherpur primary school and high school, Notun Madnadanga Jame mosque and local market within 500 m radius of the land. No trees or built structures are found on the land.

Table 22: Physical Features of Proposed Meherpur Grid Substation (3 acres)

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 16: Location of Meherpur Grid Substation

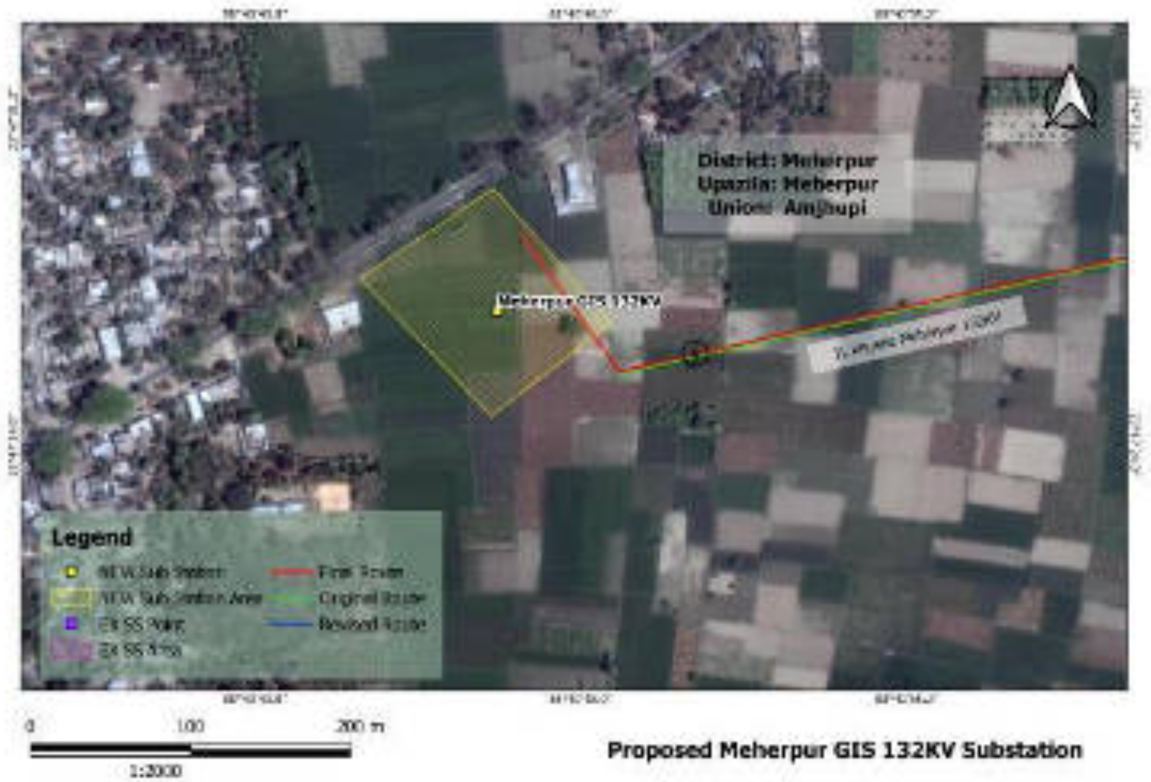


Plate 3.12 Mererpur substation land

(x) Phultala 132/33 kV indoor GIS substation (2 acre)

23. A 2-acre land allocated for the construction of Phultala substation is located in Mattomdanga and Mashsli mouza in Phultala sub-district of Khulna (Khulna Division) (Figure 17). The type of land is a waterbody. Water lily is cultivated in the waterbody and different vegetables at the boundary of the waterbody. A part of the waterbody is leased to the local prawn farmers. Khulna city bypass road and a jute mill are found within 500 m radius of the land. Fourteen trees were recorded from the land. Approximately, 3 m land

filling is required before the construction of substation. A detailed drainage plan will be prepared by EPC contractor after consultation with relevant authorities.

Table 23: Physical Features of Proposed Phultala Grid Substation (2 acres)

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 17: Location of Proposed Phultala Grid Substation

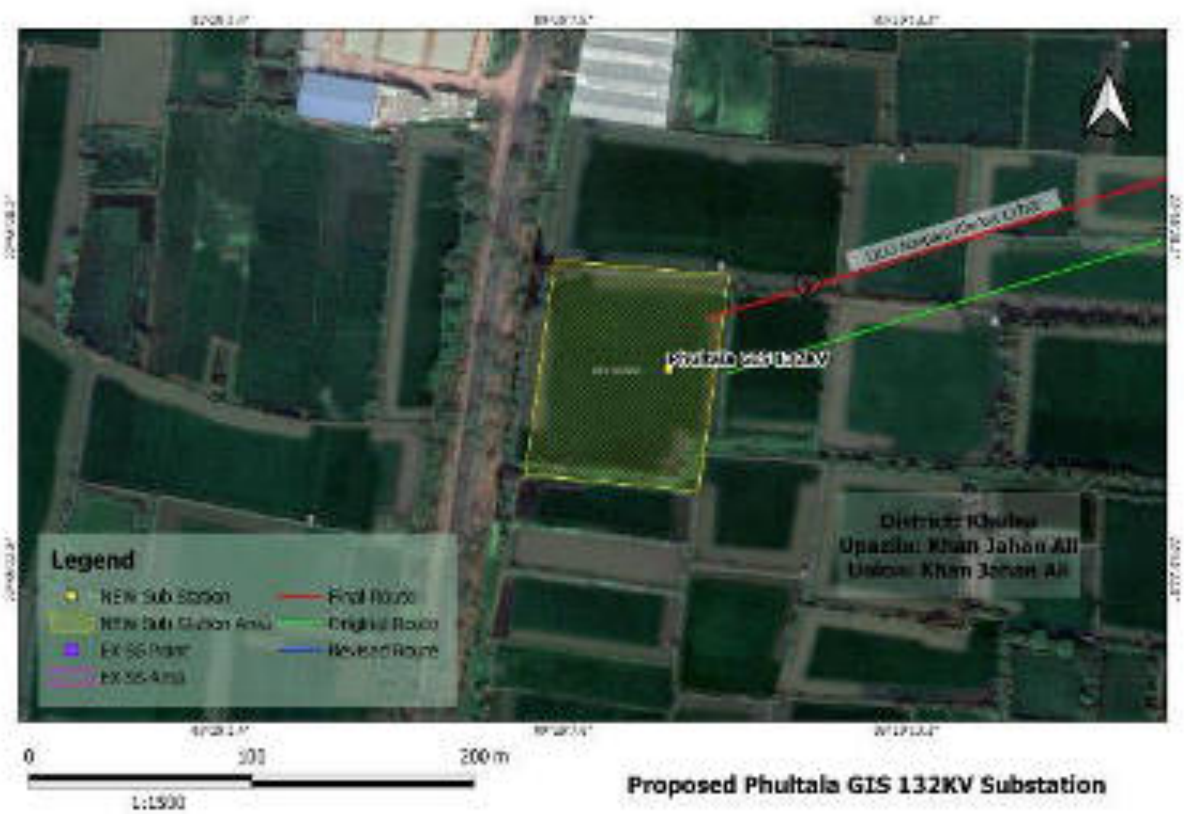


Plate 3.13 The land allocated for Phultala substation

(xi) Pirojpur 132/33 kV indoor GIS substation (3 acre)

24. A three-acre land is allocated for the construction of Pirojpir substation. It is situated in Kadamtola and Kadamtola mouza in Pirojpur Sadar of Pirojpur (Barishal Division) (Figure 18). Geographical coordinates are 22.63538N, 89.95208E. This is an irrigated agricultural and marshy land. Paddy, Coriander and sugarcane are cultivated in the land at present. Pirojpur- Najipur- Gopalganj highway, Kadamtola school, mosque, local market, canal and electricity lines are found with the 500 m radius of land. Fifteen fruit trees and 12 timber trees are found in the land. Land filling up to 2 m is required for the construction of substation.

Table 24: Physical Features of Proposed Pirojpur Grid Substation (3 acres)

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 18: Location of Pirojpur GIS Substation in Pirojpur District

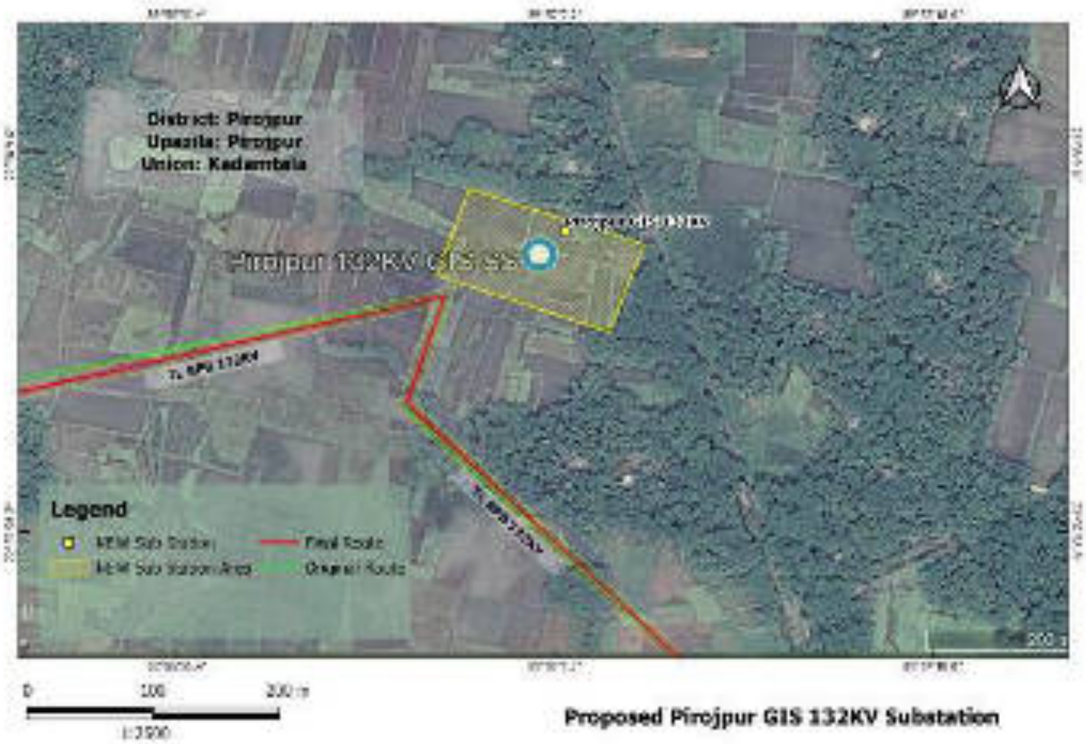



Plate 3.14 The land allocated for the construction of Pirojpur substation

(xii) Shibchar 132/33 kV indoor GIS substation (5 acre)

25. The land selected for the proposed Shibchar substation is located in Maler Kandhi mouza in sub-district Shibchar of Madaripur district (Dhaka Division) (Figure 19). The total extent of land required for the substation is five acres and the coordinates are 23.3552513N, 90.1847076E. The land is an irrigated agricultural land. Paddy is cultivated in two seasons. Few trees are found within the land (3 fruit trees, 2 medicinal trees). Arial Khan river, Shariatpur road, Madarasha, Malerkandhi-jame mosque, and Malerkandhi canal are

found within 500 m radius of the land. The land filling up to 3 m is required before the construction activities.

Table 25: Physical Features of Proposed Shibchar Grid Substation (5 acres)

Features	Specification
Land ownership	Private
Scheme	Double busbar scheme
Substation type	Indoor
Voltage	132/33 kV
Switchgear type	Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 19: Location of Shibchar GIS Substation in Madaripur District

	
Plate 3.15 The land identified for the construction of Shibchar substation	

(xiii) Rupsha-Satkhira 230 kV double circuit transmission line (62 km)

26. The proposed Rupsha-Satkhira 230 kV transmission line traverses 55 villages in five sub-districts (Fakirhat, Batiaghata, Dumuria, Satkhira Sadar, Tala) of Bagerhat, Khulna, and Satkhira distrcits in Khulna Division (Figure 20). It crosses 9 rivers, six canals and one Khal. No forest or scrublands are found along the line route. The main land uses along the route are agriculture, home gardens and water bodies (river, canal, Khal). Two terminal towers, 80 angle towers and 82 suspension towers are required for the length of 62 km. The line route is accessible via 53 roads including two highways. The line crosses national highway Jessore-Satkhira, between 0-1 km, Khulna- Satkhira highway between 2-3 km chainage of the line, and 45 other roads. 23 km of the total length of the line pass through marshy areas. Paddy fields are found along 46 km stretch of the line. Elevation of Satkhira is 11 m while Ruphsha having 9 m elevation. Number of trees in 12 m clearing width for the line of 58.3 km records 2,516 trees which are more than 5 m in height (excluding bamboo and banana). The common trees are Mahogany, Albizia, date palm, Areca palm and coconut.

Figure 20: Satkhira- Rupsha 230 kV and Satkhira- Manirampur 132 kV Transmission Lines

Table 26: Physical Features of Rupsha-Satkhira 230 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	230 kV (Initially operated at 132 kV)
2	Type of transmission line	Double circuit
3	Width of TL RoW	40 m
4	No of transmission towers	162
5	Transmission towers heights	Standard towers: 37 meters
6	Transmission line clearances	8 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 230 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	Rupsha and Satkhira Grid Substations
11	Duration of project implementation	Approximately 3 years

(xiv) Domar-Purba Sadipur 230 kV double circuit transmission line (46.5 km)

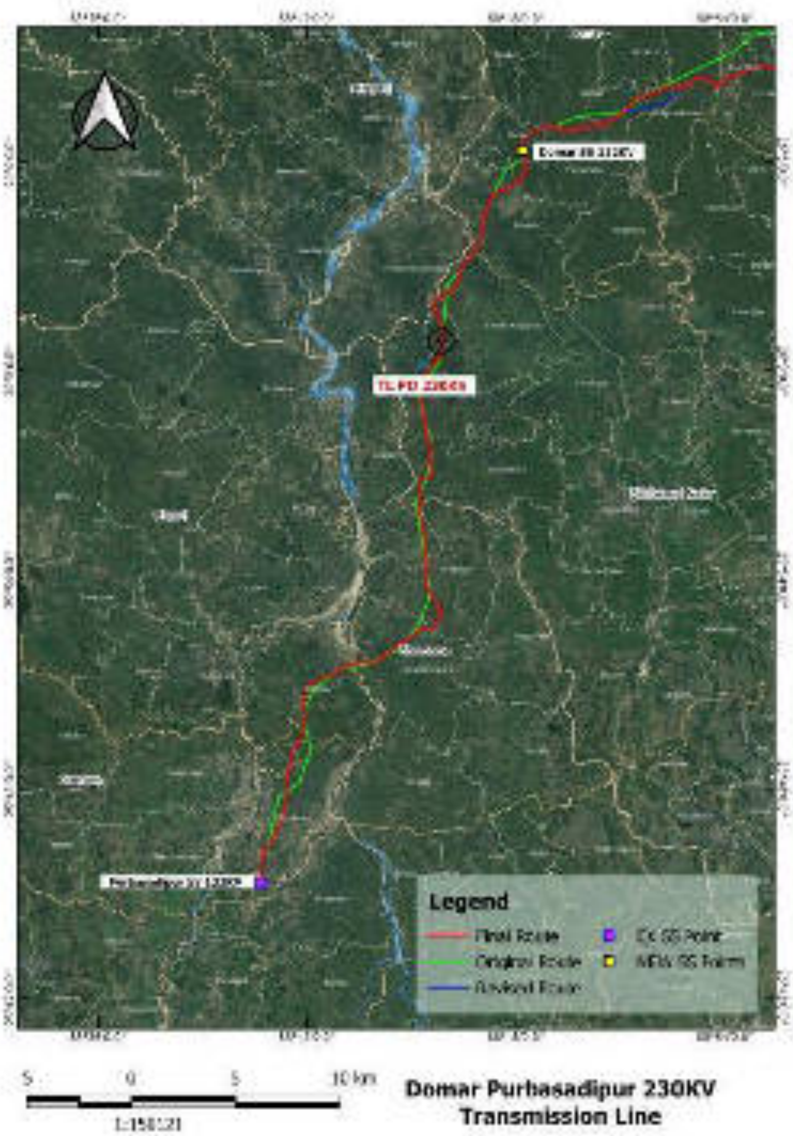
27. The total length of the transmission line is estimated at 46.5 km as reported in the Development Project Proposal (DPP) of PGCB. The proposed line traverses 41 villages, five upazilas (Birganj, Kaharole, Khansama, Domar and Nilphamari Sadar) in Dinajpur and Niphamari districts (Rangpur Division) (Figure 21). The line traverses various land uses and habitats such as agricultural fields, rivers, canals, ponds, homesteads and unutilized degraded and open lands. No forest or wildlife reserves are found in the alignment. The Ramsagar National Park is about 25 km south from the transmission line. The line crosses Atrai river between 10 and 11 km, Shewraphull river at 19-20 km and 20-21 km, Karotoya river at 21-22 km, a pond in 29-30 km and Gorgram canal at 30-31 km. 48 angle towers and 75 suspension towers are required for the line. The line is accessible through 40 roads and crosses 39 roads.

28. The RoW for 230 kV transmission line is established at 20 m either way from the centre of the line/ tower which is considered as the project impact area. Number of trees in 12 m clearing width for the line of 46.2 km records 1,432, which are more than 5 m in height (excluding bamboo and banana). The common trees are Eucalyptus, Acacia, Litchi, Margosa, Samanea saman (Renty Korol) and Mahogany.

Table 27: Physical Features of Domar-Purba Sadipur 230 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	230 kV (Initially operated at 132 kV)
2	Type of transmission line	Double circuit
3	Width of TL RoW	40 m
4	No of transmission towers	121
5	Transmission towers heights	Standard towers: 37 meters
6	Transmission line clearances	8 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 230 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	Domar and Purba Sadipur Grid Substations
11	Duration of project implementation	Approximately 3 years

Figure 21: Domar-Purba Sadipur 230 kV Transmission Line



(xv) Domar-Hatibanda 132 kV double circuit transmission line (35 km)

29. The total length of the transmission line is 35 km. It passes through 25 villages in three upazila (Domar, Dimla, Hatibanda) in two districts; Lalmonirhat and Nilphamari (Rangpur Division) (Figure 22). The RoW for 132 kV line is established at 14 m either way from the centre of the line/ tower, which is considered as the project impact area. The land under the RoW is private and government lands which are utilized for settlements, as well as cultivation of paddy and vegetables. The coordinates of angle towers of final alignment are given in the Annex 2.

30. The line is accessible from 31 roads and it crosses six rivers, four canals, and 28 roads in its entire length of 35 km. About 0.04 ha forest area is found in the RoW and Teesta

Barrage Park is about 400 m from the line at chainage 29-31. 56 angle 50 suspension and two terminal towers are needed for the line. The line crosses existing 33/ 11 kV lines several times. Length of line in marshy and paddy cultivated area is 28.9 km. The elevation at Domar and Hatibhanda is 38 m and 14 m, respectively. The area under the clearing width of 12 m is 41.7 ha. Bamboo represents the dominant tree in the clearing width with 6,040 individuals. The other tree species such as Eucalyptus, Albizia, Acacia and Mahogany having 1,187 individuals which are more than 5 m in height.

Figure 22: Domar-Hatibanda 132 kV Transmission Line

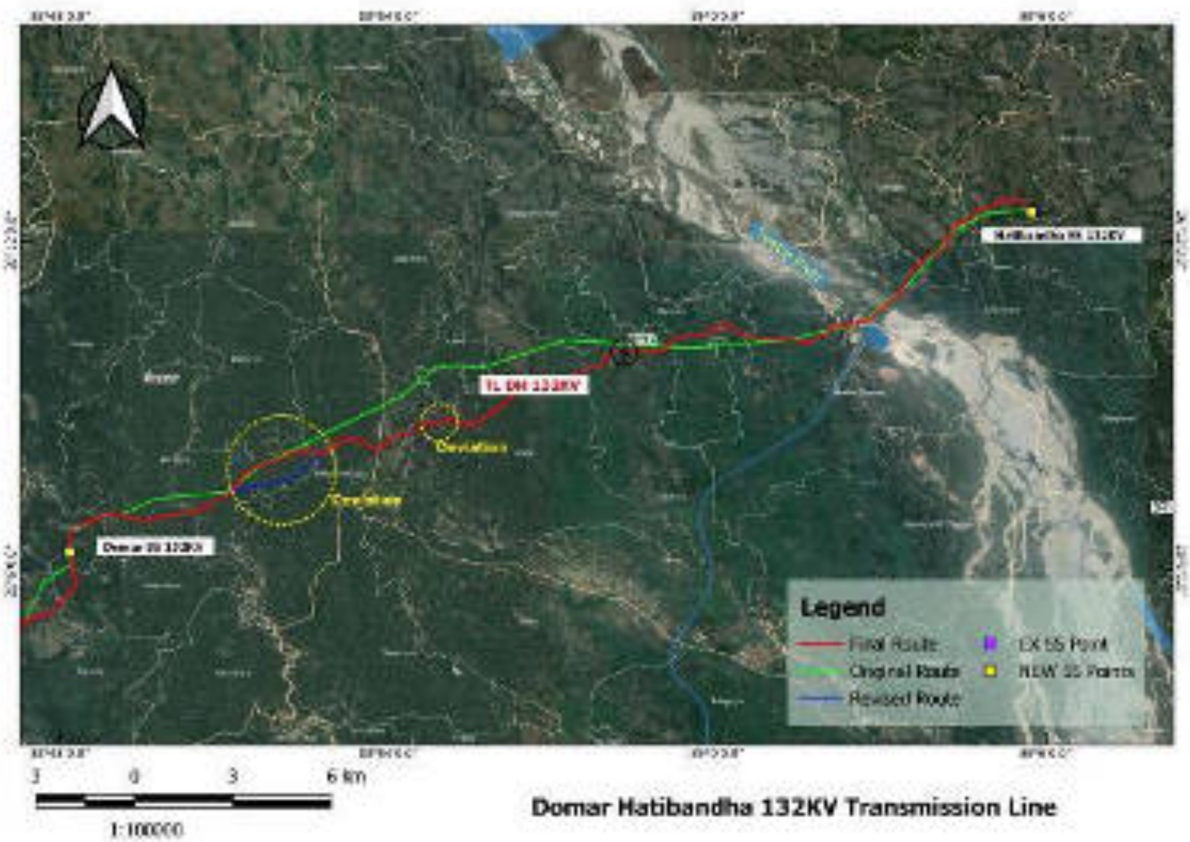


Table 28: Physical Features of Domar-Hatibanda 132 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m
4	No of transmission towers	106
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	Domar and Hatibanda Grid Substations
11	Duration of project implementation	Approximately 3 years

(xvi) Kaliganj-Maheshpur 132 kV double circuit transmission line (28 km)

31. The total length of Kaliganj-Maheshpur 132 kV transmission line is estimated at 25.3 km by the PGCB. After conducting the field survey of the route, the length of line was increased to 28 km, due to some deviations to the original line route. The line traverses 26 villages in Kaliganj, Kotchandpur and Maheshpur sub-districts of Jhenaidah district (Khulna Division) (Figure 23). The line is accessible through 15 roads. It crosses Kapotakha and Chitra rivers and 13 roads including Jeshore- Chuadanga highway and Dhaka- Khulna railway. The line requires two terminal towers, 12 angle towers and 72 suspension towers. The main land use along the line is agriculture/ paddy, 23.1 km of the line.

32. The number of trees estimated in the 12 m clearing width of the line was 667 (>5 m in height). The common trees are Mahogany, Date palm (Khejur) and Palmyra. The number of trees in the clearing width which are less than 5 m was 1,129.

Figure 23: Kaliganj-Maheshpur 132 kV Transmission Line

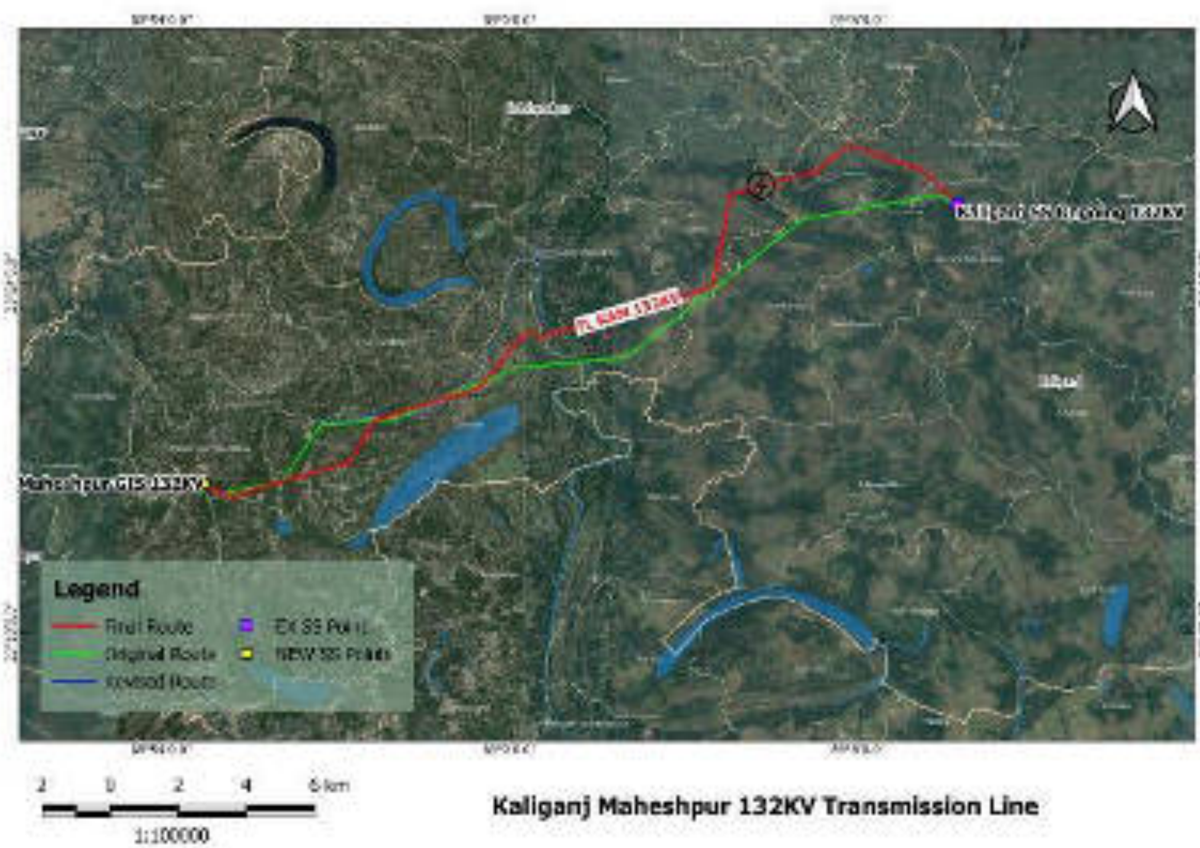


Table 29: Physical Features of Kaliganj-Maheshpur 132 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m

Sl. No.	Physical Features	Attribute
4	No of transmission towers	84
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	Kaliganj and Maheshpur Grid Substations
11	Duration of project implementation	Approximately 3 years

(xvii) Manirampur-Satkhira 132 kV double circuit transmission line (33.0 km)

33. The total length of Manirampur-Satkhira 132 kV transmission line is estimated at 31.9 km by the PGCB. After conducting the field survey of the route, the length of line was increased to 33.0 km, due to some deviations to the original line route. This line requires two terminal, 33 angle and 66 suspension towers. The line traverses 28 villages in Keshabpur, Manirampur, Patkelghata, Satkhira Sadar and Tala sub-districts of Jashore and Satkhira districts (Khulna Division) (Figure 20). The line crosses 18 roads, four rivers (Kapotaksha, Betna, Buri Bhadra, Harihar) and two canals (Khuchakhali and Gajasri). It is accessible through 21 roads including Jessore- Satkhira highway.

34. Forest, scrublands or wildlife reserves are not found along the line route. Agricultural/ paddy lands, marshes, water bodies and home gardens are the main land uses along the line. Elevation at Satkhira and Manirampur is 11 and 12 m, respectively. Jassore airport is 52 km from the project site.

35. The number of trees estimated in the 12 m clearing width of the line was 1,597 (>5 m in height). The common trees are Areca nut palm, Date palm (Khejur), Mahogany, Mango, Margosa, and Palmyra. The number of trees in the clearing width which are less than 5 m was 969.

Table 30: Physical Features of Manirampur-Satkhira 132 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m
4	No of transmission towers	101
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	Manirampur and Satkhira Grid Substations
11	Duration of project implementation	Approximately 3 years

(xviii) Kushtia-Meherpur 132 kV double circuit transmission line (48.0 km)

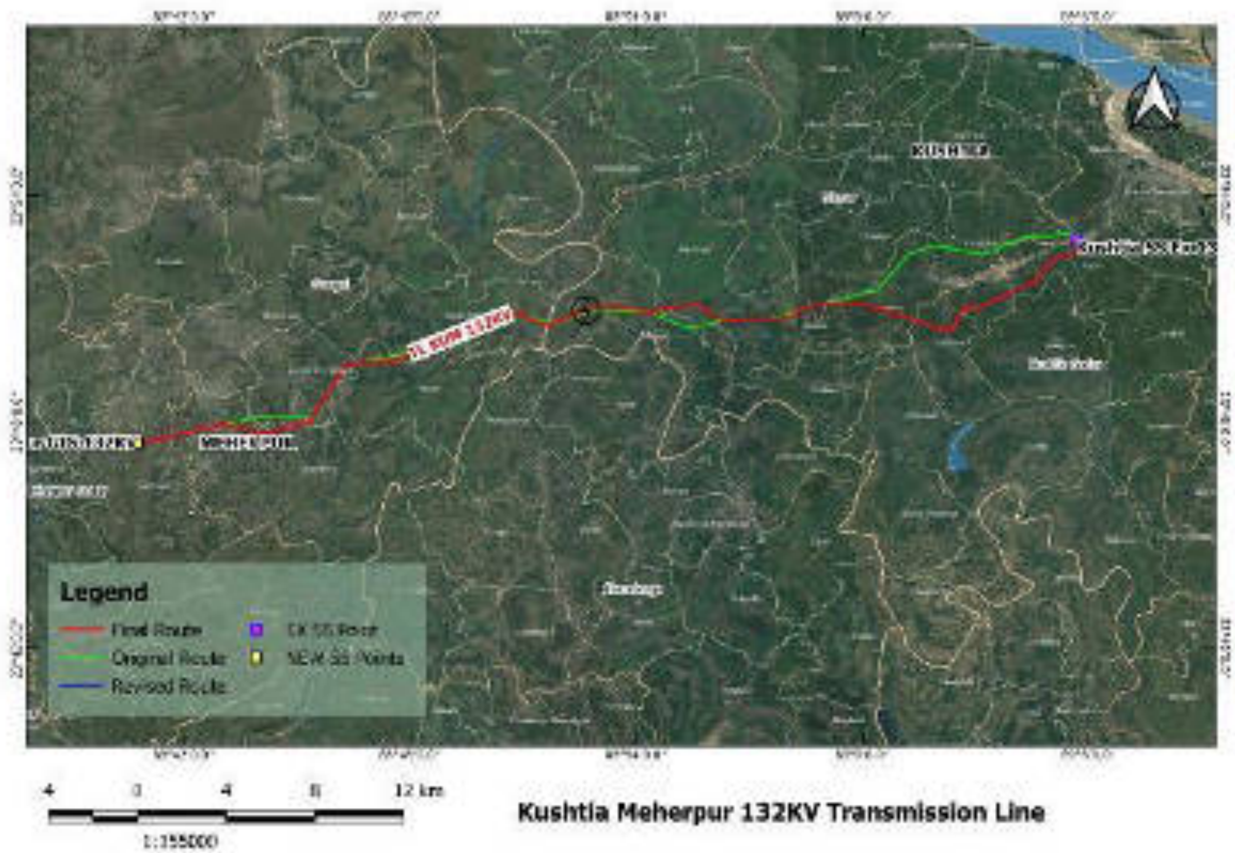
36. The total length of Kushtia-Meherpur 132 kV line is estimated at 46.2 km by the PGCB. After the field surveys the total length of the line has been increased to 48.0 km with some deviations of the alignment. The line traverses 39 villages in Kushtia Sadar, Mirpur and Gangni sub- districts of Kushtia and Meherpur districts (Khulna Division) (Figure 24). The line crosses 29 roads, four rivers (Kajla, Mathavanga, Pangashi, Sagar), 7 canals, and two ponds along the length of the line. Forest or wildlife habitats are not found in the project area. The line requires two terminal, 30 angle and 115 suspension towers. The line is accessible through 29 roads including Meherpur- Kushtia, Kushtia- Jhenaidah and Kushtia Chuadanga highways. Average elevation at Kushtia is 27 m and 24 m in Meherpur.

37. The total number of trees which are more than 5 m in height, recorded in 12 m clearing width of the line is 717, excluding the bamboo and banana trees. Trees which are less than 5 m in height were also estimated at 1,704 in 12 m width, however, these trees will not be cut down for the construction of the line.

Table 31: Physical Features of Kushtia-Meherpur 132 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m
4	No of transmission towers	145
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	Kushitia and Meherpur Grid Substations
11	Duration of project implementation	Approximately 3 years

Figure 24: Kushtia-Meherpur 132 kV Transmission Line



(xix) Bagerhat-Pirojpur-Bhandaria 132 kV double circuit transmission line (49.5 km)

38. Bagerhat- Pirojpur- Bhandaria 132 kV transmission line traverses 41 villages in five sub-districts (Bagerhat Sadar, Kachua, Bhandaria, Kawkhali, Pirojpur) in Bagerhat, Pirojpur and Jalokathi districts (Khulna/ Barishal Divisions) (Figure 25). It crosses five rivers, 15 canals and one Khal. The line is accessible via 44 roads, it crosses 35 roads and Bagerhat-Pirojpur highway. Forests or wildlife reserves are not found in the line route. This line requires two terminal, 55 angle and 94 suspension towers.

39. The land under the clearing width of 12 m is 58.9 ha. The number of trees found in this area is 24,449, including the bamboo and trees which are less than 5 m in height. Total number of trees which are more than 5 m in height is 12,674, excluding the bamboo. The dominant trees are Betel nut, coconut, date palm, Mahogany and Samanea saman (Renty Korol). The average elevation in Bagerhat, Pirojpur and Bhandaria is 2-3 m.

Figure 25: Bagerhat-Pirojpur-Bandharia 132 kV Transmission Line

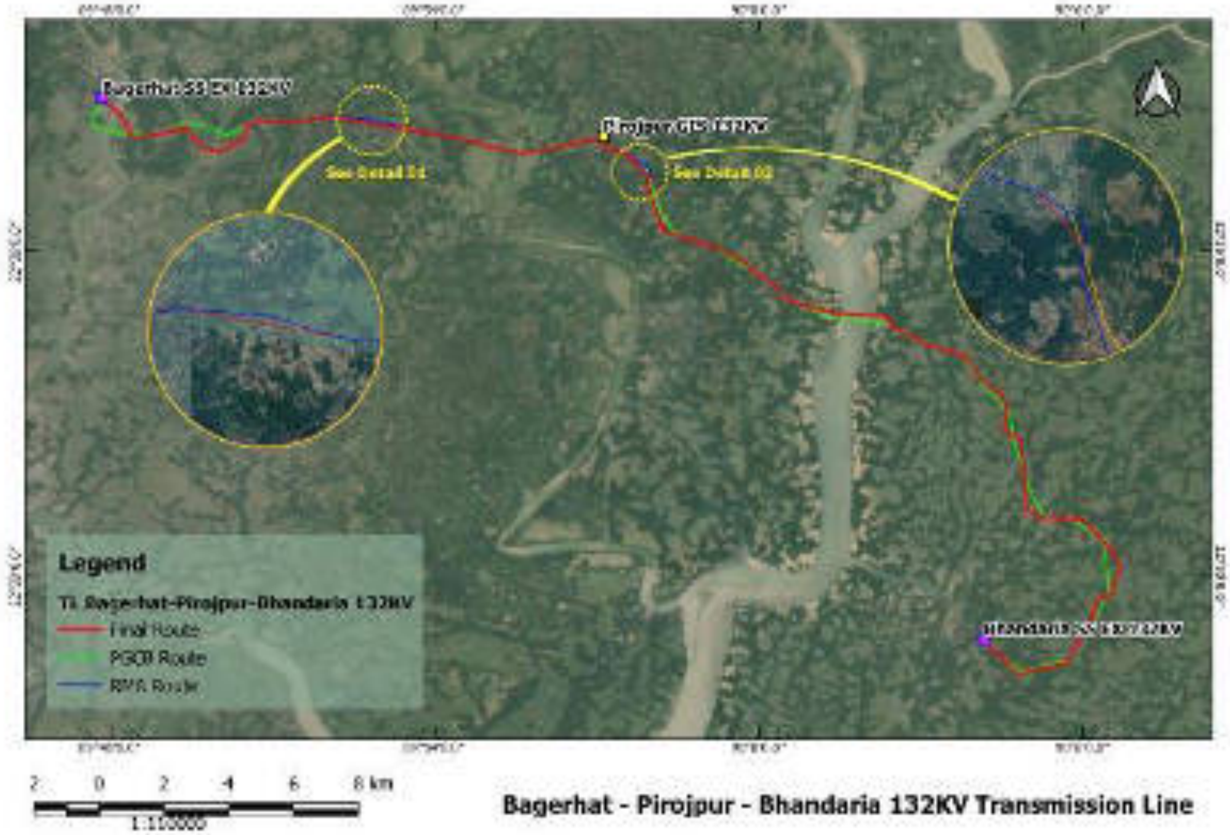


Table 32: Physical Features of Pirojpur-Bandharia 132 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m
4	No of transmission towers	149
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	Bagerhat, Pirojpur and Bhandaria Grid Substations
11	Duration of project implementation	Approximately 3 years

(xx) Gopalganj (North)-Shibchar 230 kV double circuit transmission line (25 km)

40. The total length of 230 kV transmission line is estimated at 21.7 km by the PGCB. After the field surveys the length of the line has been increased to 25 km due to some deviations to the original line route. The line traverses 23 villages in Bhanga, Rajoir and Shibchar sub- districts of Faridpur and Madaripur (Dhaka Division) (Figure 26). The line crosses 18

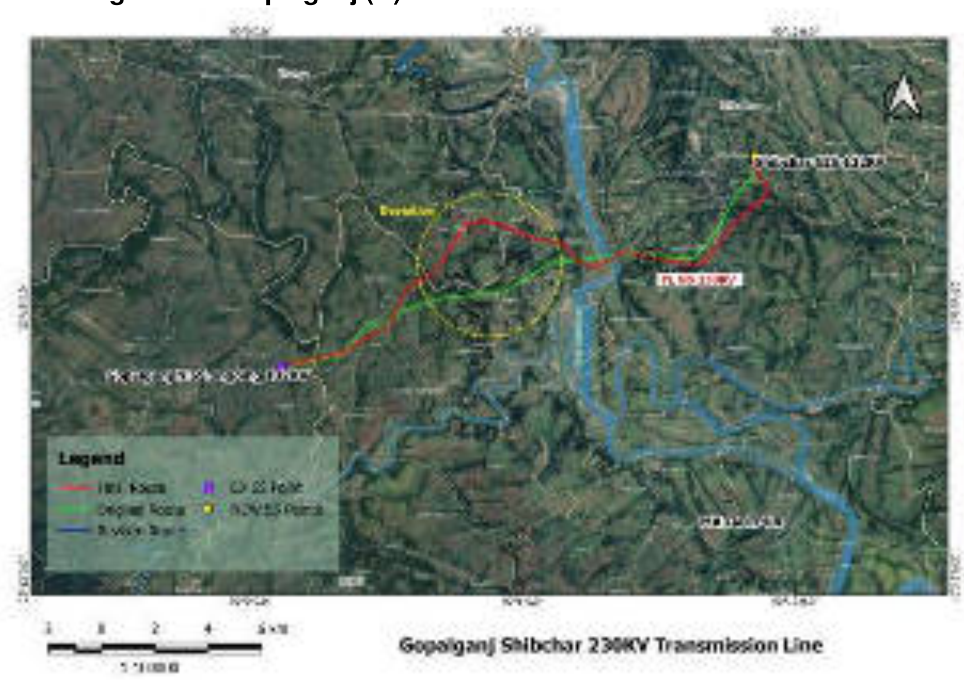
roads including the Barishal-Faridpur highway, Kumar and Arialkha rivers, village local canal system, Purbo Kakoir, Moraganj and West Kachikat canals. The line is accessible through 21 roads including the Barishal- Faridpur highway. Wildlife reserves or forests are not found along the proposed line route. Two terminal, 21 angle and 43 suspension towers are required for the line. The main land uses along the line are agriculture, homesteads open degraded lands and water bodies (river, canal, pond).

41. The trees which are greater than 5 m in height found in the direct impact zone (12 m clearing width) of the transmission line is 1,525, excluding bamboo and banana trees. The trees less than 5 m in height recorded at 3,362 within the direct impact zone. The common tree species are Albizia (Karol), Mahogany, Mango, Palmyra, Dalbergia (Shisu), Jackfruit, Date palm, Acacia and Chamble.

Table 33: Physical Features of Gopalganj (N)-Shibchar 230 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	230 kV (Initially operated at 132 kV)
2	Type of transmission line	Double circuit
3	Width of TL RoW	40 m
4	No of transmission towers	64
5	Transmission towers heights	Standard towers: 37 meters
6	Transmission line clearances	8 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 230 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	Gopalganj (N) and Shibchar Grid Substations
11	Duration of project implementation	Approximately 3 years

Figure 26 - Gopalganj (N)–Shibchar 230 kV Transmission Line



(xxi) Niam

42. The total length of Niamatpur-Patnitola 132 kV transmission line is estimated at 33.3 by the PGCB. After the field surveys the length of the line has been decreased to 33 km due to few deviations to the original line route. The line traverses 30 villages in Mahadepur, Niamatpur and Patnitola sub-districts of Naogoan (Rajshahi Division) (Figure 27). The line is accessible through 22 roads. It crosses 18 roads including Chandash- Mahadebpur highway and three canals (Chatra, Singhadi, Esapur). Two terminal, 23 angle and 74 suspension towers are required for the line. The main land uses along the line are agriculture, homesteads open degraded lands and water bodies (canal, pond). Elevation at Niamatpur and Patnitola is 15 and 22 m, respectively. Saidpur airport is 55 km away from the project site.

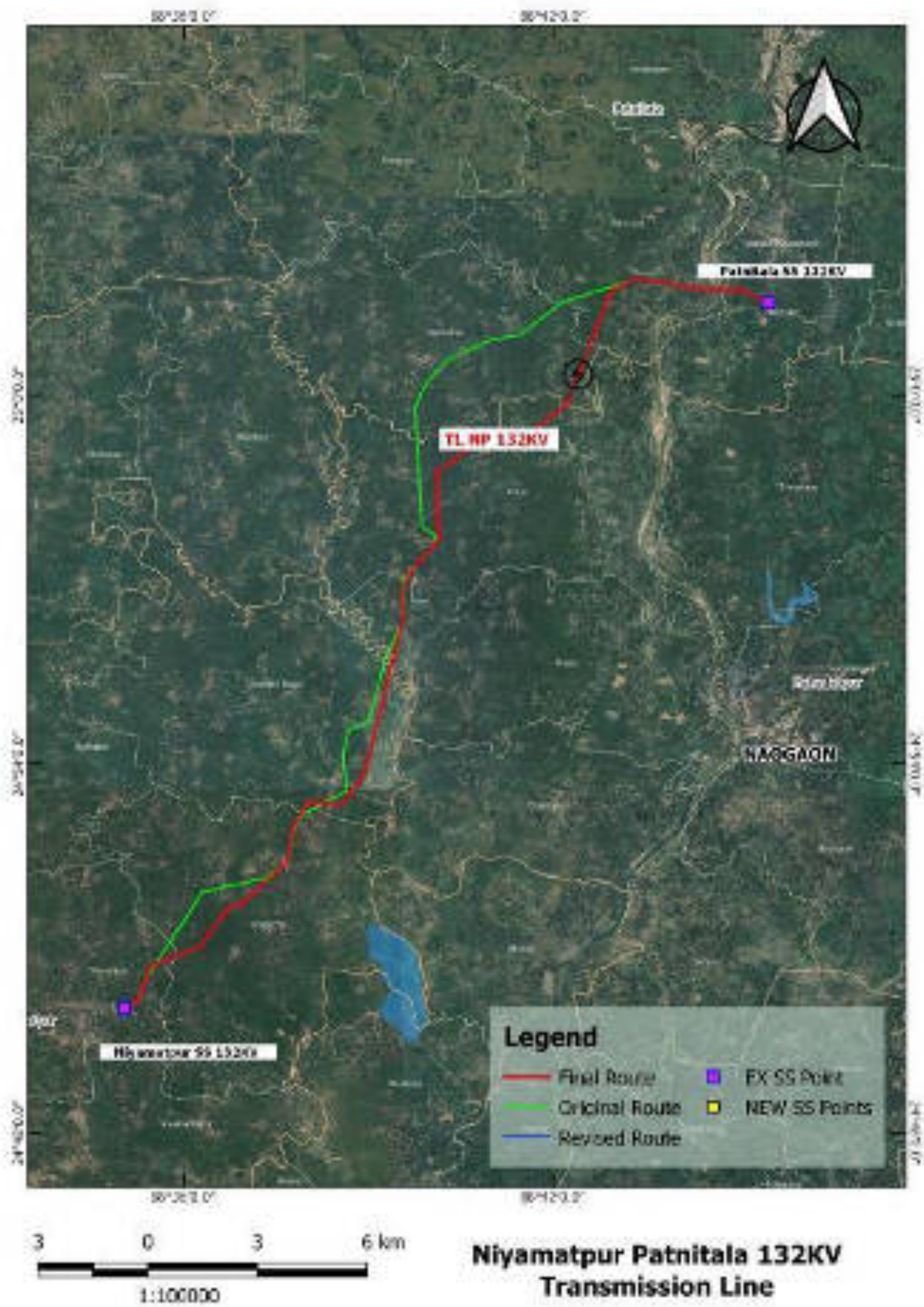
43. The trees which are greater than 5 m in height found in the direct impact zone (12 m clearing width) of the transmission line is 301. The trees less than 5 m in height recorded at 73 within the direct impact zone. The common tree species are Eucalyptus, Mahogany, Margosa, Palmyra, and Dalbergia (Shisu).

Table 34: Physical Features of Niamatpur-Patnitola 132 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m
4	No of transmission towers	97
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	Niamatpur and Patnitola Grid Substations
11	Duration of project implementation	Approximately 3 years

Figure 27: Niamatpur-Patnitola 132 kV Transmission Line

(xxii)



Line-in line-out connection from Barishal-Bhola-Burhanuddin 230 kV double circuit transmission line to Bhola substation (1 km)

44. The LILO connection from Barishal-Bhola-Burhanuddin 230 kV line to Bhola substation is 1 km in length. It is located in Banglabazar village, Daulat Khan sub-district in Bhola (Barishal Division) (Figure 28). River, canals, forest or wildlife reserves are not found along the line. One angel tower and two terminal towers are required for the line. It passes through Kharut- Banglabazar road. No trees are recorded within the RoW. Average elevation is 2 m.

Table 35: Physical Features of LILO Connection from Barishal-Bhola-Burhanuddin 230 kV Double Circuit Transmission Line to Bhola Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	230 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	40 m
4	No of transmission towers	1
5	Transmission towers heights	Standard towers: 37 meters
6	Transmission line clearances	8 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 230 kV lattice
8	Conductor material	Aluminium Conductor Steel Reinforced
9	Line insulator	Disc type, porcelain
10	Type of connection	LILO connection to Bhola substation from Barishal-Bhola-Borhanuddin 230 kV transmission line
11	Duration of project implementation	Approximately 3 years

Figure 28: LILO Connection to Bhola Substation

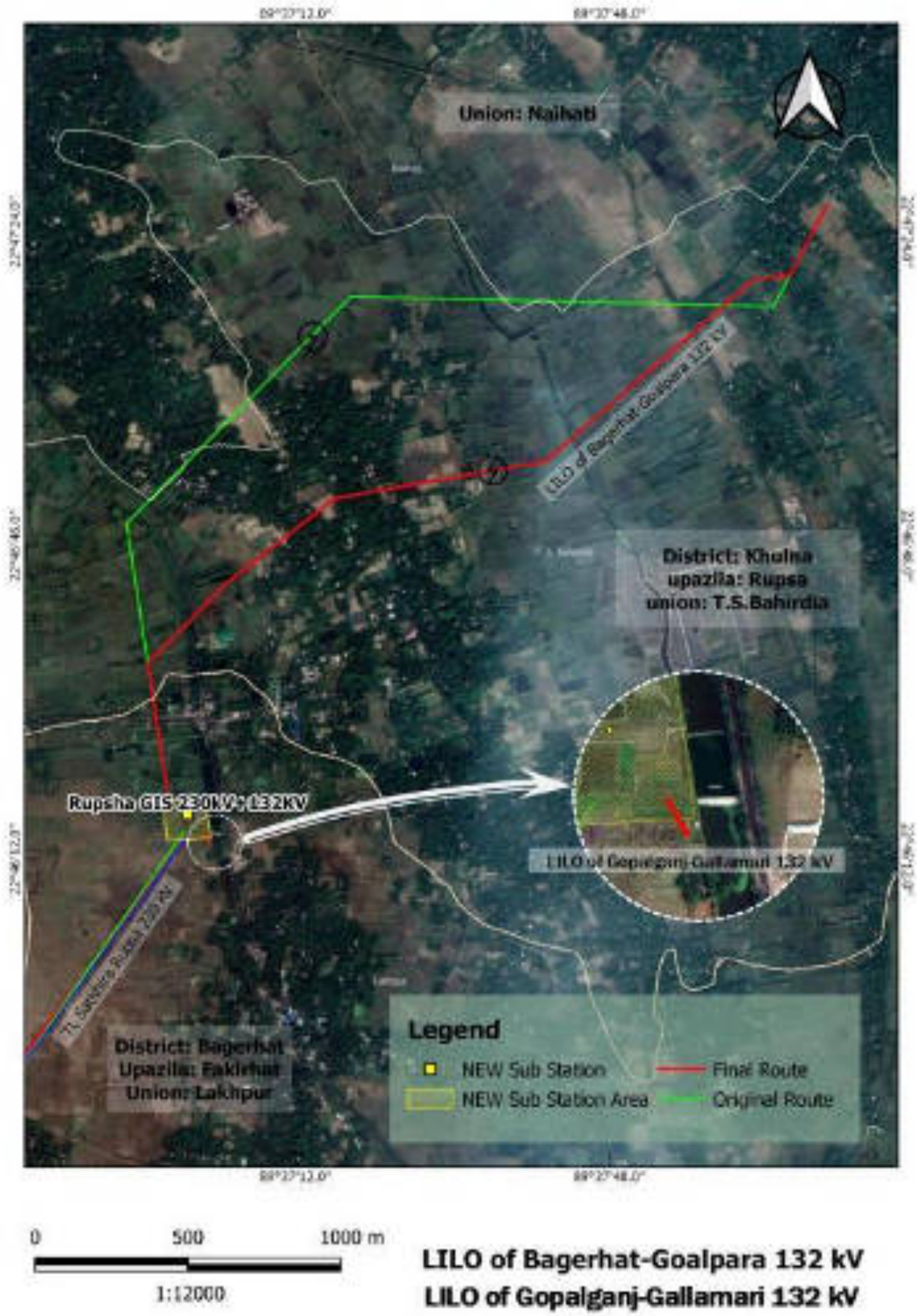
(xxiii) Line-in line-out connection from Bagerhat-Goalpara 132 kV double circuit transmission line to Rupsha substation (3.5 km)

45. LILO from Bagerhat–Goalpara 132 kV line to Rupsha substation is located in Tilok, Tilok Moddha para villages, Rupsha sub-district in Khulna (Division Khulna) (Figure 29). The length of line is 3.5 km and it passes through agricultural lands and home gardens. Forest or wildlife reserves are not found in the project area. The line crosses Poddabil canal in angle towers 3-4, 4-5 and 5-6. Two terminal, 6 angle and 4 suspension towers are required for the line. Road accessibility is via Khulna city bypass road, Khulna- Mongla road and Tilok- Khadiza road and the line crosses all three roads. The clearing width is 12 m and the land area underneath is 4 ha along the entire line. The tree inventory recorded 92 timber trees, 9 trees with medicinal value and 112 fruit trees which are > 5 m in height. The elevation at Bagerhat is 2 m, and 35 m at Goalpara. Barishal airport is 35 km away from the project area.

Table 36: Physical Features of LILO Connection from Bagerhat-Goalpara 132 kV Line to Rupsha Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m
4	No of transmission towers	10
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Steel Reinforced
9	Line insulator	Disc type, porcelain
10	Type of connection	LILO connection to Rupsha substation from Bagerhat-Goalpara 132 kV transmission line
11	Duration of project implementation	Approximately 3 years

Figure 29: LILO connections at Rupsha substation, Bagerhat- Goalpara and Gallamari- Gopalganj



(xxiv) Line-in line-out connection from Gallamari-Gopalganj 132 kV double circuit transmission line to Rupsha substation (0.5 km)

46. The length of LILO connection from Gallamari-Gopalganj 132 line to Rupsha substation is 0.5 km. It is located in Tilok village, Fakirhat sub-district in Bagerhat district (Khulna Division) (Figure 29). It passes through agricultural land and home gardens. Elevation at Gallamari is 5 m and 10 m at Gopalganj. No trees have to be removed for the line and only two angel towers are required for the line.

Table 37: Physical Features of LILO Connection from Gallamari-Gopalganj 132 kV Line to Rupsha Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m
4	No of transmission towers	
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Steel Reinforced
9	Line insulator	Disc type, porcelain
10	Type of connection	LILO connection to Rupsha substation from Gallamari-Gopalganj 132 kV transmission line
11	Duration of project implementation	Approximately 3 years

(xxv) Line-in line-out connection from Khulna (South)-Rupsha power plant 230 kV double circuit transmission line to Rupsha substation (0.5 km)

47. The transmission line from Khulna (South) to Rupsha power plant passes through the land identified for the Rupsha substation. Therefore, the substation land is underneath the line (Figure 29). None of the subprojects including this are for exclusive use of existing or future power generation or any other facilities. Therefore, this project does not have any associated facilities to be parallelly evaluated.

Table 38: Physical Features of LILO Connection from Khulna (S)-Rupsha 230 kV Line to Rupsha Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	230 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	40 m
4	No of transmission towers	Line over the substation
5	Transmission towers heights	Standard towers: 37 meters
6	Transmission line clearances	8 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 230 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	LILO connection to Rupsha substation from Khulna (S) - Rupsha Power Plant 230 kV transmission line
11	Duration of project implementation	Approximately 3 years

(xxvi) Line-in line-out connection from Faridpur-Madaripur 132 kV double circuit transmission line to Bhanga substation (0.5 km)

48. The length of LILO from Faridpur–Madaripur 132 kV line to Bhanga substation is 0.5 km and only two angle towers are required for the line. The line is located in Hamirdi village, Bhanga sub- district in Faridpur district (Dhaka Division) (Figure 30). This line can be reached by Bhanga- Faridpur highway. The line crosses agricultural lands and home gardens. Forest or wildlife reserves are not located nearby. Tree cutting is not required for the line. Elevation at Bhanga is 7 m, 15 m at Faridpur and 10 m at Madaripur. Barishal airport is 43 km away from the project area.

Table 39: Physical Features of LILO Connection from Faridpur-Madaripur 132 kV Line to Bhanga Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m
4	No of transmission towers	
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain
10	Type of connection	LILO connection to Bhanga substation from Faridpur-Madaripur 132 kV transmission line
11	Duration of project implementation	Approximately 3 years

Figure 30: LILO Connection from Faridpur-Madaripur 132 kV Line to Bhanga Substation

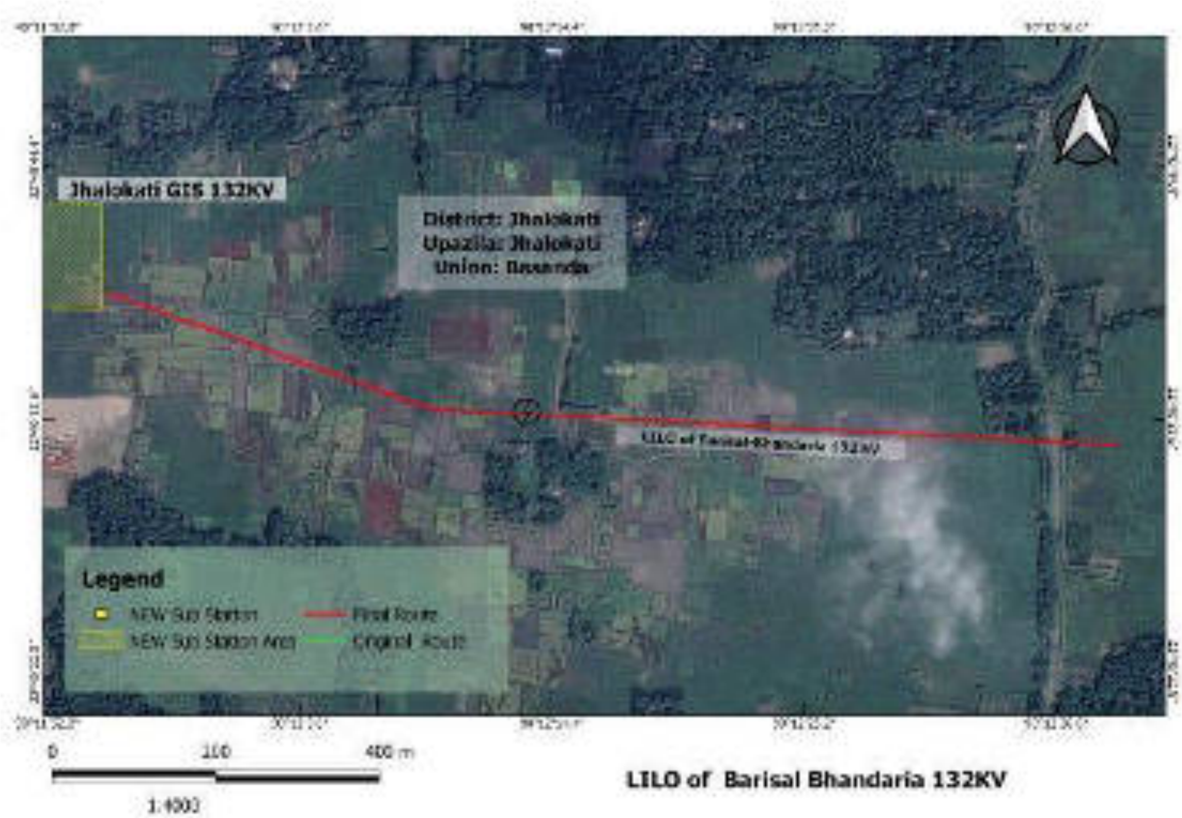
(xxvii) Line-in line-out connection from Barishal-Bhandaria 132 kV double circuit transmission line to Jhalokati substation (1.5km)

49. This line is located in Sakhari village, Jhalokati Sadar sub-district in Jhalokati district (Barishal Division) (Figure 31). The length of the LILO is 1.5 km. Two terminal, one angle and two suspension towers are required for the line. Road accessibility is through Sakhari road. Line passes through agricultural lands and home gardens. Elevation at Barishal is 1.2 m and it is 2 m at Bhandaria. The project site is 42 km away from Barishal airport.

Table 40: Physical features of LILO Connection from Barishal- Bhandaria 132 kV Line to Jhalokati Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m
4	No of transmission towers	3
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Steel Reinforced
9	Line insulator	Disc type, porcelain
10	Type of connection	LILO connection to Jhalokati substation from Barishal-Bhandaria 132 kV transmission line
11	Duration of project implementation	Approximately 3 years

Figure 31: LILO Connection at Jhalokati Substation



(xxviii) Line-in line-out connection from Khulna Central-Noapara 132 kV double circuit transmission line to Phultala substation (1 km)

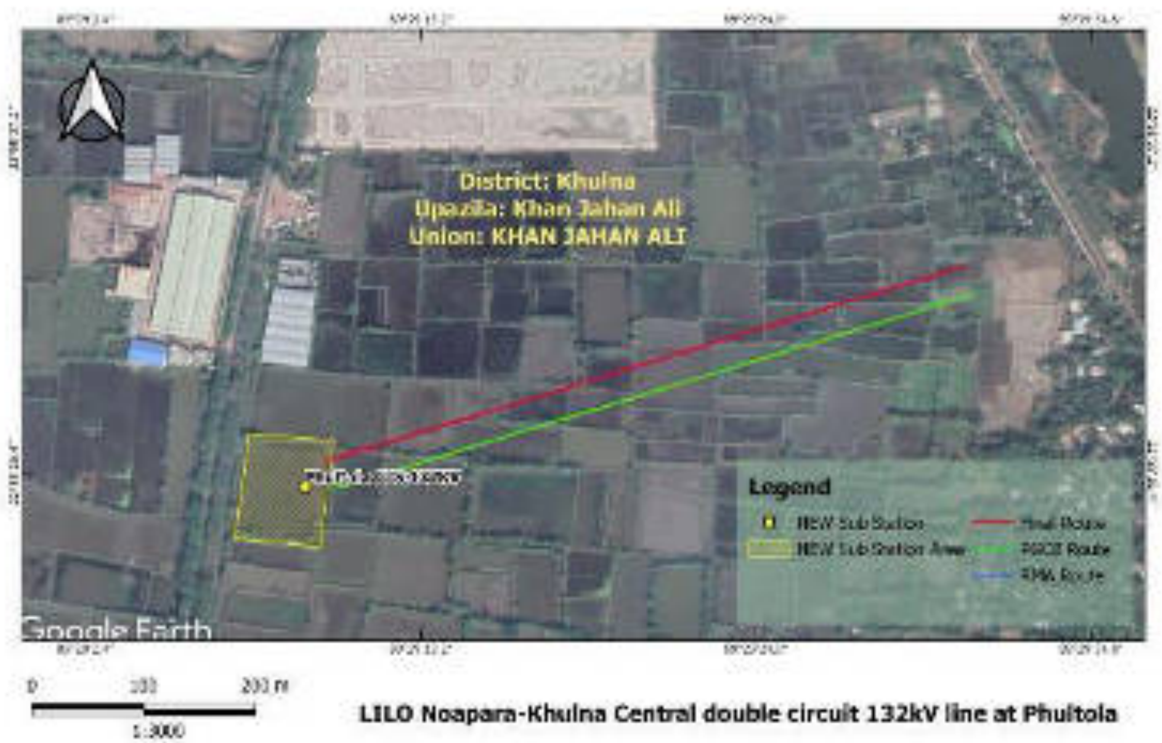
50. The length of LILO is 1 km and located in Atraji tala village, Phultala sub-district in Khulna district (Division Khulna) (Figure 32). The line will not cross any river, canal or road. The line passes through agricultural land and home gardens. Road accessibility is through Atraji tala village road. Two angle towers and one suspension tower are required for the line. The elevation at Khulna is 9 m and 2 km to the Khulna airport.

Table 41: Physical Features of LILO Connection from Khulna Central-Noapara 132 kV Line to Phultala Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 m
4	No of transmission towers	1
5	Transmission towers heights	Standard towers: 28.963 meters
6	Transmission line clearances	7 m (ground clearance measured from the highest flood level)
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium Conductor Composite Core
9	Line insulator	Disc type, porcelain

10	Type of connection	LILO connection to Phultala substation from Khulna Central-Noapara 132 kV transmission line
11	Duration of project implementation	Approximately 3 years

Figure 32: LILO Connection at Phultala Substation



(xxix) 132 kV air insulated switchgear (AIS) bay extensions at Satkhira substation

51. Satkhira substation was commissioned in 2005 and located in Taltola and Binerpota mouza, Satkhira Sadar sub-district in Satkhira district (Khulna Division) (Figure 33). The total extent of the land of the substation is 5 acres. The bay extension will require 3 acres of land and this is available adjacent to the existing substation. Several land owners will be affected and the land could be purchased at the current market price.

Figure 33: Location of Proposed Satkhira Substation and proposed 3-acre Extension for the Bay Extension

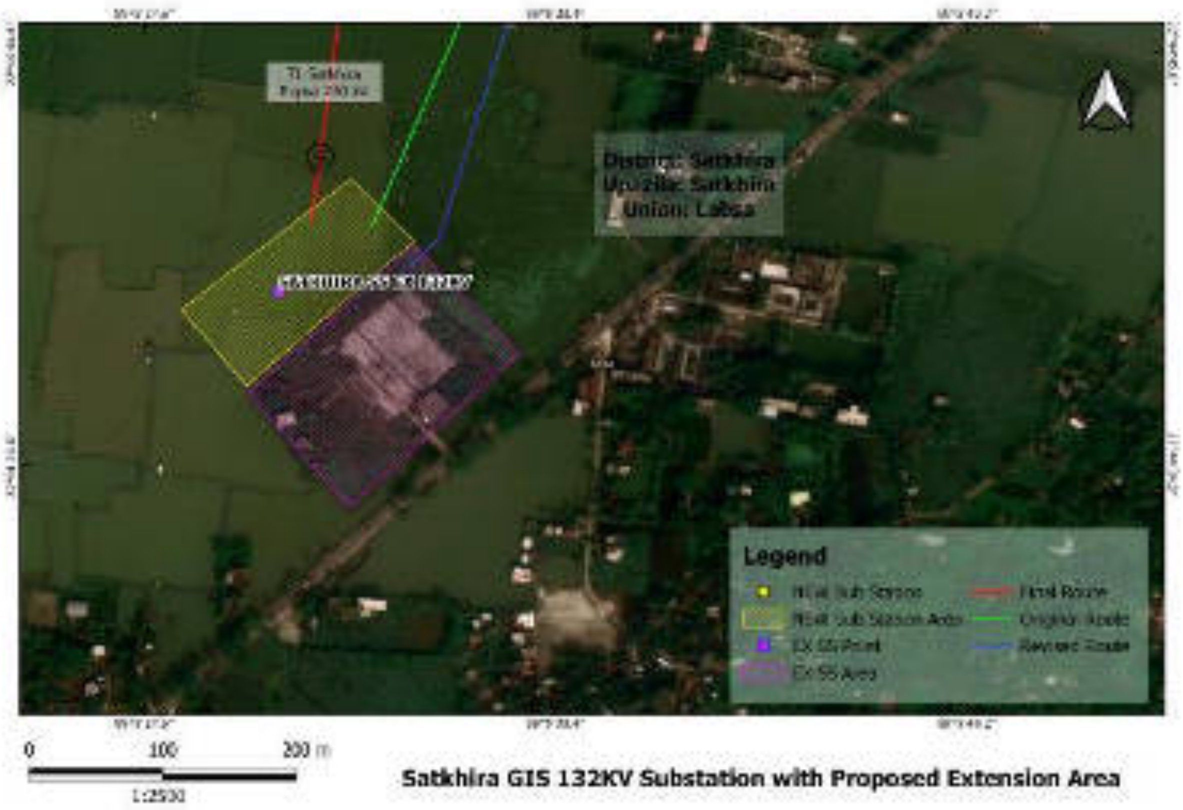


Table 42: Physical Features of Satkhira Grid Substation – Bay Extension

Features	Specification
Status	Existing
Land ownership	PGCB
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Existing: Air-insulated Bay Extension: Air-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Plate 3.16 Satkhira substation

Plate 3.17 Satkhira substation and the adjacent land (3 acre) identified for the bay extension

(xxx) 132 kV outdoor GIS bay extensions at Purba Sadipur substation

52. Purba Sadipur substation is located in Sundapur union, Ward- 5 village in Sadipur sub-district of Dinajpur district (Rangpur Division) (Figure 34). Total extent of the land of the substation is 10.44 acres and the proposed bay extension requires 0.5 acre, found within the substation premises. The substation was commissioned in 1980.

Table 43: Physical Features of Purbasadipur Grid Substation – Bay Extension

Features	Specification
Status	Existing
Land ownership	PGCB
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	230/132 kV
Switchgear type	Existing: Air-insulated Bay Extension: Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated

Features	Specification
Protection system description	Auto firefighting water spray system

Figure 34: Location of Purba Sadipur Existing Grid Substation

Plate 3.18 Puba Sadipur substation

Plate 3.19 The land allocated for the bay extension

(xxxi) 132 kV AIS bay extensions at Kaliganj substation

53. Kaliganj substation is under construction at present and it will be commissioned in 2020. It is located in Kaliganj mouza in Jhenaidah district (Khulna Division) (Figure 35). Total extent of the land under the substation is 5 acres.

Figure 35: Location Map of Kaliganj Proposed Grid Substation

Table 44: Physical Features of Kaliganj Grid Substation – Bay Extension

Features	Specification
Status	Under construction
Land ownership	PGCB
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Existing: Air-insulated Bay Extension: Air-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

(xxxii) 132 kV outdoor GIS bay extensions at Kushtia substation

54. Kushtia substation is located in Bottoil village in Kushtia Sadar of Kushtia district (Khulna Division) (Figure 36). The substation is in operation since 1968. Total extent of the land of the substation is 14.3 acres and the proposed bay extension required 0.5 acre which is available within the premises. Few trees such as Mango, Jackfruit, and Papaya have to be removed from the land.

Figure 36: Location of Kushtia Existing Grid Substation

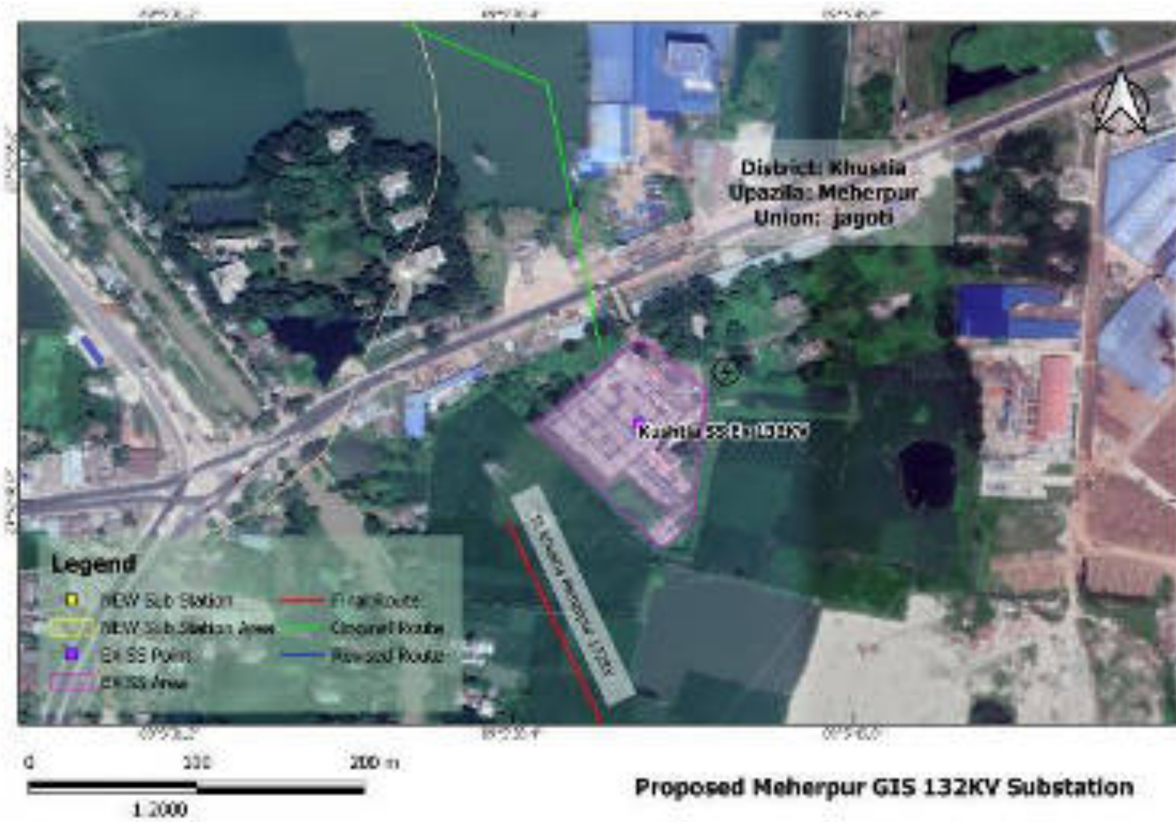


Table 45: Physical Features of Kushtia Grid Substation – Bay Extension

Features	Specification
Status	Existing
Land ownership	PGCB
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Existing: Air-insulated Bay Extension: Air-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Plate 3.20 Kushtia substation and the land allocated for the proposed bay extension

(xxxiii) 132 kV outdoor GIS bay extensions at Bagerhat substation

55. Bagerhat substation is located in Bagerhat Pourashova village in Bagerhat Sadar sub-district of Bagerhat (Khulna Division) (Figure 37). It has been commissioned in 1980 and the extent of the land of the substation is 7.6 acres. The space for the bay extension is available with the premises and only a few trees are found in the land.

Table 46: Physical Features of Bagerhat Grid Substation – Bay Extension

Features	Specification
Status	Existing
Land ownership	PGCB
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Air-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 37: Location of Bagerhat Existing Grid Substation

Plate 3.21 Bagerhat substation and the land earmarked for the bay extension

(xxxiv) 132 kV outdoor GIS bay extensions at Bhandaria substation

56. Bhandaria substation is situated in Purbo Bhandaria Ward No. 5 village in Bhandaria sub-district of Pirojpur (Barishal Division). This was commissioned in 1994 and the land extent is 2 acres. Land for the proposed bay extension has to be acquired as no space is available within the premises.

Table 47: Physical Features of Bhandaria Grid Substation – Bay Extension

Features	Specification
Status	Existing

Features	Specification
Land ownership	PGCB
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Existing: Air-insulated Bay Extension: Air-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Plate 3.22 Bhandaria substation

(xxxv) 132 kV AIS bay extensions at Gopalganj (North) substation

57. Gopalganj substation is under construction and it will be commissioned in 2020. The substation is located in Sagalsira village in Mukshedpur sub-district of Gopalganj district (Dhaka Division) (Figure 38). The land filing activities were in progress during the field visit to the substation in December 2018. Total extent of the land of the substation is 63 acres. Bhanga- Takerhat road is in the eastern part of the project site.

Table 48: Physical Features of Gopalganj (N) Grid Substation – Bay Extension

Features	Specification
Status	Under construction
Land ownership	PGCB
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	400/132 kV
Switchgear type	Existing: Air-insulated Bay Extension: Air-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Figure 38: Location Map of Gopalganj (N) Grid Substation

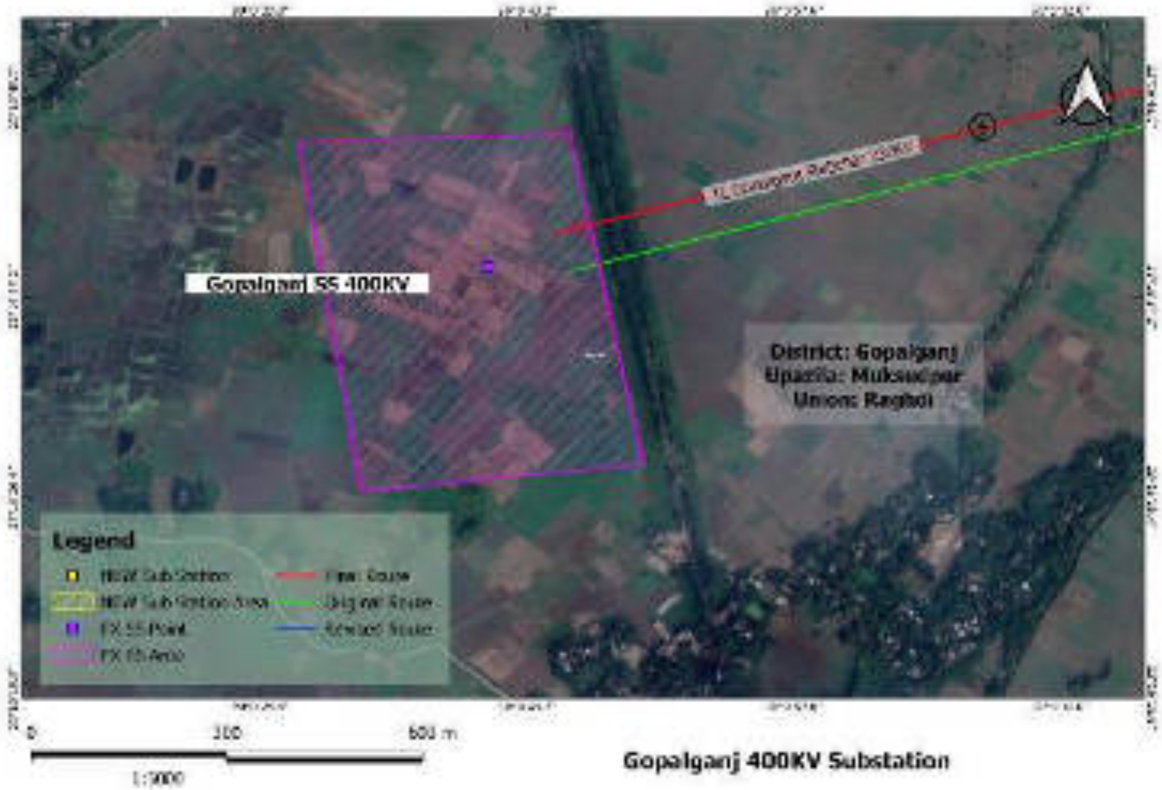


Plate 3.23 Land filling in Gopalganj is in progress, Bhanga- Takerhat road border the project site

(xxxvi) 132 kV AIS bay extensions at Niamatpur substation

58. Niamatpur substation is located in Korkoria village in Niamatpur sub-district of Naogoan district (Rajshali Division) (Figure 39). It was commissioned in 2010 and the extent of land of the substation is 5 acres. The proposed bay extension required about 1 acre and this extent is available with the substation premises.

Figure 39: Location of Niamatpur Existing Grid Substation

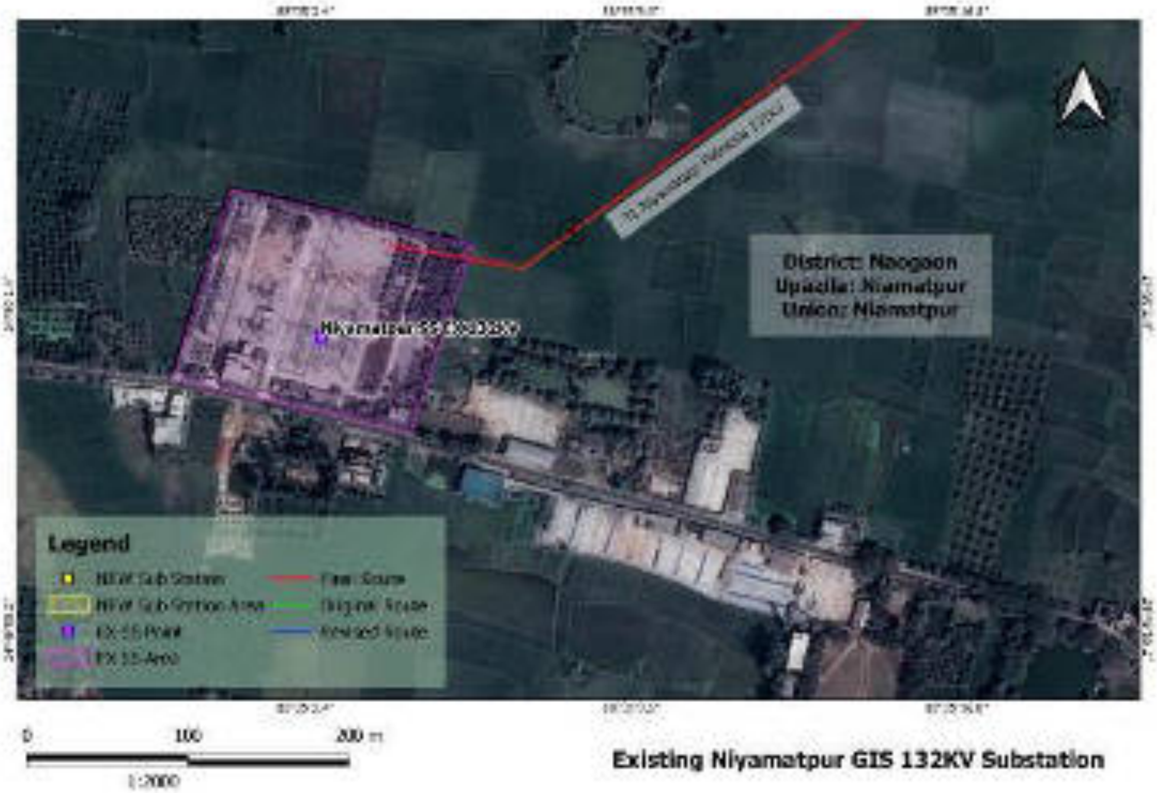


Table 49: Physical Features of Niamatpur Grid Substation – Bay Extension

Features	Specification
Status	Existing
Land ownership	PGCB
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Existing: Air-insulated Bay Extension: Air-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Plate 3.24 Substation entrance and the land set aside for the proposed bay extension

(xxxvii) 132 kV AIS bay extensions at Patnitola substation

59. Patnitola substation will be located in Butolgasi village in Patnitola sub-district of Naogaon (Rajshahi Division) (Figure 40). During the field survey in December 2018 it was informed that the land acquisition process is underway. The construction work is planned on 2020 and commissioning of the substation will take place in 2021. The extent of the land that will be acquired is 5 acres. This is an agricultural land and filling up to 1 m is planned. Mohadevpur- Patnitola road is found in the west of the project site.

Figure 40: Location of Patnitola Proposed Grid Substation

Table 50: Physical Features of Patnitola Grid Substation – Bay Extension

Features	Specification
Status	Under construction
Land ownership	PGCB
Scheme	Double busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Existing: Air-insulated Bay Extension: Air-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto firefighting water spray system

Plate 3.25 The project site Patnitola at present (Dec. 2018)

Table 51: Name of rivers and transmission lines

No.	Overhead Transmission Line	Name of River
1	Kaliganj (Gazipur)-Purbachal 400 kV DC double circuit overhead transmission line	Turag river (175* m)
2	Rupsha-Satkhira 230 kV double circuit transmission line (initially charged at 132 kV)	Betna river, Kapotaksha river, Saltha river, Hatibanda river (213 m), Gengrail river, Vodra river (224 m), Saltha river, Rupsha river (590 m)
3	Domar-Purba Sadipur 230 kV double circuit transmission line (initially charges at 132 kV)	Atrai river (149 m), Shewraphulli river, Karatoya river
4	Domar-Hatibanda 132 kV double circuit transmission line	Buri Teesta river, Nautara river, Teesta river (690 m), Chika Dara river, Saniajan river, Jamuneshwari river
5	Kaliganj-Maheshpur 132 kV double circuit transmission line	Kapotakha river, Chitra river (all rivers are <100 m)
6	Manirampur-Satkhira 132 kV double circuit transmission line	Kapotaksha river, Betna river, Buri Bhadra river, Harihar river (all rivers <100 m)

7	Kushtia-Meherpur 132 kV double circuit transmission line	Kajla river, Mathavanga river, Pangasi river, Sagar river
8	Bagerhat-Pirojpur-Bhandaria 132 kV double circuit transmission line,	Bahirab river (239 m), Katcha river (838 m width) Boleswar river, Huldarhat river, Garia river
9	Gopalganj (North)-Shibchar 230 kV double circuit transmission line	Kumar river, Arialkha river (276 m)
10	Niamatpur-Patnitola 132 kV double circuit transmission line	Atrai river (124 m)

*- width of river is given at the crossing, if the width is > 100m

3. Component 3 – Institutional Capacity Development of PGCB

60. This includes (i) supporting installation and operation of an Enterprise Resource Planning (ERP) System to assist PGCB in optimally managing its capital-intensive assets, (ii) establishing a Drone Inspection Center within the Operation and Maintenance Department of PGCB, with some gender equality elements. promoting gender equality and diversity in the workplace and inclusive business practices.

61. The first subproject is the ERP installation and implementation. There will be training component as well. The second subproject will buy drones and establish a new centre to operate and maintain these drones for transmission system maintenance.

Annex 2 : Coordinates of Final Alignments of Transmission and LILO Lines of DWZTGEP

Component 1

Kaliganj (Gazipur)-Purbachal 400 kV Transmission Line

Line Length: 18 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	23.96727	90.55137	8	Start Point
2	23.96672	90.53892	4	AP-1 (26 degrees - LT)
3	23.95454	90.51576	5	AP-2 (26 degrees - LT)
4	23.94829	90.51114	5	AP-3 (9 degrees - RT)
5	23.94208	90.50493	6	AP-4 (16 degrees - RT)
6	23.93507	90.49232	6	AP-5 (61 degrees - LT)
7	23.93182	90.49229	7	AP-6 (33 degrees - RT)
8	23.92483	90.48781	5	AP-7 (34 degrees - RT)
9	23.91375	90.46283	9	AP-8 (67 degrees - LT)
10	23.90129	90.46283	6	AP-9 (6 degrees - RT)
11	23.88844	90.46166	6	AP-10 (26 degrees - LT)
12	23.88248	90.46381	7	AP-11 (46 degrees - LT)
13	23.88003	90.46923	7	AP-12 (66 degrees - RT)
14	23.875	90.46926	7	AP-13 (43 degrees - RT)
15	23.87309	90.46754	7	AP-14 (46 degrees - LT)
16	23.86903	90.46779	6	AP-15 (29 degrees - LT)
17	23.86133	90.47265	5	End Point
18	23.95645	90.51937	5	Canal
19	23.96638	90.53844	5	Canal
20	23.96072	90.52746	6	Canal
21	23.87429	90.46879		River (Turang)
22	23.88441	90.46301		River (Turang)
23	23.90198	90.46282		River (Turang)
24	23.91487	90.46544		River (Turang)
25	23.91788	90.47386		River (Turang)
26	23.92932	90.49068		River (Turang)
27	23.87134	90.46779		River (Turang)
28	23.87776	90.46928	6	Pond
29	23.88102	90.467	7	Pond
30	23.88679	90.4623	6	Pond
31	23.89791	90.46258	6	Pond
32	23.86547	90.46987	6	Pond
33	23.87879	90.46928	8	Road (Secondary)
34	23.87954	90.46931	8	Road (Tertiary)

35	23.88321	90.46348	6	Road (Secondary)
36	23.90156	90.4628	6	Road (Tertiary)
37	23.90986	90.46279	12	Road (Secondary)
38	23.92577	90.48843	7	Road (Tertiary)
39	23.93384	90.49231	9	Road (Highway)
40	23.91663	90.469	5	Road (Highway)
41	23.96718	90.54938	6	Road (Pucca)
42	23.96699	90.54507	5	Road (Pucca)
43	23.93287	90.49232	5	D/T Line
44	23.9501	90.51263	3	D/T Line
45	23.87893	90.46925	8	D/T Line
46	23.90169	90.46285	6	D/T Line
47	23.90997	90.46287	12	D/T Line
48	23.91662	90.46922	5	D/T Line
49	23.926	90.48858	7	D/T Line
50	23.93426	90.49231	9	Railway Line

Kushtia-Meherpur 132 kV Transmission Line

Line Length: 48.0 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	23.79045	88.68023	16	Start Point
2	23.79892	88.71787	17	AP -1 (27 degrees - RT)
3	23.79484	88.73474	16	AP -2 (27 degrees - LT)
4	23.79963	88.75533	14	AP -3 (45 degrees - LT)
5	23.8251	88.77176	16	AP -4 (47 degrees - RT)
6	23.82631	88.77798	14	AP -5 (10 degrees - RT)
7	23.82672	88.79276	15	AP -6 (20 degrees - LT)
8	23.84834	88.84746	18	AP -7 (47 degrees - RT)
9	23.84238	88.86034	17	AP -8 (46 degrees - LT)
10	23.85113	88.884	19	AP -9 (25 degrees - RT)
11	23.85021	88.89685	15	AP -10 (11 degrees - RT)
12	23.84784	88.90585	20	AP -11 (35 degrees - LT)
13	23.85041	88.91281	16	AP -12 (35 degrees - RT)
14	23.8493	88.91721	16	AP -13 (37 degrees - LT)
15	23.85285	88.92575	14	AP -14 (56 degrees - RT)
16	23.84447	88.93889	14	AP -15 (36 degrees - LT)
17	23.84597	88.96665	11	AP -16 (27 degrees - LT)
18	23.84925	88.9725	14	AP -17 (15 degrees - RT)
19	23.85179	88.9822	13	AP -18 (12 degrees - RT)

20	23.85267	88.99934	13	AP -19 (22 degrees - RT)
21	23.84085	89.03508	13	AP -20 (22 degrees - LT)
22	23.84116	89.04061	12	AP -21 (69 degrees - LT)
23	23.84683	89.04246	13	AP -22 (20 degrees - RT)
24	23.85101	89.04561	13	AP -23 (58 degrees - RT)
25	23.85057	89.05148	11	AP -24 (30 degrees - LT)
26	23.86194	89.07686	10	AP -25 (36 degrees - LT)
27	23.86644	89.0794	14	AP -26 (18 degrees - RT)
28	23.87339	89.08679	15	AP -27 (42 degrees - RT)
29	23.87353	89.091	17	AP -28 (23 degrees - LT)
30	23.87488	89.09395	14	AP -29 (58 degrees - LT)
31	23.87872	89.09452	15	AP -30 (34 degrees - LT)
32	23.87988	89.09397	16	End Point
33	23.79312	88.69228	19	Road (Secondary)
34	23.79444	88.69793	19	Road (Tertiary)
35	23.7946	88.69871	18	Road (Secondary)
36	23.79515	88.70116	17	Road (Secondary)
37	23.79871	88.717	17	Road (Secondary)
38	23.79575	88.73129	15	Road (Tertiary)
39	23.7951	88.73603	17	Road (Secondary)
40	23.79722	88.74498	15	Road (Secondary)
41	23.79905	88.75275	18	Road (Tertiary)
42	23.80784	88.76059	17	Road (Secondary)
43	23.82074	88.76891	18	Road (Secondary)
44	23.82074	88.76891	18	Road (Secondary)
45	23.82613	88.77724	14	Road (Secondary)
46	23.82677	88.79181	16	Road (Secondary)
47	23.83183	88.80581	14	Road (Secondary)
48	23.8418	88.83086	15	Road (Tertiary)
49	23.84452	88.83791	17	Road (Tertiary)
50	23.8477	88.8459	15	Road (Tertiary)
51	23.84664	88.85118	17	Road (Secondary)
52	23.84263	88.86002	17	Road (Secondary)
53	23.85109	88.88495	18	Road (Secondary)
54	23.84821	88.90453	16	Road (Secondary)
55	23.84821	88.90453	16	Road (Secondary)
56	23.85032	88.91326	18	Road (Tertiary)
57	23.85002	88.91394	16	Road (Tertiary)
58	23.8496	88.91791	17	Road (Secondary)
59	23.85201	88.9238	17	Road (Secondary)
60	23.85092	88.92857	15	Road (Tertiary)

61	23.84492	88.93821	16	Road (Tertiary)
62	23.84502	88.94778	15	Road (Secondary)
63	23.84943	88.97349	16	Road (Tertiary)
64	23.84964	88.97394	16	Road (Secondary)
65	23.85252	88.99478	11	Road (Tertiary)
66	23.84091	89.03624	13	Road (Tertiary)
67	23.84102	89.03899	14	Road (Secondary)
68	23.8497	89.04454	12	Road (Secondary)
69	23.85502	89.06103	13	Road (Secondary)
70	23.85894	89.06994	12	Road (Tertiary)
71	23.86413	89.07816	15	Road (Secondary)
72	23.86413	89.07816	15	Road (Secondary)
73	23.86843	89.08147	14	Road (Tertiary)
74	23.87343	89.08942	17	Road (Secondary)
75	23.87411	89.09234	17	Road (Highway)
76	23.85115	89.05266	12	D/T Line
77	23.79127	88.68381	17	D/T Line
78	23.79602	88.73072	16	D/T Line
79	23.79602	88.73072	16	D/T Line
80	23.79887	88.75225	18	D/T Line
81	23.8243	88.77119	14	D/T Line
82	23.85043	88.91324	17	D/T Line
83	23.8495	88.91739	16	D/T Line
84	23.85182	88.92334	17	D/T Line
85	23.85263	88.92597	14	D/T Line
86	23.84498	88.94734	15	D/T Line
87	23.84102	89.03586	13	D/T Line
88	23.84099	89.037	14	D/T Line
89	23.84623	89.04212	13	D/T Line
90	23.85513	89.06157	13	D/T Line
91	23.87827	89.09448	15	D/T Line
92	23.87957	89.09411	15	D/T Line
93	23.83193	88.80592	14	Canal
94	23.85022	88.91362	18	Canal
95	23.8527	88.92547	14	Canal
96	23.85212	88.98869	13	Canal
97	23.84581	89.02044	11	Canal
98	23.84086	89.03547	13	Canal
99	23.84103	89.03927	14	Canal
100	23.87433	89.09291	17	Canal
101	23.83485	88.81342	15	Pond

102	23.87401	89.09197	15	Pond
103	23.7934	88.69339		River (Kajla)
104	23.82661	88.79138		River (Kajla)
105	23.84266	88.86105		River (Mathavanga)
106	23.85099	88.88579		River (Panggsasi)
107	23.84915	88.90089		River (Panggsasi)
108	23.84958	88.97365		River (Sagar)
109	23.79471	88.6989	18	Home Garden
110	23.7955	88.70237	17	Home Garden
111	23.79502	88.73569	17	Home Garden
112	23.79522	88.73634	17	Home Garden
113	23.79738	88.74558	14	Home Garden
114	23.83226	88.80672	15	Home Garden
115	23.84148	88.83004	16	Home Garden
116	23.8474	88.84518	15	Home Garden
117	23.87342	89.08748	17	Home Garden
118	23.79311	88.6921	19	Home Gardens/ plantation
119	23.82601	88.77625	13	Home Gardens/ plantation
120	23.84942	88.97321	16	Home Gardens/ plantation

Component 2

Rupsha-Satkhira 230 kV

Line Length: 62km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	22.74465	89.09315	1	Start Point
2	22.74664	89.09377	1	AP - 1 (29 degrees - RT)
3	22.75611	89.1036	5	AP - 2 (48 degrees - RT)
4	22.75583	89.10784	1	AP - 3 (36 degrees - RT)
5	22.74983	89.11521	4	AP - 4 (15 degrees - LT)
6	22.74111	89.13398	1	AP - 5 (17 degrees - LT)
7	22.73791	89.1563	4	AP - 6 (16 degrees - LT)
8	22.73998	89.17235	5	AP - 7 (1 degree - RT)
9	22.74045	89.17651	5	AP - 8 (19 degrees - LT)
10	22.74273	89.18147	4	AP - 9 (17 degrees - LT)
11	22.74448	89.18345	6	AP - 10 (22 degrees - RT)
12	22.74623	89.18816	6	AP - 11 (22 degrees - RT)
13	22.74617	89.19073	9	AP - 12 (49 degrees - RT)
14	22.74072	89.19526	5	AP - 13 (37 degrees - LT)
15	22.7391	89.20183	6	AP - 14 (22 degrees - RT)

16	22.73701	89.20478	8	AP - 15 (30 degrees - LT)
17	22.73669	89.208	6	AP - 16 (13 degrees - LT)
18	22.73816	89.22048	7	AP - 17 (10 degrees - RT)
19	22.73745	89.23504	6	AP - 18 (15 degrees - LT)
20	22.73846	89.24003	9	AP - 19 (5 degrees - RT)
21	22.74003	89.25208	7	AP - 20 (28 degrees - LT)
22	22.74141	89.25408	6	AP - 21 (41 degrees - RT)
23	22.7412	89.25611	4	AP - 22 (54 degrees - RT)
24	22.74018	89.25671	6	AP - 23 (42 degrees - LT)
25	22.73877	89.26109	4	AP - 24 (5 degrees - RT)
26	22.73735	89.26457	6	AP - 25 (24 degrees - LT)
27	22.73742	89.26813	10	AP - 26 (8 degrees - RT)
28	22.73676	89.27388	5	AP - 27 (10 degrees - RT)
29	22.73287	89.28767	4	AP - 28 (30 degrees - LT)
30	22.73426	89.29322	4	AP - 29 (17 degrees - LT)
31	22.736	89.29616	2	AP - 30 (13 degrees - LT)
32	22.7405	89.30088	3	AP - 31 (22 degrees - RT)
33	22.74187	89.30433	4	AP - 32 (29 degrees - RT)
34	22.74121	89.30981	3	AP - 33 (13 degrees - RT)
35	22.73964	89.31421	1	AP - 34 (16 degrees - LT)
36	22.73822	89.3318	0	AP - 35 (18 degrees - RT)
37	22.7368	89.33539	0	AP - 36 (6 degrees - RT)
38	22.7336	89.34166	3	AP - 37 (28 degrees - LT)
39	22.73361	89.34434	2	AP - 38 (8 degrees - LT)
40	22.73412	89.34786	2	AP - 39 (13 degrees - RT)
41	22.73382	89.3516	2	AP - 40 (13 degrees - LT)
42	22.73447	89.35619	2	AP - 41 (15 degrees - LT)
43	22.73687	89.36196	3	AP - 42 (20 degrees - RT)
44	22.73695	89.36373	3	AP - 43 (19 degrees - LT)
45	22.73763	89.36545	2	AP - 44 (13 degrees - RT)
46	22.7381	89.36838	2	AP - 45 (15 degrees - RT)
47	22.73729	89.37732	2	AP - 46 (11 degrees - RT)
48	22.73613	89.38144	4	AP - 47 (4 degrees - RT)
49	22.73345	89.38901	5	AP - 48 (39 degrees - LT)
50	22.7364	89.39758	2	AP - 49 (26 degrees - RT)
51	22.73608	89.40032	1	AP - 50 (2 degrees - RT)
52	22.7341	89.4139	2	AP - 51 (13 degrees - LT)
53	22.73425	89.41612	2	AP - 52 (38 degrees - RT)
54	22.72941	89.4235	3	AP - 53 (30 degrees - LT)
55	22.72896	89.42962	3	AP - 54 (6 degrees - RT)
56	22.72607	89.44693	2	AP - 55 (12 degrees - RT)

57	22.72266	89.4558	3	AP - 56 (17 degrees - LT)
58	22.72225	89.46061	2	AP - 57 (38 degrees - LT)
59	22.7239	89.46322	3	AP - 58 (37 degrees - RT)
60	22.72353	89.46871	3	AP - 59 (17 degrees - LT)
61	22.72604	89.4801	3	AP - 60 (7 degrees - RT)
62	22.72719	89.49111	3	AP - 61 (12 degrees - RT)
63	22.72643	89.49859	3	AP - 62 (17 degrees - RT)
64	22.72354	89.50563	3	AP - 63 (21 degrees - LT)
65	22.72322	89.51843	3	AP - 64 (24 degrees - LT)
66	22.73028	89.53595	3	AP - 65 (13 degrees - LT)
67	22.73217	89.53867	3	AP - 66 (26 degrees - RT)
68	22.73284	89.54256	5	AP - 67 (25 degrees - RT)
69	22.72966	89.55491	4	AP - 68 (16 degrees - LT)
70	22.72977	89.56529	4	AP - 69 (23 degrees - RT)
71	22.72622	89.57399	4	AP - 70 (15 degrees - LT)
72	22.72552	89.57916	7	AP - 71 (7 degrees - LT)
73	22.72544	89.58333	6	AP - 72 (59 degrees - RT)
74	22.72002	89.58648	6	AP - 73 (53 degrees - LT)
75	22.7194	89.59153	5	AP - 74 (33 degrees - LT)
76	22.72183	89.5966	5	AP - 75 (52 degrees - LT)
77	22.73527	89.59966	5	AP - 76 (18 degrees - RT)
78	22.74407	89.6049	4	AP - 77 (19 degrees - LT)
79	22.75101	89.60646	4	AP - 78 (5 degrees - LT)
80	22.75642	89.60719	5	AP - 79 (10 degrees - RT)
81	22.75938	89.6081	3	AP - 80 (20 degrees - RT)
82	22.77074	89.61655	4	End Point
83	22.72544	89.57977	6	Road (Pucca)
84	22.74869	89.09597	3	Road (Highwat)
85	22.75336	89.10074	6	Road (Secondary)
86	22.75563	89.10313	5	Road (Secondary)
87	22.75442	89.1096	2	Road (Highwat)
88	22.74613	89.1232	4	Road (Secondary)
89	22.7416	89.13295	4	Road (Secondary)
90	22.74076	89.13624	5	Road (Secondary)
91	22.74046	89.13882	4	Road (Tertiary)
92	22.73812	89.1548	4	Road (Tertiary)
93	22.73821	89.15828	4	Road (Tertiary)
94	22.737	89.2046	8	Road (Tertiary)
95	22.73709	89.21085	5	Road (Secondary)
96	22.73791	89.21831	6	Road (Tertiary)
97	22.73777	89.2277	6	Road (Tertiary)

98	22.73757	89.23353	9	Road (Secondary)
99	22.73929	89.24637	8	Road (Tertiary)
100	22.73824	89.26201	3	Road (Tertiary)
101	22.74007	89.25721	4	Road (Secondary)
102	22.73671	89.27352	5	Road (Tertiary)
103	22.73603	89.2769	5	Road (Tertiary)
104	22.73528	89.27901	4	Road (Tertiary)
105	22.74162	89.30665	3	Road (Tertiary)
106	22.73921	89.31993	1	Road (Tertiary)
107	22.73921	89.31993	1	Road (Tertiary)
108	22.73768	89.33312	4	Road (Tertiary)
109	22.73382	89.35099	2	Road (Secondary)
110	22.73382	89.35099	2	Road (Secondary)
111	22.73691	89.36332	3	Road (Tertiary)
112	22.73686	89.37877	6	Road (Secondary)
113	22.73437	89.39185	3	Road (Secondary)
114	22.72905	89.42805	6	Road (Secondary)
115	22.72411	89.52066	4	Road (Secondary)
116	22.72629	89.52617	3	Road (Tertiary)
117	22.73757	89.26413	6	Road (Primary)
118	22.73536	89.29506	3	Road (Secondary)
119	22.73499	89.35764	1	Road (Tertiary)
120	22.73597	89.38185	4	Road (Tertiary)
121	22.73414	89.41501	4	Road (Secondary)
122	22.72935	89.42497	4	Road (Tertiary)
123	22.72375	89.46488	2	Road (Secondary)
124	22.72359	89.46806	3	Road (Secondary)
125	22.73054	89.53623	4	Road (Secondary)
126	22.72283	89.58481	4	Road (Pucca)
127	22.7202	89.59284	6	Road (Katcha)
128	22.74	89.25706	6	Road (Pucca)
129	22.73151	89.54792	3	Road (Pucca)
130	22.73709	89.21085	5	Road (Pucca)
131	22.74115	89.25591	4	Road (Katcha)
132	22.73987	89.17187	6	Road (Pucca)
133	22.74112	89.60308	5	Road (Pucca)
134	22.74545	89.19128	8	Road (Pucca)
135	22.74602	89.18789	6	Road
136	22.74455	89.18365	6	Road (Katcha)
137	22.73996	89.17231	5	Road (Katcha)
138	22.7404	89.17576	4	Road (Katcha)

139	22.74089	89.17753	4	Road (Katcha)
140	22.7381	89.22162	7	Road (Tertiary)
141	22.73773	89.23063	9	Road (Tertiary)
142	22.73975	89.19899	5	Road
143	22.72987	89.55405	4	Road (Pucca)
144	22.758	89.60767	7	Road
145	22.74064	89.19559	5	Road
146	22.73972	89.25	7	Road (Katcha)
147	22.7394	89.24647	8	Road
148	22.73239	89.54415	4	Road (Pucca)
149	22.73689	89.2095	8	Road (Katcha)
150	22.73704	89.20459	8	Road
151	22.74557	89.60523	5	Road
152	22.73923	89.24522	5	Road (Katcha)
153	22.72697	89.57212	4	Road (Pucca)
154	22.7391	89.24463		River (Kopotakkho)
155	22.73919	89.32095		River (Saltha)
156	22.7338	89.3453		River (Hatitana)
157	22.72923	89.42537		River (Vodra)
158	22.72348	89.45353		River (Vodra)
159	22.72634	89.44539		River (Vodra)
160	22.72373	89.46595		River (Saltha)
161	22.72521	89.52326		River (Rupsha)
162	22.73643	89.38008		River (Gengrail)
163	22.73967	89.25831		River (Kobadak)
164	22.73759	89.216		River (Kalataksho)
165	22.73218	89.5392	3	Canal
166	22.73255	89.54145	4	Canal
167	22.72007	89.59283	6	Canal
168	22.71985	89.58769	6	Canal
169	22.75787	89.60762	5	Canal
170	22.72971	89.55582	6	Canal
171	22.73122	89.54896	4	Canal
172	22.74704	89.60558	5	Canal
173	22.75341	89.1007	6	Canal
174	22.74627	89.12304	5	Canal
175	22.74073	89.13633	5	Canal
176	22.74048	89.13872	4	Canal
177	22.73789	89.155	2	Canal
178	22.73558	89.40463	4	Canal
179	22.72861	89.4319	3	Canal

180	22.72611	89.48108	4	Canal
181	22.72649	89.48445	3	Canal
182	22.76072	89.60842	3	Canal
183	22.73236	89.599	6	Canal
184	22.72746	89.57064	6	Canal
185	22.72051	89.59391	4	Pond
186	22.75713	89.60745	5	Pond
187	22.74029	89.25784	4	Bridge
188	22.7399	89.1721	5	Home Gardens/ plantation
189	22.73729	89.26648	9	Home Gardens/ plantation
190	22.75834	89.60782	7	Home Garden
191	22.73831	89.23941	9	Home Garden
192	22.73726	89.26812	10	Home Garden
193	22.72765	89.52956	5	Home Garden
194	22.73781	89.23723	9	Home Garden
195	22.73989	89.2512	8	Home Garden
196	22.73694	89.36272	4	Home Garden
197	22.72905	89.42852	6	Home Garden
198	22.75506	89.10897	4	D/T Line
199	22.74827	89.09552	3	D/T Line
200	22.75051	89.09813	4	D/T Line
201	22.75121	89.11355	4	D/T Line
202	22.75804	89.60768	7	D/T Line
203	22.73914	89.26053	4	D/T Line
204	22.73885	89.26103	4	D/T Line
205	22.73914	89.26053	4	D/T Line
206	22.73885	89.26103	4	D/T Line
207	22.73914	89.26053	4	D/T Line
208	22.73885	89.26103	4	D/T Line
209	22.73914	89.26053	4	D/T Line
210	22.73885	89.26103	4	D/T Line
211	22.73914	89.26053	4	D/T Line
212	22.73885	89.26103	4	D/T Line
213	22.73914	89.26053	4	D/T Line
214	22.73885	89.26103	4	D/T Line
215	22.75609	89.10399	5	D/T Line
216	22.75373	89.11024	2	D/T Line
217	22.73864	89.15925	5	D/T Line
218	22.73974	89.16884	3	D/T Line
219	22.73977	89.25003	7	D/T Line
220	22.73825	89.26227	3	D/T Line

221	22.73585	89.27699	5	D/T Line
222	22.73785	89.33305	4	D/T Line
223	22.73391	89.34582	4	D/T Line
224	22.73391	89.34582	4	D/T Line
225	22.73391	89.34582	4	D/T Line
226	22.73384	89.35093	2	D/T Line
227	22.7237	89.51946	2	D/T Line
228	22.72658	89.49829	3	D/T Line

Domar-Purbasadipur 230 kV

Line Length: 46.5 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	25.75559	88.67795	46	Start Point
2	25.77011	88.67891	40	AP - 1 (60 degrees - RT)
3	25.77111	88.68095	39	AP - 2 (40 degrees - LT)
4	25.79003	88.68943	40	AP - 3 (22 degrees - LT)
5	25.80871	88.69031	43	AP - 4 (29 degrees - RT)
6	25.81132	88.69189	42	AP - 5 (26 degrees - LT)
7	25.81762	88.69256	41	AP - 6 (34 degrees - RT)
8	25.82424	88.69812	43	AP - 7 (38 degrees - LT)
9	25.84603	88.69912	46	AP - 8 (30 degrees - RT)
10	25.85045	88.70193	44	AP - 9 (36 degrees - RT)
11	25.85587	88.71507	45	AP - 10 (25 degrees - LT)
12	25.85907	88.71806	46	AP - 11 (38 degrees - RT)
13	25.86103	88.7293	45	AP - 12 (21 degrees - RT)
14	25.86035	88.73276	48	AP - 13 (48 degrees - LT)
15	25.87654	88.75439	46	AP - 14 (32 degrees - RT)
16	25.87704	88.75996	46	AP - 15 (53 degrees - LT)
17	25.88366	88.76416	45	AP - 16 (60 degrees - LT)
18	25.89855	88.75665	45	AP - 17 (46 degrees - RT)
19	25.90231	88.75792	49	AP - 18 (24 degrees - LT)
20	25.92397	88.75591	50	AP - 19 (11 degrees - LT)
21	25.93155	88.75371	49	AP - 20 (26 degrees - RT)
22	25.93765	88.75473	49	AP - 21 (27 degrees - LT)
23	25.94161	88.75353	52	AP - 22 (24 degrees - RT)
24	25.94701	88.7542	48	AP - 23 (29 degrees - RT)
25	25.94811	88.75498	49	AP - 24 (35 degrees - RT)
26	25.9495	88.75866	48	AP - 25 (27 degrees - LT)

27	25.95105	88.7601	46	AP - 26 (57 degrees - LT)
28	25.95805	88.75837	48	AP - 27 (36 degrees - RT)
29	25.96106	88.75959	47	AP - 28 (37 degrees - LT)
30	25.96657	88.75811	50	AP - 29 (6 degrees - RT)
31	25.984	88.75527	51	AP - 30 (9 degrees - LT)
32	25.98963	88.75345	51	AP - 31 (44 degrees - RT)
33	25.99953	88.75819	50	AP - 32 (10 degrees - RT)
34	26.00727	88.76365	51	AP - 33 (30 degrees - LT)
35	26.0194	88.76493	53	AP - 34 (25 degrees - LT)
36	26.03255	88.76062	51	AP - 35 (37 degrees - RT)
37	26.03436	88.76122	53	AP - 36 (40 degrees - RT)
38	26.04121	88.77225	55	AP - 37 (53 degrees - LT)
39	26.0482	88.77294	54	AP - 38 (34 degrees - RT)
40	26.05316	88.77703	53	AP - 39 (11 degrees - LT)
41	26.06532	88.78385	55	AP - 40 (26 degrees - LT)
42	26.07527	88.78444	53	AP - 41 (23 degrees - RT)
43	26.08512	88.78923	55	AP - 42 (49 degrees - RT)
44	26.08721	88.7967	55	AP - 43 (30 degrees - LT)
45	26.09406	88.80357	55	AP - 44 (15 degrees - LT)
46	26.09657	88.80503	55	AP - 45 (49 degrees - LT)
47	26.10137	88.80339	56	AP - 46 (23 degrees - RT)
48	26.10467	88.80361	55	End Point
49	25.77069	88.68005	39	D/T Line
50	25.8586	88.71771	45	D/T Line
51	25.86105	88.7338	43	D/T Line
52	25.92407	88.7557	50	D/T Line
53	25.93154	88.75382	49	D/T Line
54	25.93154	88.75382	49	D/T Line
55	25.75577	88.67796	46	Road (Highway)
56	25.82351	88.6975	42	Road (Katcha)
57	25.8375	88.69875	43	Road (Katcha)
58	25.84624	88.69914	46	Road (Katcha)
59	25.8497	88.70145	44	Road (Katcha)
60	25.85156	88.7046	43	Road (Katcha)
61	25.85456	88.71187	46	Road (Katcha)
62	25.85542	88.71397	47	Road (Katcha)
63	25.85853	88.71776	45	Road (Katcha)
64	25.8591	88.71822	46	Road (Katcha)
65	25.85955	88.72091	46	Road
66	25.76648	88.6787	42	Road (Katcha)
67	25.86021	88.72451	44	Road (Katcha)

68	25.86071	88.73147	47	Road
69	25.86162	88.73455	41	Road (Pucca)
70	25.87162	88.74758	43	Road (Katcha)
71	25.8762	88.75357	48	Road (Katcha)
72	25.87718	88.76	45	Road (Katcha)
73	25.87758	88.76048	47	Road
74	25.88612	88.76259	45	Road (Katcha)
75	25.8973	88.75744	46	Road (Pucca)
76	25.90311	88.75797	47	Road (Katcha)
77	25.77029	88.6793	40	Road (Katcha)
78	25.91081	88.75717	49	Road (Pucca)
79	25.91507	88.75676	47	Road (Pucca)
80	25.9171	88.75617	48	Road (Katcha)
81	25.9224	88.75622	46	Road (Katcha)
82	25.92367	88.75608	48	Road (Pucca)
83	25.93254	88.75383	48	Road (Katcha)
84	25.94638	88.75411	48	Road
85	25.95291	88.75958	47	Road
86	25.96288	88.75911	50	Road
87	25.97384	88.75693	51	Road
88	25.78353	88.68652	40	Road (Katcha)
89	25.98334	88.75538	50	Road
90	25.99155	88.75448	51	Road
91	25.99979	88.75835	49	Road
92	26.00308	88.76076	51	Road
93	26.01279	88.76422	51	Road
94	26.0182	88.76486	51	Road
95	26.02535	88.76296	54	Road
96	26.03052	88.76127	53	Road
97	26.03318	88.7609	54	Road
98	26.03555	88.76326	54	Road
99	25.79224	88.68952	40	Road
100	26.03853	88.7679	51	Road (Pucca)
101	26.04261	88.7724	52	Road
102	26.04608	88.77271	53	Road
103	26.05225	88.7763	53	Road
104	26.05826	88.77997	54	Road
105	26.06181	88.78196	54	Road
106	26.07463	88.78449	53	Road
107	26.08614	88.79293	56	Road
108	26.09575	88.80458	54	Road

109	26.09901	88.80435	56	Road
110	25.79991	88.6899	43	Road
111	26.10305	88.80359	58	Road
112	25.80472	88.69013	43	Road (Katcha)
113	25.8098	88.69098	43	Road (Katcha)
114	25.81696	88.69249	40	Road (Katcha)
115	25.93254	88.75383	48	Road (Katcha)
116	25.87162	88.74758	43	Road (Katcha)
117	25.9356	88.75432		River
118	25.86004	88.72303		River
119	25.98933	88.75353	51	Canal
120	25.99161	88.75456	51	Canal
121	25.99289	88.75503	48	Canal

Domar -Hatibanda 132 kV

Line Length: 35.0 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	26.10618	88.80248	57	Start Point
2	26.11116	88.80314	52	AP -1 (44 degrees - RT)
3	26.11443	88.80711	57	AP -2 (20 degrees - RT)
4	26.1161	88.8117	56	AP -3 (12 degrees - RT)
5	26.11707	88.81821	54	AP -4 (26 degrees - RT)
6	26.11513	88.82456	53	AP -5 (27 degrees - LT)
7	26.11817	88.84207	54	AP -6 (21 degrees - LT)
8	26.12393	88.85187	53	AP -7 (22 degrees - LT)
9	26.12999	88.85658	55	AP -8 (30 degrees - RT)
10	26.13641	88.87238	54	AP -9 (29 degrees - RT)
11	26.13556	88.88011	56	AP -10 (44 degrees - LT)
12	26.13985	88.88573	57	AP -11 (40 degrees - RT)
13	26.13961	88.89098	56	AP -12 (26 degrees - RT)
14	26.13662	88.89656	56	AP -13 (67 degrees - LT)
15	26.14135	88.90264	56	AP -14 (34 degrees - RT)
16	26.1417	88.90688	55	AP -15 (28 degrees - LT)
17	26.14509	88.91233	56	AP -16 (40 degrees - RT)
18	26.14467	88.91528	56	AP -17 (45 degrees - LT)
19	26.14561	88.91656	56	AP -18 (25 degrees - RT)
20	26.14605	88.91868	58	AP -19 (36 degrees - RT)
21	26.14483	88.92143	56	AP -20 (19 degrees - LT)
22	26.14439	88.92596	57	AP -21 (40 degrees - LT)

23	26.15012	88.93457	53	AP -22 (12 degrees - LT)
24	26.15501	88.93949	56	AP -23 (33 degrees - RT)
25	26.15813	88.95334	54	AP -24 (14 degrees - LT)
26	26.16106	88.95935	55	AP -25 (13 degrees - RT)
27	26.16226	88.96426	55	AP -26 (39 degrees - LT)
28	26.16662	88.96766	54	AP -27 (56 degrees - RT)
29	26.16634	88.97178	54	AP -28 (5 degrees - LT)
30	26.16638	88.97981	56	AP -29 (11 degrees - LT)
31	26.16705	88.98346	53	AP -30 (33 degrees - LT)
32	26.17087	88.98752	53	AP -31 (39 degrees - RT)
33	26.1716	88.99619	54	AP -32 (29 degrees - LT)
34	26.17451	89.00056	55	AP -33 (36 degrees - RT)
35	26.17444	89.00277	56	AP -34 (31 degrees - RT)
36	26.17133	89.00779	52	AP -35 (24 degrees - LT)
37	26.16998	89.01699	53	AP -36 (15 degrees - LT)
38	26.17043	89.02124	53	AP -37 (17 degrees - RT)
39	26.1691	89.02843	52	AP -38 (50 degrees - LT)
40	26.17166	89.03157	55	AP -39 (27 degrees - RT)
41	26.17216	89.03381	55	AP -40 (43 degrees - LT)
42	26.17394	89.03505	53	AP -41 (48 degrees - RT)
43	26.17485	89.04137	57	AP -42 (19 degrees - LT)
44	26.17578	89.04319	54	AP -43 (31 degrees - RT)
45	26.17567	89.04523	54	AP -44 (44 degrees - LT)
46	26.18462	89.05599	54	AP -45 (30 degrees - LT)
47	26.18877	89.05757	55	AP -46 (19 degrees - RT)
48	26.19293	89.06095	56	AP -47 (13 degrees - RT)
49	26.19593	89.06469	54	AP -48 (22 degrees - RT)
50	26.19697	89.06794	55	AP -49 (33 degrees - LT)
51	26.19894	89.06961	55	AP -50 (35 degrees - LT)
52	26.20045	89.06977	56	AP -51 (28 degrees - RT)
53	26.20528	89.07294	55	AP -52 (48 degrees - RT)
54	26.20567	89.07529	54	AP -53 (32 degrees - LT)
55	26.20871	89.07886	54	AP -54 (15 degrees - RT)
56	26.21244	89.08644	55	AP -55 (28 degrees - RT)
57	26.2123	89.09291	55	AP -56 (55 degrees - RT)
58	26.20901	89.09511	53	End Point
59	26.1663	88.97408	54	Bridge
60	26.14597	88.91903	57	Wetland
61	26.13601	88.87604	59	Pond
62	26.12364	88.85138	52	Pond
63	26.13066	88.85844	53	Canal

64	26.13276	88.86344	53	Canal
65	26.11592	88.81122	53	Canal
66	26.11933	88.84408	51	Canal
67	26.18558	89.05628	53	Canal
68	26.19047	89.05901	56	Canal
69	26.19793	89.06881	54	Canal
70	26.11591	88.82901		River (Cheka Dara)
71	26.11788	88.84052		River (Jamuneshwari)
72	26.13976	88.9005		River (Buri Tista)
73	26.16638	88.97404		River (Nautara)
74	26.1817	89.05238		River (Tista)
75	26.20593	89.07571		River (Sanianjan)
76	26.11244	88.80469	55	Road (Katcha)
77	26.12799	88.87026	57	Road (Pucca)
78	26.12686	88.85417	53	Road (Pucca)
79	26.13382	88.86611	54	Road (Katcha)
80	26.14488	88.91375	57	Road (Pucca)
81	26.13151	88.87486	54	Road (Katcha)
82	26.13896	88.88463	57	Road (Pucca)
83	26.13964	88.89003	56	Road
84	26.13669	88.89637	56	Road
85	26.14152	88.9043	55	Road
86	26.14517	88.91373	57	Road (Pucca)
87	26.1456	88.91961	57	Road
88	26.14446	88.92495	55	Road (Pucca)
89	26.14514	88.92708	60	Road (Pucca)
90	26.11673	88.816	56	Road
91	26.14983	88.93438	53	Road (Pucca)
92	26.15869	88.95424	54	Road (Katcha)
93	26.16153	88.96137	55	Road (Katcha)
94	26.16201	88.9632	54	Road (Katcha)
95	26.16579	88.96694	54	Road
96	26.16646	88.96946	55	Road (Katcha)
97	26.16637	88.97983	56	Road (Katcha)
98	26.16855	88.98505	53	Road (Katcha)
99	26.17156	88.99613	54	Road (Katcha)
100	26.17446	89.00187	57	Road (Pucca)
101	26.11604	88.82226	56	Road (Pucca)
102	26.1725	89.00583	53	Road (Katcha)
103	26.17226	89.00633	52	Road (Katcha)
104	26.17139	89.00762	52	Road (Katcha)

105	26.17098	89.01016	53	Road (Katcha)
106	26.17036	89.02163	51	Road (Katcha)
107	26.17009	89.0296	53	Road (Pucca)
108	26.17149	89.03146	55	Road (Pucca)
109	26.17425	89.03713	54	Road (Pucca)
110	26.17766	89.04759	57	Road (Pucca)
111	26.1842	89.05563	56	Road (Katcha)
112	26.11677	88.83389	56	Road
113	26.19326	89.06146	56	Road
114	26.1977	89.06862	57	Road
115	26.19955	89.06967	55	Road (Katcha)
116	26.2014	89.0704	57	Road (Pucca)
117	26.20538	89.07351	55	Road (Pucca)
118	26.20563	89.07517	54	Road (Katcha)
119	26.20668	89.07646	52	Road
120	26.20743	89.07726	55	Road (Katcha)
121	26.20767	89.07767	55	Road (Katcha)
122	26.20913	89.07973	54	Road (Katcha)
123	26.11805	88.84134	54	Road
124	26.21098	89.08347	54	Road (Katcha)
125	26.21232	89.0923	55	Road (Pucca)
126	26.21	89.09449	53	Road (Pucca)
127	26.11915	88.84384	51	Road
128	26.12445	88.85495	56	Road (Pucca)
129	26.12493	88.85633	54	Road (Katcha)
130	26.12611	88.86226	55	Road (Pucca)
131	26.11632	88.82061	56	Railway Line
132	26.11213	88.80429	53	D/T Line
133	26.12832	88.85527	54	D/T Line
134	26.13559	88.87954	58	D/T Line
135	26.14484	88.91561	55	D/T Line

Kaliganj-Maheshpur 132 kV Transmission Line

Line Length: 28.0 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	23.34189	88.91237	9	Start Point
2	23.33821	88.92071	9	AP - 1 (54 degrees - LT)
3	23.34038	88.9245	11	AP -2 (15 degrees - RT)
4	23.3485	88.9541	14	AP - 3 (45 degrees - LT)

5	23.36028	88.96087	9	AP - 4 (43 degrees - RT)
6	23.3699	88.991	8	AP - 5 (33 degrees - LT)
7	23.38575	89.00437	9	AP - 6 (61 degrees - RT)
8	23.3847	89.01011	7	AP - 7 (27 degrees - LT)
9	23.39881	89.05813	11	AP - 8 (63 degrees - LT)
10	23.42527	89.0633	9	AP - 9 (64 degrees - RT)
11	23.43173	89.08747	11	AP - 10 (23 degrees - LT)
12	23.43941	89.09742	12	AP - 11 (57 degrees - RT)
13	23.43212	89.11839	10	AP - 12 (25 degrees - RT)
14	23.42282	89.12797	11	End Point
15	23.43886	89.09893	12	Home Garden
16	23.43931	89.09785	12	Home Garden
17	23.39287	89.03769	13	Home Garden
18	23.4232	89.12763	11	Road (Secondary)
19	23.43321	89.11532	8	Road (Secondary)
20	23.43485	89.11056	9	Road (Secondary)
21	23.43724	89.10366	12	Road (Secondary)
22	23.43896	89.09861	13	Road (Tertiary)
23	23.43896	89.09861	13	Road (Tertiary)
24	23.43118	89.08547	12	Road (Tertiary)
25	23.43021	89.08185	12	Road (Tertiary)
26	23.42953	89.07924	11	Road (Tertiary)
27	23.4275	89.07174	11	Road (Secondary)
28	23.42472	89.06311	9	Road (Tertiary)
29	23.41689	89.06162	10	Road (Tertiary)
30	23.41342	89.06099	10	Road (Tertiary)
31	23.40012	89.05816	10	Road (Secondary)
32	23.39295	89.03796	12	Road (Tertiary)
33	23.38845	89.02269	12	Road (Secondary)
34	23.38474	89.00962	7	Road (Secondary)
35	23.38455	89.00332	10	Road (Tertiary)
36	23.38227	89.00157	13	Road (Tertiary)
37	23.37735	88.99732	13	Road (Tertiary)
38	23.3723	88.99301	12	Road (Tertiary)
39	23.36908	88.98843	9	Road (Tertiary)
40	23.36469	88.97464	8	Road (Secondary)
41	23.36033	88.96107	9	Road (Secondary)
42	23.35675	88.95886	13	Road (Secondary)
43	23.35067	88.95534	11	Road (Tertiary)
44	23.34567	88.94373	13	Road (Tertiary)
45	23.34283	88.93328	13	Road (Primary)

46	23.3425	88.93221	14	Road (Secondary)
47	23.33858	88.92144	14	Road (Tertiary)
48	23.42565	89.12507	15	Road (Tertiary)
49	23.4132	89.06092	10	Railway Line
50	23.42854	89.12214	10	D/T Line
51	23.35091	88.95554	11	Pond
52	23.33875	88.91937	8	Pond
53	23.42567	89.06432	9	Pond
54	23.43048	89.08264		River (Chitra)
55	23.38496	89.01107		River (Kapotakkha)
56	23.36741	88.98285		River (Kapotakkha)
57	23.36158	88.96496		River (Kapotakkha)

Manirampur-Satkhira 132 kV Transmission Line

Line Length: 33.0 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	22.74479	89.09222	2	Start Point
2	22.75662	89.09381	5	AP -1 (11 degrees - LT)
3	22.76044	89.09359	3	AP -2 (10 degrees - RT)
4	22.78193	89.09601	4	AP -3 (14 degrees - LT)
5	22.78953	89.09503	3	AP -4 (40 degrees - RT)
6	22.81435	89.11052	5	AP -5 (29 degrees - RT)
7	22.81714	89.11538	5	AP -6 (17 degrees - RT)
8	22.82049	89.13004	3	AP -7 (8 degrees - RT)
9	22.82162	89.14112	7	AP -8 (18 degrees - LT)
10	22.82411	89.14695	6	AP -9 (25 degrees - LT)
11	22.82835	89.15083	7	AP -10 (35 degrees - RT)
12	22.83036	89.15962	6	AP -11 (50 degrees - LT)
13	22.83657	89.16283	5	AP -12 (14 degrees - LT)
14	22.84297	89.16442	8	AP -13 (40 degrees - RT)
15	22.8436	89.16527	7	AP -14 (48 degrees - LT)
16	22.84482	89.16538	8	AP -15 (27 degrees - LT)
17	22.84563	89.16508	8	AP -16 (35 degrees - RT)
18	22.84827	89.16573	6	AP -17 (33 degrees - RT)
19	22.86505	89.18335	5	AP -18 (23 degrees - LT)
20	22.87952	89.18977	3	AP -19 (31 degrees - LT)
21	22.88899	89.18869	7	AP -20 (35 degrees - RT)
22	22.90105	89.19502	5	AP -21 (47 degrees - LT)
23	22.90314	89.1943	3	AP -22 (22 degrees - RT)

24	22.91351	89.19466	5	AP -23 (55 degrees - RT)
25	22.91581	89.19807	5	AP -24 (21 degrees - LT)
26	22.92798	89.20663	2	AP -25 (16 degrees - RT)
27	22.94393	89.22609	2	AP -26 (9 degrees - RT)
28	22.94906	89.23455	7	AP -27 (59 degrees - LT)
29	22.95205	89.23456	7	AP -28 (17 degrees - LT)
30	22.954	89.23399	7	AP -29 (39 degrees - RT)
31	22.95712	89.23527	8	AP -30 (24 degrees - RT)
32	22.95875	89.23693	10	AP -31 (66 degrees - LT)
33	22.96646	89.2341	9	AP -32 (10 degrees - RT)
34	22.97097	89.23325	5	AP -33 (22 degrees - LT)
35	22.97597	89.23009	4	End Point
36	22.82681	89.14928	8	Home Gardens/ plantation
37	22.82983	89.15765	6	Home Gardens/ plantation
38	22.84678	89.16538	7	Home Gardens/ plantation
39	22.84775	89.16561	7	Home Gardens/ plantation
40	22.91541	89.19727	9	Home Garden
41	22.94787	89.23254	8	Home Garden
42	22.94828	89.23331	9	Home Garden
43	22.95841	89.23667	10	Home Garden
44	22.96241	89.23554	7	Home Garden
45	22.95883	89.23693	9	Home Garden
46	22.84455	89.16541	6	Home Garden
47	22.84661	89.16531	7	Home Garden
48	22.82607	89.14882	10	Road (Tertiary)
49	22.95259	89.2345	8	Road (Katcha)
50	22.95669	89.23509	8	Road (Katcha)
51	22.95444	89.2342	7	Road (Pucca)
52	22.962	89.23573	6	Road (Katcha)
53	22.9657	89.23433	8	Road (Katcha)
54	22.94699	89.23118	9	Road (Pucca)
55	22.84337	89.16505	7	Road (Katcha)
56	22.82087	89.13314	4	Road (Secondary)
57	22.91568	89.1979	9	Road (Tertiary)
58	22.94474	89.22753	3	Road (Highway)
59	22.97136	89.23301	4	Road (Tertiary)
60	22.92074	89.20162	8	Road (Secondary)
61	22.91642	89.1985	6	Road (Secondary)
62	22.90424	89.19433	6	Road (Secondary)
63	22.8895	89.18894	8	Road (Tertiary)
64	22.87577	89.18807	6	Road (Tertiary)

65	22.86896	89.18521	4	Road (Secondary)
66	22.8424	89.16427	6	Road (Tertiary)
67	22.8276	89.1501	9	Road (Tertiary)
68	22.82493	89.14781	7	Road (Tertiary)
69	22.82111	89.13606	5	Road (Tertiary)
70	22.81779	89.11822	5	Road (Secondary)
71	22.81753	89.11607	4	Road (Tertiary)
72	22.78324	89.09625	2	Road (Tertiary)
73	22.75883	89.09361	6	Road (Tertiary)
74	22.75791	89.09361	4	Road (Tertiary)
75	22.75542	89.09369	5	Road (Secondary)
76	22.74881	89.09278	4	Road (Highway)
77	22.75841	89.09366		River (Betna)
78	22.82977	89.15704		River (Kopotakkho)
79	22.89571	89.19218		River (Buri)
80	22.94872	89.23392		River (Horihor)
81	22.95781	89.23599		River (Horihor)
82	22.90357	89.19433	3	Canal
83	22.93216	89.21183	4	Canal
84	22.96936	89.23351	6	Canal
85	22.94708	89.2314	8	Pond
86	22.84254	89.16427	6	Pond
87	22.7486	89.09264	2	D/T Line
88	22.82123	89.13517	4	D/T Line
89	22.8348	89.16193	8	D/T Line
90	22.83607	89.16252	6	D/T Line
91	22.84235	89.16429	6	D/T Line
92	22.86378	89.18209	6	D/T Line
93	22.89468	89.19167	9	D/T Line
94	22.8908	89.18969	10	D/T Line
95	22.91381	89.19513	5	D/T Line
96	22.95439	89.2341	7	D/T Line
97	22.81718	89.11518	5	D/T Line

Kushtia-Meherpur 132 kV Transmission Line

Line Length: 48.0 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	23.79045	88.68023	16	Start Point

2	23.79892	88.71787	17	AP -1 (27 degrees - RT)
3	23.79484	88.73474	16	AP -2 (27 degrees - LT)
4	23.79963	88.75533	14	AP -3 (45 degrees - LT)
5	23.8251	88.77176	16	AP -4 (47 degrees - RT)
6	23.82631	88.77798	14	AP -5 (10 degrees - RT)
7	23.82672	88.79276	15	AP -6 (20 degrees - LT)
8	23.84834	88.84746	18	AP -7 (47 degrees - RT)
9	23.84238	88.86034	17	AP -8 (46 degrees - LT)
10	23.85113	88.884	19	AP -9 (25 degrees - RT)
11	23.85021	88.89685	15	AP -10 (11 degrees - RT)
12	23.84784	88.90585	20	AP -11 (35 degrees - LT)
13	23.85041	88.91281	16	AP -12 (35 degrees - RT)
14	23.8493	88.91721	16	AP -13 (37 degrees - LT)
15	23.85285	88.92575	14	AP -14 (56 degrees - RT)
16	23.84447	88.93889	14	AP -15 (36 degrees - LT)
17	23.84597	88.96665	11	AP -16 (27 degrees - LT)
18	23.84925	88.9725	14	AP -17 (15 degrees - RT)
19	23.85179	88.9822	13	AP -18 (12 degrees - RT)
20	23.85267	88.99934	13	AP -19 (22 degrees - RT)
21	23.84085	89.03508	13	AP -20 (22 degrees - LT)
22	23.84116	89.04061	12	AP -21 (69 degrees - LT)
23	23.84683	89.04246	13	AP -22 (20 degrees - RT)
24	23.85101	89.04561	13	AP -23 (58 degrees - RT)
25	23.85057	89.05148	11	AP -24 (30 degrees - LT)
26	23.86194	89.07686	10	AP -25 (36 degrees - LT)
27	23.86644	89.0794	14	AP -26 (18 degrees - RT)
28	23.87339	89.08679	15	AP -27 (42 degrees - RT)
29	23.87353	89.091	17	AP -28 (23 degrees - LT)
30	23.87488	89.09395	14	AP -29 (58 degrees - LT)
31	23.87872	89.09452	15	AP -30 (34 degrees - LT)
32	23.87988	89.09397	16	End Point
33	23.79312	88.69228	19	Road (Secondary)
34	23.79444	88.69793	19	Road (Tertiary)
35	23.7946	88.69871	18	Road (Secondary)
36	23.79515	88.70116	17	Road (Secondary)
37	23.79871	88.717	17	Road (Secondary)
38	23.79575	88.73129	15	Road (Tertiary)
39	23.7951	88.73603	17	Road (Secondary)
40	23.79722	88.74498	15	Road (Secondary)
41	23.79905	88.75275	18	Road (Tertiary)
42	23.80784	88.76059	17	Road (Secondary)

43	23.82074	88.76891	18	Road (Secondary)
44	23.82074	88.76891	18	Road (Secondary)
45	23.82613	88.77724	14	Road (Secondary)
46	23.82677	88.79181	16	Road (Secondary)
47	23.83183	88.80581	14	Road (Secondary)
48	23.8418	88.83086	15	Road (Tertiary)
49	23.84452	88.83791	17	Road (Tertiary)
50	23.8477	88.8459	15	Road (Tertiary)
51	23.84664	88.85118	17	Road (Secondary)
52	23.84263	88.86002	17	Road (Secondary)
53	23.85109	88.88495	18	Road (Secondary)
54	23.84821	88.90453	16	Road (Secondary)
55	23.84821	88.90453	16	Road (Secondary)
56	23.85032	88.91326	18	Road (Tertiary)
57	23.85002	88.91394	16	Road (Tertiary)
58	23.8496	88.91791	17	Road (Secondary)
59	23.85201	88.9238	17	Road (Secondary)
60	23.85092	88.92857	15	Road (Tertiary)
61	23.84492	88.93821	16	Road (Tertiary)
62	23.84502	88.94778	15	Road (Secondary)
63	23.84943	88.97349	16	Road (Tertiary)
64	23.84964	88.97394	16	Road (Secondary)
65	23.85252	88.99478	11	Road (Tertiary)
66	23.84091	89.03624	13	Road (Tertiary)
67	23.84102	89.03899	14	Road (Secondary)
68	23.8497	89.04454	12	Road (Secondary)
69	23.85502	89.06103	13	Road (Secondary)
70	23.85894	89.06994	12	Road (Tertiary)
71	23.86413	89.07816	15	Road (Secondary)
72	23.86413	89.07816	15	Road (Secondary)
73	23.86843	89.08147	14	Road (Tertiary)
74	23.87343	89.08942	17	Road (Secondary)
75	23.87411	89.09234	17	Road (Highway)
76	23.85115	89.05266	12	D/T Line
77	23.79127	88.68381	17	D/T Line
78	23.79602	88.73072	16	D/T Line
79	23.79602	88.73072	16	D/T Line
80	23.79887	88.75225	18	D/T Line
81	23.8243	88.77119	14	D/T Line
82	23.85043	88.91324	17	D/T Line
83	23.8495	88.91739	16	D/T Line

84	23.85182	88.92334	17	D/T Line
85	23.85263	88.92597	14	D/T Line
86	23.84498	88.94734	15	D/T Line
87	23.84102	89.03586	13	D/T Line
88	23.84099	89.037	14	D/T Line
89	23.84623	89.04212	13	D/T Line
90	23.85513	89.06157	13	D/T Line
91	23.87827	89.09448	15	D/T Line
92	23.87957	89.09411	15	D/T Line
93	23.83193	88.80592	14	Canal
94	23.85022	88.91362	18	Canal
95	23.8527	88.92547	14	Canal
96	23.85212	88.98869	13	Canal
97	23.84581	89.02044	11	Canal
98	23.84086	89.03547	13	Canal
99	23.84103	89.03927	14	Canal
100	23.87433	89.09291	17	Canal
101	23.83485	88.81342	15	Pond
102	23.87401	89.09197	15	Pond
103	23.7934	88.69339		River (Kajla)
104	23.82661	88.79138		River (Kajla)
105	23.84266	88.86105		River (Mathavanga)
106	23.85099	88.88579		River (Panggsasi)
107	23.84915	88.90089		River (Panggsasi)
108	23.84958	88.97365		River (Sagar)
109	23.79471	88.6989	18	Home Garden
110	23.7955	88.70237	17	Home Garden
111	23.79502	88.73569	17	Home Garden
112	23.79522	88.73634	17	Home Garden
113	23.79738	88.74558	14	Home Garden
114	23.83226	88.80672	15	Home Garden
115	23.84148	88.83004	16	Home Garden
116	23.8474	88.84518	15	Home Garden
117	23.87342	89.08748	17	Home Garden
118	23.79311	88.6921	19	Home Gardens/ plantation
119	23.82601	88.77625	13	Home Gardens/ plantation
120	23.84942	88.97321	16	Home Gardens/ plantation

Bagerhat-Pirojpur-Bhandaria 132 kV

Line Length: 49.5 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	22.64558	89.79808	6	Start Point (Bagerhat-Pirojpur)
2	22.64432	89.80039	6	AP - 1 (12 degrees - RT)
3	22.64185	89.80337	5	AP - 2 (25 degrees - RT)
4	22.63537	89.80656	5	AP - 3 (66 degrees - LT)
5	22.63563	89.81376	5	AP - 4 (13 degrees - LT)
6	22.63816	89.82353	4	AP - 5 (71 degrees - RT)
7	22.63169	89.82795	4	AP - 6 (49 degrees - LT)
8	22.63095	89.83415	4	AP - 7 (34 degrees - LT)
9	22.63417	89.84043	4	AP - 8 (45 degrees - LT)
10	22.63845	89.84187	5	AP - 9 (47 degrees - RT)
11	22.64023	89.84567	5	AP - 10 (28 degrees - RT)
12	22.63976	89.85663	5	AP - 11 (12 degrees - LT)
13	22.64148	89.86807	4	AP - 12 (19 degrees - RT)
14	22.63737	89.89246	6	AP - 13 (3 degrees - LT)
15	22.63626	89.90092	5	AP - 14 (7 degrees - RT)
16	22.63012	89.92644	3	AP - 15 (23 degrees - LT)
17	22.63212	89.93884	4	AP - 16 (4 degrees - LT)
18	22.6347	89.95036	5	End Point (Bagerhat-Pirojpur)
19	22.6344	89.95095	4	Start Point (Pirojpur-Bhandaria)
20	22.63402	89.95082	4	AP - 17 (67 degrees - LT)
21	22.63158	89.95344	5	AP - 18 (26 degrees - LT)
22	22.62963	89.95978	4	AP - 19 (30 degrees - RT)
23	22.62254	89.9664	4	AP - 20 (50 degrees - RT)
24	22.61839	89.96595	7	AP - 21 (40 degrees - LT)
25	22.61725	89.96671	6	AP - 22 (14 degrees - RT)
26	22.6062	89.97081	6	AP - 23 (53 degrees - LT)
27	22.60183	89.98471	6	AP - 24 (8 degrees - RT)
28	22.59657	89.99593	3	AP - 25 (30 degrees - RT)
29	22.59424	89.99757	6	AP - 26 (25 degrees - LT)
30	22.59068	90.00358	7	AP - 27 (17 degrees - RT)
31	22.58563	90.00825	7	AP - 28 (24 degrees - LT)
32	22.58366	90.0128	7	AP - 29 (10 degrees - LT)
33	22.58106	90.02341	7	AP - 30 (10 degrees - LT)
34	22.57991	90.03955	7	AP - 31 (69 degrees - RT)
35	22.57736	90.04035	7	AP - 32 (46 degrees - LT)
36	22.57308	90.04873	8	AP - 33 (11 degrees - RT)
37	22.57153	90.05076	4	AP - 34 (21 degrees - LT)
38	22.56761	90.06385	7	AP - 35 (40 degrees - RT)

39	22.56014	90.06886	5	AP - 36 (23 degrees - LT)
40	22.55584	90.07522	3	AP - 37 (42 degrees - RT)
41	22.5516	90.07632	5	AP - 38 (20 degrees - RT)
42	22.54452	90.07568	6	AP - 39 (71 degrees - LT)
43	22.54203	90.08102	4	AP - 40 (61 degrees - RT)
44	22.52028	90.08289	5	AP - 41 (56 degrees - LT)
45	22.51793	90.087	8	AP - 42 (28 degrees - LT)
46	22.51755	90.09891	4	AP - 43 (33 degrees - RT)
47	22.51547	90.10193	7	AP - 44 (13 degrees - RT)
48	22.50819	90.1087	4	AP - 45 (12 degrees - RT)
49	22.50322	90.11168	9	AP - 46 (51 degrees - RT)
50	22.49459	90.1086	4	AP - 47 (39 degrees - RT)
51	22.49184	90.10412	3	AP - 48 (47 degrees - LT)
52	22.4867	90.10299	4	AP - 49 (20 degrees - RT)
53	22.47307	90.09445	5	AP - 50 (48 degrees - RT)
54	22.47186	90.0877	7	AP - 51 (5 degrees - LT)
55	22.46984	90.07998	4	AP - 52 (63 degrees - RT)
56	22.47585	90.07447	11	AP - 53 (8 degrees - LT)
57	22.4797	90.06992	5	End Point (Pirojpur-Bhandaria)
58	22.64332	89.8016		River (Bhairab)
59	22.6306	89.92347		River (Boleswar)
60	22.58072	90.02968		River (Katcha)
61	22.51832	90.08633		River (Goroyar)
62	22.51765	90.09167		River (Pona)
63	22.63136	89.93418	8	Canal
64	22.63194	89.93769	6	Canal
65	22.64021	89.80419	5	Canal
66	22.63655	89.80591	5	Canal
67	22.63556	89.81304	6	Canal
68	22.64138	89.86904	7	Canal
69	22.63957	89.87941	4	Canal
70	22.63671	89.89748	6	Canal
71	22.63383	89.91161	5	Canal
72	22.58902	90.00512	7	Canal
73	22.50773	90.10896	7	Canal
74	22.5688	90.0599	8	Canal
75	22.56502	90.0656	4	Canal
76	22.55336	90.07585	8	Canal
77	22.54405	90.07671	7	Canal
78	22.53881	90.0813	6	Canal
79	22.52236	90.08269	5	Canal

80	22.47739	90.09718	4	Canal
81	22.56896	90.0595	7	Pond
82	22.47471	90.07557	11	Pond
83	22.63483	89.90681	8	Home Garden
84	22.63545	89.80952	6	Home Garden
85	22.63675	89.89708	5	Home Garden
86	22.63061	89.95675	8	Home Garden
87	22.63554	89.81058	10	Home Garden
88	22.63557	89.81103	10	Home Garden
89	22.63774	89.82189	11	Home Garden
90	22.63995	89.85316	8	Home Garden
91	22.63694	89.89601	8	Home Garden
92	22.63665	89.89739	6	Home Garden
93	22.63571	89.90279	9	Home Garden
94	22.63676	89.89725	6	Home Garden
95	22.63356	89.91213	5	Home Garden
96	22.63098	89.93162	2	Home Garden
97	22.63353	89.94487	6	Home Garden
98	22.63397	89.94711	3	Home Garden
99	22.60061	89.98729	8	Home Garden
100	22.58513	90.00947	5	Home Garden
101	22.58468	90.01044	7	Home Garden
102	22.58309	90.01506	11	Home Garden
103	22.58097	90.02458	9	Home Garden
104	22.63675	89.8972	6	Home Garden
105	22.63536	89.90464	8	Home Garden
106	22.63489	89.90645	8	Home Garden
107	22.63402	89.91009	5	Home Garden
108	22.51776	90.09403	10	Home Garden
109	22.50751	90.10915	7	Home Garden
110	22.4714	90.08594	12	Home Garden
111	22.47512	90.07504	9	Home Garden
112	22.47647	90.07373	11	Home Garden
113	22.64587	89.79786	6	Road (Highway)
114	22.63734	89.82012	5	Road (Highway)
115	22.51212	90.10506	5	Road (Pucca)
116	22.54241	90.08019	3	Road (Pucca)
117	22.56999	90.05587	6	Road (Pucca)
118	22.51619	90.10089	9	Road (Pucca)
119	22.51362	90.10365	6	Road (Pucca)
120	22.5185	90.08599	8	Road (Pucca)

121	22.52955	90.08208	6	Road (Katcha)
122	22.47118	90.0851	7	Road
123	22.57351	90.04786	10	Road (Katcha)
124	22.57083	90.05266	8	Road (Pucca)
125	22.56681	90.06438	9	Road (Katcha)
126	22.5578	90.07232	4	Road (Pucca)
127	22.5542	90.07568	5	Road (Pucca)
128	22.55286	90.07598	7	Road (Pucca)
129	22.54864	90.07605	5	Road (Pucca)
130	22.52955	90.08208	6	Road (Pucca)
131	22.5279	90.0823	6	Road (Pucca)
132	22.47755	90.09724	4	Road (Pucca)
133	22.47129	90.08553	12	Road (Katcha)
134	22.47438	90.0758	8	Road (Pucca)
135	22.48891	90.10347	6	Road (Pucca)
136	22.57356	90.04778	10	Road (Pucca)
137	22.5441	90.07663	7	Road (Katcha)
138	22.63193	89.93759	6	Road
139	22.63548	89.81015	7	Road
140	22.63983	89.85421	10	Road
141	22.6413	89.86896	7	Road
142	22.64065	89.87298	9	Road
143	22.63955	89.87952	4	Road
144	22.63858	89.88536	5	Road
145	22.63644	89.89957	7	Road
146	22.63502	89.82564	4	Road
147	22.63105	89.93213	3	Road
148	22.59218	90.00101	9	Road
149	22.58509	90.00965	7	Road
150	22.58328	90.01464	11	Road
151	22.58139	90.02228	8	Road
152	22.63381	89.91134	5	Road
153	22.6059	89.97155	4	Road
154	22.60375	89.97895	10	Road
155	22.6007	89.98709	8	Road
156	22.59959	89.98968	7	Road
157	22.58889	90.00525	7	Road
158	22.58092	90.02479	7	Road
159	22.64461	89.79977	4	Road
160	22.63703	89.89536	6	Road
161	22.58015	90.03607	4	Road (Katcha)

162	22.63482	89.90707	8	Road (Pucca)
163	22.57349	90.04792	8	Road (Pucca)
164	22.5162	90.10082	9	D/T Line
165	22.51218	90.10505	5	D/T Line
166	22.47475	90.07546	11	D/T Line
167	22.47128	90.08549	12	D/T Line
168	22.64512	89.79882	6	D/T Line
169	22.63735	89.82018	5	D/T Line
170	22.63881	89.88396	3	D/T Line
171	22.63765	89.82392	4	D/T Line
172	22.61755	89.96672	6	D/T Line
173	22.59419	89.99771	6	D/T Line
174	22.59076	90.00347	7	D/T Line
175	22.58831	90.00577	6	D/T Line
176	22.58308	90.01501	11	D/T Line
177	22.56986	90.0559	6	Bridge

Gopalganj(N) - Shibchar 230 kV

Line Length: 25 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	23.27795	90.01242	5	Start Point
2	23.28297	90.03283	5	AP - 1 (17 degrees - LT)
3	23.28801	90.04141	5	AP - 2 (4 degrees - RT)
4	23.29309	90.05133	8	AP - 3 (41 degrees - LT)
5	23.30537	90.05642	6	AP - 4 (36 degrees - RT)
6	23.31214	90.06747	7	AP - 5 (28 degrees - LT)
7	23.3294	90.07791	7	AP - 6 (41 degrees - RT)
8	23.33145	90.08422	6	AP - 7 (30 degrees - RT)
9	23.32969	90.09273	6	AP - 8 (12 degrees - RT)
10	23.32534	90.10268	9	AP - 9 (11 degrees - LT)
11	23.32246	90.1153	8	AP - 10 (43 degrees - RT)
12	23.31647	90.1195	8	AP - 11 (31 degrees - LT)
13	23.31377	90.12537	5	AP - 12 (52 degrees - LT)
14	23.31955	90.1366	8	AP - 13 (38 degrees - RT)
15	23.31504	90.16102	7	AP - 14 (14 degrees - LT)
16	23.31525	90.16585	8	AP - 15 (51 degrees - LT)
17	23.33134	90.17796	10	AP - 16 (25 degrees - RT)
18	23.33242	90.17997	8	AP - 17 (20 degrees - LT)
19	23.33714	90.1842	10	AP - 18 (16 degrees - RT)

20	23.3405	90.18936	10	AP - 19 (49 degrees - LT)
21	23.34408	90.18988	10	AP - 20 (47 degrees - LT)
22	23.35082	90.18449	9	AP - 21 (40 degrees - RT)
23	23.35412	90.18457	8	End Point
24	23.27999	90.02065	6	Road (Secondary)
25	23.35396	90.18457	8	Road (Secondary)
26	23.35381	90.18471	9	Road (Tertiary)
27	23.3411	90.18928	10	Road (Tertiary)
28	23.34007	90.18871	10	Road (Secondary)
29	23.33719	90.18407	10	Road (Secondary)
30	23.33169	90.1786	10	Road (Secondary)
31	23.33169	90.1786	10	Road (Secondary)
32	23.31502	90.16185	7	Road (Secondary)
33	23.31652	90.15322	7	Road (Tertiary)
34	23.31746	90.14796	6	Road (Secondary)
35	23.3186	90.14195	9	Road (Secondary)
36	23.31868	90.14172	9	Road (Tertiary)
37	23.31434	90.12409	5	Road (Tertiary)
38	23.31582	90.12089	9	Road (Tertiary)
39	23.31976	90.11715	8	Road (Tertiary)
40	23.31976	90.11715	8	Road (Tertiary)
41	23.32265	90.11482	8	Road (Secondary)
42	23.3258	90.10162	8	Road (Secondary)
43	23.31976	90.11715	8	Road (Tertiary)
44	23.32265	90.11482	8	Road (Secondary)
45	23.3258	90.10162	8	Road (Secondary)
46	23.33002	90.09111	6	Road (Secondary)
47	23.33043	90.08104	7	Road (Tertiary)
48	23.3181	90.07119	5	Road (Secondary)
49	23.31805	90.07096	5	Road (Secondary)
50	23.31122	90.06606	10	Road (Tertiary)
51	23.31024	90.06417	10	Road (Tertiary)
52	23.3064	90.05769	7	Road (Tertiary)
53	23.3045	90.05605	6	Road (Tertiary)
54	23.2919	90.04901	3	Road (Tertiary)
55	23.28246	90.03109	6	Road (Secondary)
56	23.28094	90.02475	6	Road (Secondary)
57	23.2783	90.01335	6	Road (Highway)
58	23.28908	90.04362	6	D/T Line
59	23.3406	90.18936	10	D/T Line
60	23.31531	90.16529	8	D/T Line

61	23.31531	90.16529	8	D/T Line
62	23.31507	90.16194	7	D/T Line
63	23.3255	90.1023	7	D/T Line
64	23.33283	90.18034	8	Canal
65	23.33152	90.17843	10	Canal
66	23.31557	90.12141	7	Canal
67	23.32578	90.10182	8	Canal
68	23.33002	90.09101	6	Canal
69	23.31794	90.07106	5	Canal
70	23.31853	90.07125	8	Canal
71	23.30466	90.05615	4	Canal
72	23.28092	90.02453	5	Canal
73	23.28092	90.02453	5	Canal
74	23.33842	90.18609	8	Pond
75	23.3513	90.18453		River (Ariyal Khan)
76	23.31503	90.16179		River (Ariyal Khan)
77	23.31691	90.15073		River (Ariyal Khan)
78	23.31793	90.13344		River (Ariyal Khan)
79	23.3166	90.13089		River (Ariyal Khan)
80	23.31068	90.06501		River (Kumar)
81	23.34241	90.1897	11	Home Gardens/ plantation

Niamatpur-Patnitola 132 kV

Line Length: 32.5 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	24.83436	88.58452	22	Start Point
2	24.83422	88.58533	21	AP - 1 (46 degrees - LT)
3	24.83602	88.58781	22	AP - 2 (34 degrees - LT)
4	24.84525	88.59119	20	AP - 3 (49 degrees - RT)
5	24.85048	88.60455	22	AP - 4 (34 degrees - LT)
6	24.8609	88.61193	20	AP - 5 (41 degrees - RT)
7	24.8618	88.61543	19	AP - 6 (28 degrees - LT)
8	24.87341	88.6281	22	AP - 7 (38 degrees - LT)
9	24.88255	88.62966	19	AP - 8 (20 degrees - RT)
10	24.88941	88.63347	23	AP - 9 (62 degrees - RT)
11	24.8893	88.64331	18	AP - 10 (56 degrees - LT)
12	24.89732	88.64893	17	AP - 11 (21 degrees - LT)
13	24.93965	88.6595	18	AP - 12 (17 degrees - LT)
14	24.94754	88.65913	18	AP - 13 (32 degrees - RT)

15	24.95281	88.66208	18	AP - 14 (12 degrees - RT)
16	24.96089	88.66907	21	AP - 15 (43 degrees - LT)
17	24.9791	88.66855	20	AP - 16 (56 degrees - RT)
18	24.98669	88.67891	21	AP - 17 (25 degrees - RT)
19	24.98984	88.69371	21	AP - 18 (26 degrees - LT)
20	24.99744	88.7037	22	AP - 19 (32 degrees - LT)
21	25.02847	88.71592	24	AP - 20 (44 degrees - RT)
22	25.03154	88.72254	21	AP - 21 (35 degrees - RT)
23	25.02863	88.74041	21	AP - 22 (9 degrees - LT)
24	25.02854	88.75106	22	AP - 23 (27 degrees - RT)
25	25.02507	88.75771	22	End Point
26	24.8389	88.58885	22	Road (Katcha)
27	24.94099	88.65945	21	Road (Katcha)
28	24.9503	88.66068	20	Road (Pucca)
29	24.9526	88.66195	18	Road
30	24.95841	88.66686	22	Road (Tertiary)
31	24.95875	88.66719	21	Road (Pucca)
32	24.96957	88.66882	20	Road
33	24.977	88.6686	22	Road (Pucca)
34	24.98781	88.68405	24	Road (Highwat)
35	24.99237	88.69705	24	Road
36	25.00944	88.70846	22	Road (Katcha)
37	24.8426	88.59022	18	Road (Katcha)
38	25.02569	88.71485	21	Road (Pucca)
39	25.03054	88.72884	24	Road (Pucca)
40	25.02984	88.73283	20	Road (Katcha)
41	25.02982	88.73321	23	Road (Katcha)
42	25.02829	88.74542	24	Road (Katcha)
43	25.02812	88.75183	22	Road (Katcha)
44	25.02529	88.75735	22	Road (Pucca)
45	24.85106	88.60496	21	Road
46	24.86549	88.6194	21	Road (Pucca)
47	24.87124	88.62574	20	Road
48	24.8787	88.62899	21	Road
49	24.88476	88.63089	20	Road (Tertiary)
50	24.88934	88.63914	23	Road (Pucca)
51	24.89311	88.646	17	Road (Pucca)
52	24.84252	88.59015	18	Canal
53	24.84695	88.5956	18	Canal
54	24.90708	88.65137	13	Canal
55	24.92435	88.65564	17	Canal

56	24.93139	88.65744	16	Canal
57	24.97079	88.6688	20	Canal
58	24.88745	88.63239	23	Pond
59	25.02859	88.74357		River (Atrai)

LILO of Bagerhat-Goalpara 132 kV DC line at Rupsha

Line Length: 3.5 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	22.77203	89.61593	4	Start Point
2	22.77625	89.61528	7	AP - 1 (54 degrees - RT)
3	22.77872	89.6177	6	AP - 2 (8 degrees - RT)
4	22.7815	89.62123	9	AP - 3 (29 degrees - RT)
5	22.78268	89.62795	5	AP - 4 (32 degrees - LT)
6	22.78847	89.63458	5	AP - 5 (35 degrees - RT)
7	22.78862	89.63574	8	AP - 6 (56 degrees - LT)
8	22.79083	89.6369	5	End Point
9	22.7745	89.6156	5	Road (Highway)
10	22.78077	89.6202	10	Road (Secondary)
11	22.78181	89.62316	8	Road (Secondary)
12	22.77753	89.61669	4	Road (Primary)
13	22.78341	89.62888	5	Canal
14	22.77768	89.61615	3	D/T Line
15	22.77468	89.61557	5	D/T Line
16	22.77988	89.61917	7	D/T Line
17	22.77756	89.61655	4	D/T Line

LILO of Barishal-Bhandaria 132 kV DC line at Jhalokati

Line Length: 1.26 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	22.67749	90.19874	6	Start Point
2	22.67612	90.20256	4	AP - 1 (17 degrees - LT)
3	22.6757	90.21071	5	End Point
4	22.67568	90.21004	5	Canal
5	22.67567	90.20987	5	Road

LILO of Faridpur-Madaripur 132 kV DC line at Bhanga

Line Length: 0.14 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	23.41754	89.9607	8	Start Point
2	23.41878	89.96111	7	End Point

LILO of Gallamari-Gopalganj 132 kV DC line at Rupsha

Line Length: 0.039 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	22.77087	89.61703	4	Start Point
2	22.77054	89.6172	5	End Point

LILO of Khulna Central-Noapara 132 kV DC line at Phultala

Line Length: 1.0 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	22.9241	89.48613	3	Start Point
2	22.92586	89.49185	4	End Point

LILO of Barishal-Bhola-Borhanuddin 230 kV DC line at Bhola

Line Length: 1.0km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	22.57649	90.65834	6	Start Point
2	22.57723	90.6608	9	AP - 1 (7 degrees - RT)
3	22.57792	90.66446	6	End Point
4	22.57728	90.66104	8	Road (Pucca)

LILO of Ghorashal-Tongi 230 kV DC line at Kaliganj (Gazipur)

Line Length: 3.5 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	23.96644	90.55296	5	Start Point
2	23.96503	90.55335	5	AP - 1 (67 degrees - LT)
3	23.96455	90.55697	8	AP - 2 (51 degrees - RT)
4	23.96102	90.55916	6	AP - 3 (22 degrees - LT)
5	23.95406	90.56858	7	AP - 4 (9 degrees - RT)
6	23.9462	90.57642	11	End Point
7	23.95167	90.57096	8	Road (Pucca)
8	23.96329	90.55776	9	Road (Katcha)
9	23.96474	90.55541	7	Road (Pucca)

LILO of Ghorashal-Tongi 400 kV DC at Kaliganj (Gazipur)

Line Length: 3.5 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	23.96624	90.55053	5	Start Point
2	23.95837	90.55624	7	AP - 1 (33 degrees - RT)
3	23.95569	90.5564	7	AP - 2 (16 degrees - RT)
4	23.95156	90.55553	6	AP - 3 (32 degrees - LT)
5	23.94522	90.55782	6	AP - 4 (32 degrees - RT)
6	23.93747	90.55629	9	End Point
7	23.96559	90.551	6	Canal
8	23.95702	90.55629	7	Pond
9	23.95759	90.55629	8	Road (Pucca)

LILO of Khulna (S)-Rupsha Power Plant 230 kV DC line at Rupsha Substation		
Note: Line runs over Rupsha Substation		

LILO of Bhulta-Kaliakair 400 kV DC line at Kaliganj (Gazipur)

Note: Line runs over Kaliganj (Gazipur) Substation

Annex 3: Tree to be Affected

Table 1. Total number of affected trees in the clearing RoW (12 m) of transmission lines, LILOs, underground/ partially overhead lines, proposed substation and existing substation lands

SL	Name of the Lines	Fruits trees	Non-fruits	Medicinal trees	Total Trees
Transmission Lines					
1	Kaliganj-Moheshpur 132 (KV)	629	737	39	**1405**
2	Bagerhat-Pirojpur-Bhandaria 132 (KV)	14654	6934	35	**21623**
3	Kusthia-Meherpur 132 (KV)	432	746	124	**1302**
4	Satkhira-Monirampur 132 (KV)	1350	603	116	**2069**
5	Domar -Hatibandha 132 (KV)	22	1275	0	**1297**
6	Niamatpur-Patnitala 132 (KV)	179	162	16	**357**
7	Satkhira-Rupsha 230 (KV)	1109	1610	170	**2889**
8	Gopalganj (N) – Shibchar 230 (KV)	519	2267	28	**2814**
9	Purbasadipur-Domar 230 (KV)	368	1584	34	**1986**
10	Kaliganj - Purbachal 400 (KV)	54	85	7	**146**
Transmission Line Sub Total		**19316**	**16003**	**569**	**35888**
LILOs					
1	LILO of Goalpara-Bagerhat 132 kV double circuit line at Rupsha	190	142	9	**341**
2	LILO of Gopalganj-Gallamari 132 kV double circuit line at Rupsha	0	0	0	**0**
3	LILO at Bhanga 132KV from Madaripur-Faridpur line	0	0	0	**0**
4	LILO of Barishal-Bhandaria double circuit 132kV line at Jhalokhati	0	0	0	**0**
5	LILO of Noapara-Khulna Central double circuit 132kV line at Phultala	0	0	0	**0**
6	LILO of Barishal-Bhola-Borhanuddin at Bhola 230 KV	0	0	0	**0**
7	LILO of Rupsha Power Plant-Khulna (S) double circuit 230 kV line at Rupsha Substation	0	0	0	**0**
8	LILO of Tongi -Ghorashal 230 kV double circuit at Kaliganj	4	10	0	**14**
9	LILO of Tongi -Ghorashal 400 kV double circuit at Kaliganj	4	83	0	**87**
10	LILO of Kaliakoir - Bhulta 400 kV double circuit line at Kaliganj		0	0	**0**
LILO Sub Total		**198**	**235**	**9**	**442**
Underground/Partially Overhead Lines					
1	Purbachal - Purbachal 2 **(Overhead Section) 230 KV**	2	4	0	**6**
	Purbachal - Purbachal 2 **(Underground Section) 230 KV**	0	0	0	**0**
2	Rampura- Basundhara 132kV underground cable line	190	160	0	**350**
Sub Total - Underground Sections		**190**	**160**	**0**	**350**
Sub Total - Overhead Sections		**02**	**04**	**0**	**06**

Sub Total - Underground & Overhead		**192**	**164**	**0**	**356**
Total		**19706**	**16402**	**578**	**36686**
New Substations					
1	Rupsha GIS 230/132 kV + 132/33 kV	0	0	0	**0**
2	Bhola GIS 230/33 kV	0	0	0	**0**
3	Shibchar GIS 132/33 kV	3	0	2	**5**
4	Bhanga GIS 132/33 kV	0	0	0	**0**
5	Jhalokhati GIS 132/33 kV	0	0	0	**0**
6	Pirojpur GIS 132/33 kV	15	15	0	**30**
7	Phultala GIS 132/33 kV	6	8	0	**14**
8	Monirampur GIS 132/33 kV	0	0	0	**0**
9	Moheshpur GIS 132/33 kV	0	0	0	**0**
10	Meherpur GIS 132/33 kV	0	0	0	**0**
11	Domar GIS 132/33 kV	3	23	0	**26**
12	Hatibandha GIS 132/33 kV	0	0	0	**0**
13	Purbachal GIS 400/230 kV	0	0	0	**0**
14	Kaliganj GIS, Gazipur (Future 132 kV Provision)	4	6	0	**10**
15	Purbachal 2 GIS 230/132 kV	0	0	0	**0**
Sub-Total New Sub-Station		**31**	**52**	**02**	**85**
Existing substations which will be augmented under the project					
1	Satkhira	0	0	0	**0**
Total		**31**	**52**	**02**	**85**
Overall		**19737**	**16454**	**580**	**36771**

Table 2: Trees Affected by the Transmission Lines (TL Clearing ROW 12 m) and sub-stations

SL	**Name of the Lines**	**Fruit Trees**			**Wood/Timber Trees**			**Medicinal**			**Total Trees**
		(> 10 m height)	**(5-10 m height)**	**(< 5 m height)**	**(> 10 m height)**	**(5-10 m height)**	**(< 5 m height)**	**(> 10 m height)**	**(5-10 m height)**	**(< 5 m height)**	
Transmission Lines											
1	Kaliganj-Moheshpur 132 (kV)	43	258	328	35	316	386	0	15	24	1405
2	Bagerhat-Pirojpur-Bhandaria 132 (kV)	5890	3768	4996	669	2319	3946	5	23	7	21623
3	Kusthia-Meherpur 132 (kV)	55	226	151	16	346	384	1	73	50	1302
4	Satkhira-Monirampur 132 (kV)	598	437	315	144	315	144	96	7	13	2069

SL	Name of the Lines	Fruit Trees			Wood/Timber Trees			Medicinal			Total Trees
		(> 10 m height)	(5-10 m height)	(< 5 m height)	(> 10 m height)	(5-10 m height)	(< 5 m height)	(> 10 m height)	(5-10 m height)	(< 5 m height)	
5	Domar - Hatibandha 132 (kV)	0	22	0	684	481	110	0	0	0	1297
6	Niamatpur-Patnitala 132 (kV)	32	101	46	91	61	10	7	9	0	357
7	Satkhira-Rupsha 230 (kV)	296	507	306	115	951	544	1	71	98	2889
8	Gopalganj (N) – Shibchar 230 (kV)	80	260	179	105	1066	1096	2	12	14	2814
9	Purbasadipur-Domar 230 (kV)	58	82	228	666	606	312	10	10	14	1986
10	Kaliganj - Purbachal 400 (kV)	2	30	22	0	38	47	0	2	5	146
Transmission Line Sub Total		**7054**	**5691**	**6571**	**2525**	**6499**	**6979**	**122**	**222**	**225**	**35888**
LILOs											
1	LILO of Goalpara-Bagerhat 132 kV double circuit line at Rupsha	58	55	77	44	53	45	4	5	0	341
2	LILO of Gopalganj-Gallamari 132 kV double circuit line at Rupsha	0	0	0	0	0	0	0	0	0	0
3	LILO at Bhanga 132KV from Madaripur-Faridpur line	0	0	0	0	0	0	0	0	0	0
4	LILO of Barishal-Bhandaria double circuit 132kV line at Jhalokhati	0	0	0	0	0	0	0	0	0	0
5	LILO of Noapara-Khulna Central double circuit 132kV line at Phultala	0	0	0	0	0	0	0	0	0	0
6	LILO of Barishal-Bhola-	0	0	0	0	0	0	0	0	0	0

SL	Name of the Lines	Fruit Trees			Wood/Timber Trees			Medicinal			Total Trees
		(> 10 m height)	(5-10 m height)	(< 5 m height)	(> 10 m height)	(5-10 m height)	(< 5 m height)	(> 10 m height)	(5-10 m height)	(< 5 m height)	
	Borhanuddin at Bhola 230 KV										
7	LILO of Rupsha Power Plant-Khulna (S) double circuit 230 kV line at Rupsha Substation	0	0	0	0	0	0	0	0	0	0
8	LILO of Tongi - Ghorashal 230 kV double circuit at Kaliganj	0	1	3	0	6	4	0	0	0	14
9	LILO of Tongi - Ghorashal 400 kV double circuit at Kaliganj	1	3	0	1	34	48	0	0	0	87
10	LILO of Kaliakoir - Bhulta 400 kV double circuit line at Kaliganj	0	0	0	0	0	0	0	0	0	0
LILO Sub Total		**59**	**59**	**80**	**45**	**93**	**97**	**4**	**5**	**0**	**442**
Underground/Partially Overhead Lines											
1	Purbachal - Purbachal 2 **(Overhead Section) 230 KV**	0	2	0	0	4	0	0	0	0	6
	Purbachal - Purbachal 2 **(Underground Section) 230 KV**	0	0	0	0	0	0	0	0	0	0
2	Rampura-Basundhara 132kV underground cable line	0	190	0	0	160	0	0	0	0	350
Sub Total - Underground Sections		**0**	**190**	**0**	**0**	**160**	**0**	**0**	**0**	**0**	**350**
Sub Total - Overhead Sections		**0**	**02**	**0**	**0**	**04**	**0**	**0**	**0**	**0**	**06**
Sub Total - Underground & Overhead		**0**	**192**	**0**	**0**	**164**	**0**	**0**	**0**	**0**	**356**
Total		**7113**	**5942**	**6651**	**2570**	**6756**	**7076**	**126**	**227**	**225**	**36686**
New Substations											

SL	Name of the Lines	Fruit Trees			Wood/Timber Trees			Medicinal			Total Trees
		(> 10 m height)	(5-10 m height)	(< 5 m height)	(> 10 m height)	(5-10 m height)	(< 5 m height)	(> 10 m height)	(5-10 m height)	(< 5 m height)	
1	Rupsha GIS 230/132 kV + 132/33 kV	0	0	0	0	0	0	0	0	0	0
2	Bhola GIS 230/33 kV	0	0	0	0	0	0	0	0	0	0
3	Shibchar GIS 132/33 kV	1	0	2	0	0	0	2	0	0	5
4	Bhanga GIS 132/33 kV	0	0	0	0	0	0	0	0	0	0
5	Jhalokhati GIS 132/33 kV	0	0	0	0	0	0	0	0	0	0
6	Pirojpur GIS 132/33 kV	10	0	5	0	10	5	0	0	0	30
7	Phultala GIS 132/33 kV	4	2	0	0	5	3	0	0	0	14
8	Monirampur GIS 132/33 kV	0	0	0	0	0	0	0	0	0	0
9	Moheshpur GIS 132/33 kV	0	0	0	0	0	0	0	0	0	0
10	Meherpur GIS 132/33 kV	0	0	0	0	0	0	0	0	0	0
11	Domar GIS 132/33 kV	0	3	0	0	19	4	0	0	0	26
12	Hatibandha GIS 132/33 kV	0	0	0	0	0	0	0	0	0	0
13	Purbachal GIS 400/230 kV	0	0	0	0	0	0	0	0	0	0
14	Kaliganj GIS, Gazipur (Future 132 kV Provision)	0	0	4	0	0	6	0	0	0	10
15	Purbachal 2 GIS 230/132 kV	0	0	0	0	0	0	0	0	0	0
Sub-Total New Sub-Station		**15**	**03**	**11**	**0**	**34**	**18**	**2**	**0**	**0**	**85**
Existing substations which will be augmented under the project											
1	Satkhira	0	0	0	0	0	0	0	0	0	0
Total		**15**	**3**	**11**	**0**	**34**	**18**	**2**	**0**	**0**	**85**
Overall		**7128**	**5945**	**6662**	**2570**	**6790**	**7094**	**128**	**227**	**225**	**36771**

Annex 4: Photographs of the existing environment and public consultations

The safeguards consultation mission photographs (7th to 10th April 2019)

	
Public consultation on LILO- Bagerhat-Goalpara 132 kV transmission line to Rupsha substation	Public consultation during safeguards consultation mission - Bagerhat (7th April 2019)
	
Public consultation 1	Public consultation 2
	
Bagerhat substation- visit on 8th April 2019	Bagerhat substation

	
Bagerhat substation	Bagerhat substation- land for bay extension
	
Bagerhat substation	Bagerhat substation- waste and other materials in an open area of the substation
	
Existing power lines across Kotchia river	Angle tower in the left bank of the river

	
Angle tower in the right bank	Public consultation with land owners - Pirojpur substation land (8th April 2019)
	
Public consultation- Pirojpur	Ferry crossing to Barishal

Photographs of Consultation Meetings (Sept./ Oct. 2018) – DWZTGEP project)

	
Satkhira Substation	Satkhira Transmission Line

Phultala Substation

Manirampur Substation

Pirojpur Substation

Manirampur Transmission line

Pirojpur Transmission line

Rupsha LILO

Bhola Substation

Jhalokathi Substation

Manirumpur substation

Domar Substation

Kaliganj –Purbachal Transmission line

Kaliganj –Moheshpur Transmission line

	
Bhanga Substation (LILO)	Monirampur- Satkhira Transmission line
	
Satkhira-Khulna Transmission line	Kushtia-Meherpur Transmission line

Annex 5 : Focused Group Discussion on Environment

Table 1: Summary of Participants at Public Consultations for Transmission Lines

No	Name of the Transmission Line Subproject	Dates of Consultations	No. Participants	
			Male	Female
1.	Monirampur-Satkhira (TL)	17/09/2018	13	15
2.	Purbasadipur-Domar (TL)	19/09/2018	12	5
3.	Monirampur-Satkhira (TL)	20/09/2018	24	2
4.	Shibchar- Gopalganj (TL)	21/09/2018	16	12
5.	Domar-Hatibandha (TL-environ)	22/09/2018	18	6
6.	Shibchar-Gopalganj (TL)	22/09/2018	14	10
7.	Domar-Hatibandha (TL)	25/09/2018	19	0
8.	Kaliganj-Moheshpur (TL)	25/09/2018	12	3
9.	Kaliganj-Moheshpur (TL)	25/09/2018	13	4
10.	Purbasadipur- Domar (TL)	26/09/2018	5	17
11.	Kushtia-Meherpur (TL)	27/09/2018	21	5
12.	Satkhira-Rupsa (TL)	27/09/2018	30	6
13.	Kushtia-Meherpur (TL)	28/09/2018	16	18
14.	Niyamotpur-Patnitola (TL)	30/09/2018	40	0
15.	Satkhira-Rupsa (TL)	30/09/2018	19	9
16.	Niyamotpur-Patnitola (TL)	02/10/2018	39	1
17.	Magura-Narail (TL)	04/10/2018	12	9
18.	Magura-Narail (TL)	04/10/2018	13	4
19.	Rupsa (LILO)	06/10/2018	20	9
20.	Kaliganj-Purbachal (TL)	8/10/2018	7	10
21.	Kaliganj-Purbachal (TL)	11/10/2018	17	0
22.	Bagerhat-Pirojpur-Bandaria (TL)	15/10/2018	27	3
23.	Bagerhat-Pirojpur-Bandaria (TL)	17/10/2018	25	17
24.	Bakreganj-Barguna (TL)	18/10/2018	6	17
25.	Bakreganj-Barguna (TL)	19/10/2018	19	1

Table 2: Summary of participants at public consultations conducted for substations

No	Name of the Substation	Dates of Consultations	No. Participants	
			Male	Female
1.	Monirampur Substation (FGD)	13/09/2018	12	0
2.	Shibchar Substation	17/09/2018	32	08
3.	Monirampur Substation	18/09/2018	38	0
4.	Bay Extension to Domar Substation	20/09/2018	21	13
5.	Bhanga Substation	21/09/2018	21	13
6.	*Satkhira Bay Extension*	22/09/2018	30	0
7.	Satkhira-Khulna Substation (FGD)	22/09/2018	12	0
8.	Hatibandha Substation	25/09/2018	21	04
9.	Moheshpur Substation	25/09/2018	08	09
10.	Meherpur Substation	26/09/2018	10	09
11.	Phultala Substation	29/09/2018	25	0
12.	*Rupsha Substation*	02/10/2018	26	0
13.	Niyamatpur Substation	04/10/2018	46	3
14.	Purbachal Substation	09/10/2018	16	0
15.	Purbachal Substation (FGD)	09/10/2018	11	0
16.	Pirojpur Substation	12/10/2018	27	0

17.	Jhalokathi Substation	13/10/2018	53	0
18.	Kaliganj Substation	13/10/2018	59	0
19.	Bhola Substation	15/10/2018	41	0

Table 3: Summary of Participants at Gender Consultations for Substations

No	Name of the Substation	Dates of Consultations	No. Participants	
			Male	Female
1.	Monirampur Substation (FGD)	13/09/2018	12	0
2.	Monirampur Substation	18/09/2018	0	12
3.	Shibchar Substation	18/09/2018	1	15
4.	Hatibandha Substation	18/09/2018	0	12
5.	Bhanga Substation	21/09/2018	0	11
6.	Satkhira- Khulna Substation (FGD)	22/09/2018	12	0
7.	Sathkira Bay Extension	25/09/2018	0	13
8.	Moheshpur Substation	25/09/2018	0	9
9.	Meherpur Substation	26/09/2018	0	14
10.	Domar Substation	26/09/2018	0	12
11.	Phultala Substation	29/09/2018	0	12
12.	Rupsha Substation	01/10/2018	0	12
13.	Purbachal Substation (FGD)	09/10/2018	11	0
14.	Kaliganj Substation	10/10/2018	0	12
15.	Pirojpur Substation	12/10/2018	0	12
16.	Jhalokathi Substation	14/10/2018	0	10
17.	Bhola Substation	15/10/2018	0	13

Table 4: Summary of Participants at Women's Consultations conducted for Transmission Lines

No	Name of the Transmission Line Subproject	Dates of Consultations	No. Participants
1.	Satkhira-Khulna Transmission Line	23.9.2018	11
2.	Domar-Hatibandha Transmission Line	25.09.2018	14
3.	Purbosadipur-Domar Transmission Line	26.09.2018	08
4.	Meherpur-Kushtia Transmission Line	27.09.2018	12
5.	Niyamatpur-Patnitala Transmission Line	30.09.2018	12
6.	Magura-Narail Transmission Line	03.10.2018	13
7.	Bagerhat-Pirojpur-Bhandaria Transmission Line	07.10.2018	12

Environment Checklist

FORMAT FOR PUBLIC CONSULTATION & FOCUSED GROUP DISCUSSIONS (ENVIRONMENTAL)

Name of the Component /Site: Domar – Hatibandha transmission line and Domar Substation
Number of Participants: 19
Location/Date/Time: Doyani Checkpost, 25/09/2018, 02:00pm-03:05pm
Name of village, Upazila, Zila: Doyani, Hatibandha, Lalmonirhat

Issues	Participants' Opinion, Comments and Suggestions
1. General perception about the project and the awareness about the proposed project.	People of this area had no idea about the project. After knowing that the project is about to increase the supply of electricity, majority of the people of community appreciated it, because their area remains almost half a day without the supply of electricity. However, they also have expressed concern in many aspects regarding the establishment of the substation.
2. Protected areas (national park, sanctuaries, nature reserves, forest reserves, religiously sensitive sites, historical or archaeological sites), if any	There is no such protected area where the substation had been planned to be constructed.
3. Status of current environmental conditions in the area – air, dust, noise levels, status of soil in the area.	The proposed area is currently using for cultivation located near to the village. However, a huge portion of land is owned by Bangladesh Water Development Board (BWDB).
4. Will the project site adversely impact the habitats (natural and man-modified) e.g. home gardens, paddy fields, agricultural crops, plantations, natural forest, waterbodies) or soil resource in the locality?	Few of the people of community will lose cultivating lands which were a major portion of their yearly agricultural income. There may also have some environmental impacts on the area because of the construction of the substation.
5. Type of trees found in the home gardens, natural forests (if any): Fruit trees, timber trees/forest trees	The area that had been planned to be constructed the substation is mainly used for cultivation of crops. There also have some fruit producing trees, such as, mango, jackfruit, litchi etc.
6. Any threatened and endemic tree/ plant species found in the project area	No such trees or plants have been found that may come under threat because of the construction of the substation.
7. Any Indigenous, endemic, threatened animals in the project area.	No such animals or birds have been found that may come under threat because of the construction of the substation.
8. Any critical issue or concern by the local people regarding the project?	There is no such concern.

LIST OF PARTICIPANTS

Sl. No.	Name of the Participant	Occupation	Signature (If agreed by the participants)
01.	Md. Al-Amin Gazi	Driver	
02.	Foridul Islam	Business	
03.	Md. Sobhan	Business	
04.	Nessar Uddin	Business	
05.	Kopil Uddin	Farmer	
06.	Md. Rahmat Ali	Farmer	
07.	Md. Lavlu	Student	
08.	Md. Mostafa karim	Student	
09.	Md. Rabbi Hasan	Student	
10.	Ali Nur	Student	
11.	Mizanur Rahman	Student	
12.	Milon Hossain	Driver	
13.	Mizanur Rahman	Driver	
14.	Abdus Samad	Business	
15.	Md. Shariful Islam	Service	
16.	Kasu Mahmud	Day-labour	
17.	Taz Uddin	Business	
18.	Md. Jonab Ali	Mason	
19.	Md. Khalequezzaman	Student	

ENVIRONMENT CHECKLIST

Format for Public Consultation & Focused Group Discussions (Environmental)
Name of the Component /Site: Domar-Hatibandha TL
Number of Participants: 24
Location/Date/Time: Melapanga Dokolpara, 22/09/2018, 11:30am-12:40pm
Name of village, Upazila, Zila: Melapanga, Domar, Nilphamari

Issues	Participants' Opinion, Comments and Suggestions
1. General perception about the project and the awareness about the proposed project.	People of this area had no idea about the project. Knowing the project is about to increase the supply of electricity, the people of the community appreciated it. However, they also have expressed concern in many aspects regarding the installation of the transmission towers and electric line drawing over their area.
2. Protected areas (national park, sanctuaries, nature reserves, forest reserves, religiously sensitive sites, historical or archaeological sites), if any	There is no such park, forest, sanctuaries or nature reserves in the planned area of the line alignment.
3. Status of current environmental conditions in the area – air, dust, noise levels, status of soil in the area.	Most of the proposed area is currently using for cultivation.
4. Will the project site adversely impact the habitats (natural and man-modified) e.g. home gardens, paddy fields, agricultural crops, plantations, natural forest, waterbodies) or soil resource in the locality?	There have some wood and fruit producing trees on the planned alignment. The community people want compensation for the losses of those trees and crops.
5. Type of trees found in the home gardens, natural forests (if any): Fruit trees, timber trees/forest trees	The types of trees are found in the area are-Mahogany, Eucalyptus, Raintree, Mango, Jackfruit, Litchi etc.
6. Any threatened and endemic tree/ plant species found in the project area	No such trees or plants have been found that may come under threat because of the installation of transmission towers and electric line.
7. Any Indigenous, endemic, threatened animals in the project area.	No such animals or birds have been found that may come under threat because of the installation of transmission towers and electric line.
8. Any critical issue or concern by the local people regarding the project?	There is no such concern.

LIST OF PARTICIPANTS

Sl. Nº	Name of the Participant	Occupation	Signature (If agreed by the participants)
01.	Md. Malek Sarker	Teacher	
02.	Md. Shamsul Haque	Business	
03.	Md. Moniruzzaman	Student	
04.	Md. Sazzad Hossain	Student	
05.	Md. Abdul Kuddus	Farmer	
06.	Mst. Asma Begum	Housewife	
07.	Md. Mizanur Rahman	Farmer	
08.	Md. Saddam Hossain	Student	
09.	Md. Abdul Motin	Teacher	
10.	Md. Danu Islam	Student	
11.	Md. Rowson Ali	Business	
12.	Md. Manik Mia	Student	
13.	Md. Moklesur Rahaman	Farmer	
14.	Md. Abdul Khalek	Farmer	
15.	Md. Sahinur Rahman	Student	
16.	Md. Rahel Mia	Farmer	
17.	Md. Lutfar Rahman	Farmer	
18.	Md. Saifur Rahman	Farmer	
19.	Md. Nur Mohammad	Farmer	
20.	Mst. Mahmuda Begum	Housewife	
21.	Mst. Saleha Begum	Farmer	
22.	Mst. Rokea Begum	Farmer	
23.	Mst. Delwara Begum	Farmer	
24.	Mst. Kona Begum	Farmer	

Environment Checklist

FORMAT FOR PUBLIC CONSULTATION & FOCUSED GROUP DISCUSSIONS (ENVIRONMENTAL)

Name of the Component /Site: Monirampur Substation
Number of Participants: 38
Location/Date/Time: Lauri Bazaar, 18/09/2018, 9:00am-11:00am,
Name of village, Upazila, Zila: Jamla, Monirampur, Satkhira

Issues	Participants' Opinion, Comments and Suggestions
1. General perception about the project and the awareness about the proposed project.	People of this area had no idea about the project. They appreciated major purposes of the project after knowing that it is about to increase the supply of electricity. However, they also have expressed concern in many aspects regarding the establishment of the substation.
2. Protected areas (national park, sanctuaries, nature reserves, forest reserves, religiously sensitive sites, historical or archaeological sites), if any	There is no protected area where the substation had been planned to be constructed.
3. Status of current environmental conditions in the area – air, dust, noise levels, status of soil in the area.	The proposed area is currently using for cultivation located near to a village.
4. Will the project site adversely impact the habitats (natural and man-modified) e.g. home gardens, paddy fields, agricultural crops, plantations, natural forest, waterbodies) or soil resource in the locality?	Some people of this community will lose cultivating lands which were a major portion of their yearly agricultural income. There may also have some environmental impact on the area because of the construction of the substation.
5. Type of trees found in the home gardens, natural forests (if any): Fruit trees, timber trees/forest trees	The whole area that had been planned to be constructed the substation is used for cultivation of crops.
6. Any threatened and endemic tree/ plant species found in the project area	No such trees or plants have been found that may come under threat because of the construction of the substation.
7. Any Indigenous, endemic, threatened animals in the project area.	No such trees or plants have been found that may come under threat because of the construction of the substation.
8. Any critical issue or concern by the local people regarding the project?	There is no such concern.

LIST OF PARTICIPANTS

Sl. Nº	Name of the Participant	Occupation	Signature (If agreed by the participants)
1	Md. Azad Karim	*Male*	Businessman
2	MD. Lavlu	*Male*	Businessman
3	Md. Sawkat Ali	*Male*	Unemployed
4	MD. Billal	*Male*	Van puller
5	Kanai	*Male*	Businessman
6	Fazar Ali	*Male*	Farmer
7	Barek	*Male*	Farmer
8	Hashem Ali	*Male*	Businessman
9	Mashier	*Male*	Van puller
10	Md. Moshiur Rahman	*Male*	Van puller
11	Hafizur Rahman	*Male*	Van puller
12	Md. Jalal Uddin	*Male*	Businessman
13	Moshiur Rahman	*Male*	Farmer
14	Alauddin	*Male*	Businessman
15	Md. Babar Ali	*Male*	Businessman
16	Yusuf Ali	*Male*	Student
17	Kamruzzaman	*Male*	Carpenter
18	Abdul Alim	*Male*	Businessman
19	Ari Samad	*Male*	Businessman
20	Ruhul Amin	*Male*	Farmer
21	Solaiman Mia	*Male*	Farmer
22	Mahmudur Raham	*Male*	Businessman
23	Md. Anamul	*Male*	Businessman
24	Habibullah-al-Mamun	*Male*	Student
25	Md. Rezwan	*Male*	Businessman

26	Kamruzzaman	*Male*	Service Holder[44]
27	R Alim	*Male*	Businessman
28	Md. Rezaul	*Male*	Businessman
29	Md. Maruf	*Male*	Unemployed
30	Asad	*Male*	Carpenter
31	Ananda Das	*Male*	Businessman
32	Arafat	*Male*	Student
33	Shafiqul	*Male*	Driving
34	Monir Uddin	*Male*	Unemployed
35	Md. Abul Kashem	*Male*	Farmer
36	Hafizur Rahman	*Male*	Farmer
37	Md Azim	*Male*	Businessman
38	Md Rayhan	*Male*	Businessman

[44] A service holder is defined the person who work for government or private organizations as full time.

Environment Checklist

FORMAT FOR PUBLIC CONSULTATION & FOCUSED GROUP DISCUSSIONS (ENVIRONMENTAL)

Name of the Component /Site: Phultola Substation
Number of Participants: 25
Location/Date/Time: Mamun's shop, 29.09.2018, 9:00am-11:00am,
Name of village, Upazila, Zila: Mattomdanga, Phultola, Khulna

Issues	Participants' Opinion, Comments and Suggestions
1. General perception about the project and the awareness about the proposed project.	People of this area had no idea about the project. They appreciated major purposes of the project after knowing that it is about to increase the supply of electricity. However, they also have expressed concern in many aspects regarding the establishment of the substation.
2. Protected areas (national park, sanctuaries, nature reserves, forest reserves, religiously sensitive sites, historical or archaeological sites), if any	There is no protected area where the substation had been planned to be constructed.
3. Status of current environmental conditions in the area – air, dust, noise levels, status of soil in the area.	The proposed area is currently using for cultivation located near to a village.
4. Will the project site adversely impact the habitats (natural and man-modified) e.g. home gardens, paddy fields, agricultural crops, plantations, natural forest, waterbodies) or soil resource in the locality?	Some people of this community will lose cultivating lands which were a major portion of their yearly agricultural income sources. There may also have some environmental impact on the area because of the construction of the substation.
5. Type of trees found in the home gardens, natural forests (if any): Fruit trees, timber trees/forest trees	The whole area that had been planned to be constructed the substation is used for the cultivation of fish and crops.
6. Any threatened and endemic tree/ plant species found in the project area	No such trees or plants have been found that may come under threat because of the construction of the substation.
7. Any Indigenous, endemic, threatened animals in the project area.	No such animals have been found that may come under threat because of the construction of the substation.
8. Any critical issue or concern by the local people regarding the project?	There is no such concern.

LIST OF PARTICIPANTS

Sl. №	Name of the Participant	Occupation	Signature (If agreed by the participants)
1	Md. Siddiqur Rahman	Male	Businessman
2	Gazi Jakir	Male	Businessman
3	Masud Hossain	Male	Businessman
4	Kibria	Male	Businessman
5	Saddam Hossain	Male	Farmer
6	Shakil Hossain	Male	Farmer
7	Shawkat Hossain	Male	Farmer
8	Babu	Male	Businessman
9	Gappar Fakir	Male	Village Doctor
10	Muslem	Male	Farmer
11	Fakrul	Male	Farmer
12	Rakib	Male	Farmer
13	Abul Hossain	Male	Businessman
14	Nazrul Isalam	Male	Farmer
15	Rafiqul Islam	Male	Farmer
16	Jhoney Hossain	Male	Businessman
17	Abdul Karim	Male	Farmer
18	Abul Kalam Azad	Male	Service Holder
19	Md. Rafiqul Islam	Male	Service Holder
20	Mizanur Rahman	Male	
21	Shirajul Islam	Male	Laborer
22	Ahmed Hossain	Male	Businessman
23	Sahidul Islam	Male	Businessman
24	Eman Sheikh	Male	Businessman
25	Khairul Islam	Male	Businessman

Annex 6 : Template of Environmental Safeguard Monitoring Report

Environmental Safeguard Monitoring Report

Reporting Period {From Month, Year to Month, Year}
Date {Month, Year}

BAN: xxxx Dhaka and Western Zone Transmission Grid Expansion Project

Prepared by the PGCB, Ministry of Power, Energy and Mineral Resources, Government of Bangladesh for the Asian Development Bank

TABLE OF CONTENTS

{Describe the project milestones during the reporting period and highlight any change from original scope, alignment, methodology, and/or schedule.}

{The project Gantt chart may be included}

{Include a simplified table like the sample below}

Project Component • Stage	Target Date {and Revised Target Date if delayed}	Progress Status {not yet started; on-going; completed}	Percent Completed	Remarks
Power Plant Component	*Example for reporting period Jul-Dec 2018*			
• Contract Award	31 Jan 2018	Completed	100%	Contract Awarded to XYZ Contractor
1. 2. • Construction (civil works, installation of equipment, …)	31 Mar 2019 (original target completion was 31 Dec 2018)	On-going	85%	There was a delay in the delivery of equipment…
• •				

2.0 Compliance to National Regulations

{Include the applicable National Regulations following the sample table below}

National Regulation	Compliance Requirements under the Regulation	Compliance Status {complied; not complied; n/a at current stage of the project}	Remarks {provide details to show how compliance was achieved; or explain the corrective action done if there was non-compliance}

3.0 Compliance to Environmental Covenants from the ADB Loan Agreement

{Include Loan Agreement covenants on environment following the sample table below}

Schedule #, Para. #	Covenant	Compliance Status {complied; not complied; n/a at current stage of the project}	Remarks {provide details to show how compliance was achieved; or explain the corrective action done if there was non-compliance}

4.0 Compliance to Environmental Management Plan

{With reference to the EMP of the project, include a table with the compliance status during the reporting period, with remarks to show how compliance was achieved, or corrective action done if there was non-compliance}

5.0 Safeguards Monitoring Results and Unanticipated Impacts

5.1 Environmental Monitoring

{With reference to the Environmental Monitoring Plan (EMoP) of the project, include a table to summarize the results of the monitoring done during the reporting period. Please indicate the monitoring location, date, time (or duration as applicable), parameters measured, the standards, tests and limits used, and provide the corrective action plan if there was any exceedance to the standards}

5.2 Occupational Health and Safety Monitoring

{With reference to the EMP of the project, include the trainings/drills/inspections conducted during the reporting period following the table below. Include as appendices the training/drill/inspection agenda, attendance sheets, and photos}

Trainings/Drills/ Inspections	Number and Position of Participant/s	Location/s and Date/s	Remarks
Example: Fire Drill	50 Laborers	15 Aug 2018	Participants safely evacuated the site…

{If there was any accident, near-miss, illness, or other incidents during the reporting period (or previously reported accident with ongoing rectification), provide the corrective action done following the table below. Include as appendices the work safety checklists, incident reports, and other relevant supporting documents}

Occupational Accident	Number and Position of Person/s Involved	Location/s and Date/s of Incident	Description of Incident	Corrective Action
Fatality				
Non-fatal Injury				
Near-miss				
Illness				
Other Incidents				

6.0 Implementation of Grievance Redress Mechanism and Complaints Received from Stakeholders

{Include a description of the GRM, provide a flowchart and list of grievance redress committee members}

{If there was any grievance or complaint during the reporting period (or previously reported complaint with ongoing rectification), provide the corrective action done following the table below}

Complainant/s or Affected Persons	Location/s and Date/s of Complaint	Description of Grievance/Complaint	Timeline*	Time Bound Corrective Action

- To be solved within 2 weeks

7.0 Conclusion and Recommendations

{Limit the conclusion to safeguards highlights or issues resolution during the reporting period, and the recommendations or actions to be done in the next period}

APPENDICES

Photographs {Include photographs of the project site taken during the reporting period. For each photo, provide a caption with description, location and date}

Supporting Documents {laboratory results, meeting agenda and attendance, checklists, etc.}

Annex 7 : Environmental Audit of the Existing Substations

1. Introduction

1.1 Objectives of the Environmental Compliance Audit

1. The implementation of the project could have both negative and positive impacts on the surrounding environment, depending on environmental sensitivities and the design of responsive mitigation measures. Environmental impacts include physical, ecological, and socio-economic impacts. This environmental assessment was carried out to prevent and reduce adverse impacts to an acceptable level, and to enhance the positive impacts linked with the implementation of the project. A rapid environmental assessment checklist for the Project was prepared to determine potential adverse environmental and social impacts during Project design and planning, construction, and the operation and maintenance phases of the substation and transmission line projects. This Project is categorized as an Environmental B project, based on the rapid environmental assessment and the ADB's SPS 2009. For Category B projects, the environmental impacts are expected to be less adverse than Category A projects. An Initial Environmental Examination (IEE) is required to address the anticipated impacts and to suggest appropriate mitigation measures. This IEE report was prepared based on the table of contents provided in Appendix 1 of the ADB's SPS 2009.

2. As per ADB Operations Manual, Section F1/OP para 53, for projects involving facilities and/or business activities that already exist or are under construction before ADB's involvement, ADB requires the borrower/client to conduct an environment and/or social compliance audit to determine their safeguard compliance status. The audit by the borrower/client confirms that on-site environmental and social assessments carried out to identify past or present safeguards concerns related to the impacts on the environment, involuntary resettlement and Indigenous Peoples.

3. Where noncompliance is identified, ADB and the borrower/client agree on a Corrective Action Plan (CAP), implementation schedule, and sufficient funds to bring the project into compliance with the safeguard policy requirements. If an upgrade or expansion of a project is not foreseen, the audit report (including the CAP, if any) constitutes the EIA, IEE, resettlement plan, and/or IPP.

4. The audit report is disclosed on the ADB website following the disclosure requirements in this Operations Manual section (part C). For a project involving an upgrade or expansion of existing facilities that have potential impacts on the environment, involuntary resettlement, or Indigenous People, the requirements for environmental and social assessments and planning specified in this Operations Manual section (part C) apply in addition to the audit.

5. The project must comply with the ADB's SPS 2009 and Operational Manual F1 (2013). Also, the Project complies with the Bangladesh Environment Conservation Rules (ECR), 1997. According to the categorization of ECR, 1997, (amendment in 2017) the Project has been categorized as 'Orange B' meaning that it has minimal environmental impacts, which are to be mitigated with proper mitigation measures.

6. The audit has been conducted with the aim to assess the Project's compliance with-

(i) ADB Operations Manual, Section F1/OP (2013), para 53;
(ii) Environment Conservation Rules (ECR)1997 of GoB;
(iii) Environmental and social safeguards according ADB's SPS 2009 and other relevant standards and guidelines of the ADB;

(iv) Proposed mitigation measures and monitoring procedures according to the environmental management plan (EMP), environmental monitoring plan as are applicable.

1.2 The Purpose of the Environmental Audit Assessment

7. The purposes of the Environmental Audit Assessment are:

(i) to identify present inadequacies in environmental management, and occupational health and safety issues in the facilities to be augmented;
(ii) to determine the need for remedial actions necessary to bring the subject facilities into compliance with ADB safeguard policies; and
(iii) to recommend actions to be taken to improve and strengthen PGCB's environmental, health, and safety management.

1.2.1 Scope of Work

8. The environmental audit assessment focused on the eight substations earmarked for augmentation as outlined above. The audit took place in November and December 2018.

1.2.2 Method and Approach

9. Reviewing all available relevant in-house documents including the following:

i. Development Project Proposal, Southwest Transmission Grid Expansion Project (February 2018);
ii. Power System Master Plan 2016, Power Division, Ministry of Power, Energy and Mineral Resources, supported by Japan International corporation Agency; and
iii. IFC, General and power transmission and distribution EHS guidelines.

1.2.3 Site Observation and Interview

10. Six substations were visited by a national environment expert in November and December 2018. The other three substations, Kaliganj, Gopalganj (North) and Patnitola substations are not yet constructed or under construction. During the visit, visual inspection was conducted and the critical issues using the prepared checklist were cross checked. The checklist identifies issues as per the following criteria as deduced from the guidelines mentioned above.

- General environmental management
- Waste management practices
- Hazardous material management
- Groundwater and soil contamination control
- Occupational health and safety management and
- Noise management

2. Environment Audit

11. This environmental audit was conducted in November and December 2018. The audit was based on criteria stipulated below:

- General environmental management
- Waste management practices
- Hazardous material management
- Groundwater and soil contamination control

- Occupational health and safety management and
- Noise management

12. These criteria were translated into a checklist (Table 2) which was used to identify issues of strength to the subject or issues that need corrective actions so as to meet the minimum required standard.

13. Substations which have been audited using the criteria above include the following.

14. **Purbasadipur substation:** Audit findings and the required remedial actions;

- The substation is earthed and has protective shields to minimize radiation and magnetic field effects.
- The substation has two transformers and oil circuit breakers, and use PCB.
- The substation is fenced and has warning signs to prevent the general public from being exposed to any risk of electrocution.
- Safety kits (PPE, fire extinguisher) are available in the substation site.

15. The substation needs improvements in the following areas:

- The substation needs the yard cleanness and appropriate waste handling and disposal practices.
- Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage through retrofitting proper impermeable bund to 110% capacity.

16. **Kustia substation:** Audit findings and the required remedial actions;

- The substation is earthed and has protective shields to minimize radiation and magnetic field effects.
- The substation has two transformers and oil circuit breakers, but none of these use PCB. The substation is PCB free.
- The substation is fenced and has warning signs to prevent the general public from being exposed to any risk of electrocution.
- Safety kits (PPE, fire extinguisher) are available in the substation site.

17. The substation needs improvements in the following areas:

- The substation needs the yard cleanness and appropriate waste handling and disposal practices.
- Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage through retrofitting proper impermeable bund to 110% capacity.

18. **Bagerhat substation:** Audit findings and the required remedial actions;

- The substation is earthed and has protective shields to minimize radiation and magnetic field effects.
- The substation has three transformers and oil circuit breakers, but none of these use PCB. The substation is PCB free.

- The substation is fenced and has warning signs to prevent the general public from being exposed to any risk of electrocution.
- Safety kits (PPE, fire extinguisher) are available in the substation site.

19. The substation needs improvements in the following areas:

- The substation needs the yard cleanness and appropriate waste handling and disposal practices.
- Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage through retrofitting proper impermeable bund to 110% capacity.

20. **Bandaria substation:** Audit findings and the required remedial actions;

- The substation is earthed and has protective shields to minimize radiation and magnetic field effects.
- The substation has two transformers and oil circuit breakers, but none of these use PCB. The substation is PCB free.
- The substation is fenced and has warning signs to prevent the general public from being exposed to any risk of electrocution.
- Safety kits (PPE, fire extinguisher) are available in the substation site.

21. The substation needs improvements in the following areas:

- The substation needs the yard cleanness and appropriate waste handling and disposal practices.
- Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage through retrofitting proper impermeable bund to 110% capacity.

22. **Niamatpur substation:** Audit findings and the required remedial actions;

- The substation is earthed and has protective shields to minimize radiation and magnetic field effects.
- The substation has two transformers and oil circuit breakers, and use PCB.
- The substation is fenced and has warning signs to prevent the general public from being exposed to any risk of electrocution.
- Safety kits (PPE, fire extinguisher) are available in the substation site.

23. The substation needs improvements in the following areas:

- The substation needs the yard cleanness and appropriate waste handling and disposal practices.
- Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage through retrofitting proper impermeable bund to 110% capacity.

24. **Satkhira substation:** Audit findings and the required remedial actions;

- The substation is earthed and has protective shields to minimize radiation and magnetic field effects.
- The substation has two transformers and oil circuit breakers, and use PCB.
- The substation is fenced and has warning signs to prevent the general public from being exposed to any risk of electrocution.
- Safety kits (PPE, fire extinguisher) are available in the substation site.

25. The substation needs improvements in the following areas:

- The substation needs the yard cleanness and appropriate waste handling and disposal practices.
- Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage through retrofitting proper impermeable bund to 110% capacity.

3. Corrective Action Plan (CAP)

26. Waste management and handling was seen to be a problem in all substations. Pieces of solid wastes (removed parts of transformers, scraps) had no specific and designated area for collection and eventual disposal. Substation facilities should designate special areas/ points for solid waste collection and collect all unwanted scraps for a safe disposal. Wastes such as pieces of cables, switch gears and other waste could have special bins. Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage. There was no written solid waste management system. Also, there were no written Health and Safety Plans or periodic practice carried out to prepare for emergencies. Personal Protective Equipment was insufficient.

27. To ensure used and scrap equipment/material are properly disposed after removal/replacement, it is recommended for hand-over procedures of equipment/projects to include an environmental checklist which prompts the disposal method. This is required to avoid new debris and waste/scrap being accumulated at the substations in the future, leading up to project implementation.

28. The corrective action plan should be completed before the commencement of bay extension work in all substations.

Table 1. Corrective Action Plan Proposed

S no	Issue	Corrective Action	By whom	By when
1	**Improvement of waste management facilities at the substations.** • No proper solid waste management • Scrap scattered at sites	• Wastewater discharges should avoid adverse impacts to the quality and availability of groundwater and surface water resources. • Avoiding or minimizing the generation waste materials, as far as practicable. Where waste generation cannot be avoided but has been minimized, recovering and reusing waste. Where waste	PGCB	Immediately

S no	Issue	Corrective Action	By whom	By when
		cannot be recovered or reused, treating, destroying, and disposing of it in an environmentally sound manner		
2	**Health and Safety of Staff** Staff to use personal protective equipment (PPE) at all times.	PPE (footwear, masks, protective clothing and goggles in appropriate areas) to be provided to the staff.	Staff and Contractor	Immediately
3	**Unsafe storage of material** Hazardous Transformer oil stored haphazardly with any bunding to prevent leakage to ground.	Prepare a bunded area to 110% for storage of transformer oil. Remedy the leakage into the ground. The transformers need to be protected against leaks and spill	PGCB	Immediately
4	**Health and Safety Equipment** H&S equipment such as incomplete first aid box, lesser quantities of fire buckets, fire extinguisher	PGCB to ensure complete kits, fire safety as well as fire alarms systems should be available at sites. The employer should ensure that qualified first-aid can be provided at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work. Eye-wash stations and/or emergency showers should be provided close to all workstations where immediate flushing with water is the recommended first-aid response.	PGCB	Immediately
5	**Handling emergencies**	Establishment of efficient E&H plans and emergency plans to ADB's satisfaction.	PGCB	Immediately
6	**Safety training and awareness raising program**	Conduct safety training and awareness workshop for staff and contrctors	PGCB	Immediately
7	**PCB**	Long term plan will be prepared prior to contract awarded to gradually phase out the PCB contained transformers. Surrounding soil and groundwater to be tested for presence of PCB and any contamination will be removed.	PGCB and Contractor	Plan prior to contract awarded

S no	Issue	Corrective Action	By whom	By when
		To retrofit proper impermeable bund to 110% capacity. Prior to final disposal, retired transformers and equipment containing PCB should be stored on a concrete pad with curbs sufficient to contain the liquid contents of these containers should they be spilled or leaked. The storage area should also have a roof to prevent precipitation from collecting in the storage area. Disposal should involve facilities capable of safely transporting and disposing of hazardous waste containing PCB		

4. Conclusion and Recommendations

29. PGCB has been found to be adequately responsive on environmental safeguards during the operation of existing facilities at substations. They have duly monitored the air, water and noise quality according to the requirement of EMP. The monitoring results have been found to be within the acceptable limit requiring no corrective measures.

30. The substations need the yard cleanness and appropriate waste handling and disposal practices. Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage. So, it is felt that PGCB requires to carry out corrective measure mentioned in the CAP for compliance in regards of EHS safeguards.

31. Based on the findings of environmental compliance audit, it can be concluded that PGCB is satisfactorily responsive in regard of complying with environmental safeguards during the operation and only the yard cleanness, collection and disposal of waste should be addressed before the commencement of activities planned under the Dhaka and Western Zone Transmission Grid Expansion Project (DWZTGEP).

Table 2. Environmental Audit Checklist for Electric Power Transmission and Distribution - Substations

<table>
<tr><th colspan="3">Guidelines Considered</th><th>Bagerhat 132 kV</th><th>Bandaria 132 kV</th><th>Kustia 132 kV</th><th>Niyamatpur 132 kV</th><th>Purbasadipur 132 kV</th><th>Satkhira 132 kV</th></tr>
<tr><td colspan="9">PCB oil in transformers and switchgear</td></tr>
<tr><td colspan="3">• Transformers with PCB</td><td>X</td><td>X</td><td>X</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td colspan="3">• Switchgear with PCB</td><td>X</td><td>X</td><td>X</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td colspan="3">• Safe disposal of PCB oil</td><td>NA</td><td>NA</td><td>NA</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• Prevention of PCB fires</td><td>NA</td><td>NA</td><td>NA</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• PCB Labelling</td><td>NA</td><td>NA</td><td>NA</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• PCB oil leakage</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• Retrofitting</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• PCB oil Storage</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="9">Use of SF_6 and other greenhouse/hazardous gases</td></tr>
<tr><td colspan="3">• Gas insulated switchgear</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• Gas insulated t/f</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• Presence of SF_6 in switchgear</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td colspan="3">• SF_6 retrieval arrangements</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="3">• Presence of other hazardous gases</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="9">Storage of liquid fuels, raw and in-process materials, solvents, wastes: to prevent spills, to prevent soil contamination and to prevent ground and surface water contamination</td></tr>
<tr><td colspan="3">• Containment, Dikes, and Berms (e.g. for transformers)</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• Storage facility</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• Drainage</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td colspan="3">• Oil leakage</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• Need for extra gravel</td><td>X</td><td>✓</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="9">Workplace air quality</td></tr>
<tr><td colspan="3">• Monitoring of workplace air quality</td><td>X</td><td>X</td><td>X</td><td>✓</td><td>✓</td><td>X</td></tr>
<tr><td colspan="3">• Good ventilation (ensure)</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td colspan="3">• Maintenance of air quality</td><td>✓AC</td><td>✓AC</td><td>✓AC</td><td>✓AC</td><td>✓AC</td><td>✓AC</td></tr>
<tr><td colspan="3">• Providence of respiratory equipment</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">• Enforcement of the application of personal protective equipment whenever exposure levels of fumes, solvents and other materials exceed threshold limit</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="9">Workplace noise</td></tr>
<tr><td colspan="3">• Noise control equipment</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="3">IFC/ EHS Noise levels</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ambient Noise (dB)</td><td>Day</td><td></td><td rowspan="2">Level within 45 dB limit</td><td rowspan="2">Level within 45 dB limit</td><td rowspan="2">Level within 45 dB limit</td><td rowspan="2">Level within 45 dB limit</td><td rowspan="2">Level within 45 dB limit</td><td rowspan="2">Level within 45 dB limit</td></tr>
<tr><td>Residential</td><td>55</td><td>45</td></tr>
</table>

Industrial	70	70						
• Maintenance of equipment			✓	✓	✓	✓	✓	✓
• Use of protective gear when noise level exceeds 85 dB			NA	NA	NA	NA	NA	NA
Other Physical Agents								
• Safe working area (absence of radiation, magnetic fields)			✓	✓	✓	✓	✓	✓
• Monitor regularly for radiation and field levels and equipment integrity (earthing, protective shields, lockouts etc.			✓	✓	✓	✓	✓	✓
Electrocution								
• Strict procedure for de-energizing before working on electrical equipment			✓	✓	✓	X	X	✓
• Training of personnel for safety procedures			✓	✓	✓	X	X	✓
Occupational health and safety guidelines								
• Physical factors in the workplace signage			✓	X	✓	✓	✓	✓
• Lighting (including security lights)			✓	✓	✓	✓	✓	✓
• Fire detection mechanism/equipment			X	X	X	X	X	X
• Firefighting equipment			✓	✓	✓	✓	✓	✓
• Cleanness (inside and outside substation)			✓	X	✓	✓	✓	✓
• First Aid Kit			✓	✓	✓	✓	✓	✓
• Features that pose safety risks (missing or broken slabs, dogged holes, etc.)			✓NI	✓NI	✓NI	✓NI	✓NI	✓NI
• Fence or enclosure of the site (Restriction of unauthorized people)			✓	✓	✓	X	X	✓
Welfare Facilities								
• Safe and clean drinking water			✓	✓	✓	✓	✓	✓
• Toilets			✓	✓	✓	✓	✓	✓
• TV/Radio/internet			✓	✓	✓	X	X	✓
• Guard kiosk			✓	✓	✓	✓	✓	✓
Personal Protective Equipment								
• Eye and face			✓	✓	✓	✓	✓	✓
• Head			✓	✓	✓	✓	✓	✓
• Hearing			✓	✓	✓	✓	✓	✓

• Hand	✓	✓	✓	✓	✓	✓
• Respiratory	X	X	X	X	X	X
• Leg and body	X	X	X	X	X	X
Ambient factors in the workplace						
• Noise	✓	✓	✓	✓	✓	✓
• Vibration	✓	✓	✓	✓	✓	✓
• Illumination	✓	✓	✓	✓	✓	✓
• Reflections	X	X	X	X	X	X
• Temperature	✓	✓	✓	✓	✓	✓
• Hazardous materials	✓	✓	✓	✓	✓	✓
• Biological agents	X	X	X	X	X	X
• Ionization radiation	✓	✓	✓	✓	✓	✓
Training and Documentation						
• Training (Learning materials, equipment and tools)	✓	✓	✓	X	X	X
• Training on operational hazardous and how to control the hazards	✓NI	✓NI	✓NI	X	X	✓NI
• Training on health risks, hygiene, and exposure prevention	✓NI	✓NI	✓NI	X	X	✓NI
• Training on accidents and accident prevention, protective equipment and clothing	✓NI	✓NI	✓NI	X	X	✓NI
Performance Monitoring						
• OHSMS organization policy	✓	✓	✓	✓	✓	✓
• Emergency prevention, preparedness and response	✓NI	✓NI	✓NI	✓NI	✓NI	✓NI
• Investigation of work-related injuries, ill health, disease and accidents	✓	✓	✓	✓	✓	✓
• Safety inspection, testing and calibration	✓	✓	✓	✓	✓	✓
Material handling (Hazardous and non-hazardous materials)						
• Storage	X	X	X	✓	✓	✓
• Labelling	X	X	X	✓	✓	✓
• Handling	✓	X	✓	✓	✓	✓
Solid Waste/Scraps						
• Handling	✓	X	✓	✓	✓	N/A
• Disposal	✓	✓	✓	✓	✓	N/A
Space for Expansion						
• Availability of space for expansion	✓	X	✓	✓	✓	✓

OHSMS- Occupational Health & Safety Management System

NA	Not Applicable,
✓	Yes/OK
X	No
✓t/f	Yes, on transformers
✓CB	Yes, on oil Circuit Breakers
✓AC	Yes, with air conditioners
✓NI	It is there, but Need Improvements
NI	Need Improvements
S/S	Substation
NT	Need Training
NR	Need some Repair
NM	Need Maintenance
✓Con	Yes, it is contaminated