Environmental Impact Assessment for Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District

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Acronyms and Abbreviations

AAQ	Ambient Air Quality
AEZ	Agro-Ecological Zone
BBS	Bangladesh Bureau of Statistics
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BOD	Biological Oxygen Demand
BRRI	Bangladesh Rice Research Institute
BWDB	Bangladesh Water Development Board
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSR	Corporate social responsibility
CW	Cooling Water
DAE	Department of Agricultural Extension
DC	Deputy Commissioner
DEM	Digital Elevation Model
DG	Director General
GPS	Global Positioning System
DO	Dissolve Oxygen
DOE	Department of Environment
DOF	Department of Fisheries
DPHE	Department of Public Health Engineering
EA	Environmental Assessment
ECA	Environment Conservation Act /Ecological Critical Area
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ETP	Effluent Treatment Plant
FY	Fiscal Year
GHG	Green House Gas
GIIP	Good International Industry Practice

GIS	Global Information System
HAZMAT	Hazardous Material
IEE	Initial Environmental Examination
IESCs	Important Environmental and Social Components
IMO	International Maritime Organization
IUCN	International Union for Conservation of Nature
KII	Key Informants Interview
KWh	Kilo Watt hour
LGED	Local Government Engineering Department
MoA	Ministry of Agriculture
MoEF	Ministry of Environment and Forestry
MoFL	Ministry of Fisheries and Livestock
MoPEMR	Ministry of Power, Energy and Mineral Resources
MoWR	Ministry of Water Resources
NEMAP	National Environmental Management Action Plan
NEP	National Environmental Policy
NGO	Non-Government Organization
NOC	No Objection Certificate
NOx	Oxides of Nitrogen
PAP	Project Affected Person
PCM	Public Consultation Meeting
PGCB	Power Grid Company of Bangladesh
PPE	Personal Protective Equipment
PPM	Parts Per Million
PPP	Public-Private Partnership
RS	Remote Sensing
SCC	Site Clearance Certificate
SOx	Oxides of Sulfur
SPM	Suspended Particulate Matter
SRDI	Soil Resource Development Institute
TDS	Total Dissolved Solid
ToR	Terms of Reference
UFO	Upazila Fisheries Office
UNDP	United Nations Development Program

UNO	Upazila Nirbahi Officer
USEPA	United State Environmental Protection Agency
WTP	Water Treatment Plant

Chapter 1

Executive Summary

Executive Summary

E-1 Introduction

Thakurgaon District is located along the Bangladesh-India border in the northern region of Bangladesh. A total of 08 rivers flow through this District, namely Kulik, Shuk, Tirnoi, Senua, Chhoto Senua, Aman Dhaman, Nona, and Lacchi river.

Among the rivers, Tangon, Kulik, and Nagar are transboundary rivers. Originating in Bangladesh, both the Tangon and Kulik rivers enter India respectively through Bairchura Union of Pirganj Upazila and Batuaria Union of Haripur Upazila of Thakurgaon District. The Nagar River originates in the West Bengal state of India and enters Bangladesh through Dhamor Union of Atwari Upazila in Panchagarh District and passes through the Haripur Union of Haripur Upazila in Thakurgaon District. The river flows for about 134.45 km along the Bangladesh-India Border and then again enters India.

In view of the above, the Bangladesh Water Development Board (BWDB) has plan to develop four combined water control structures and two irrigation canals in Thakurgaon District.

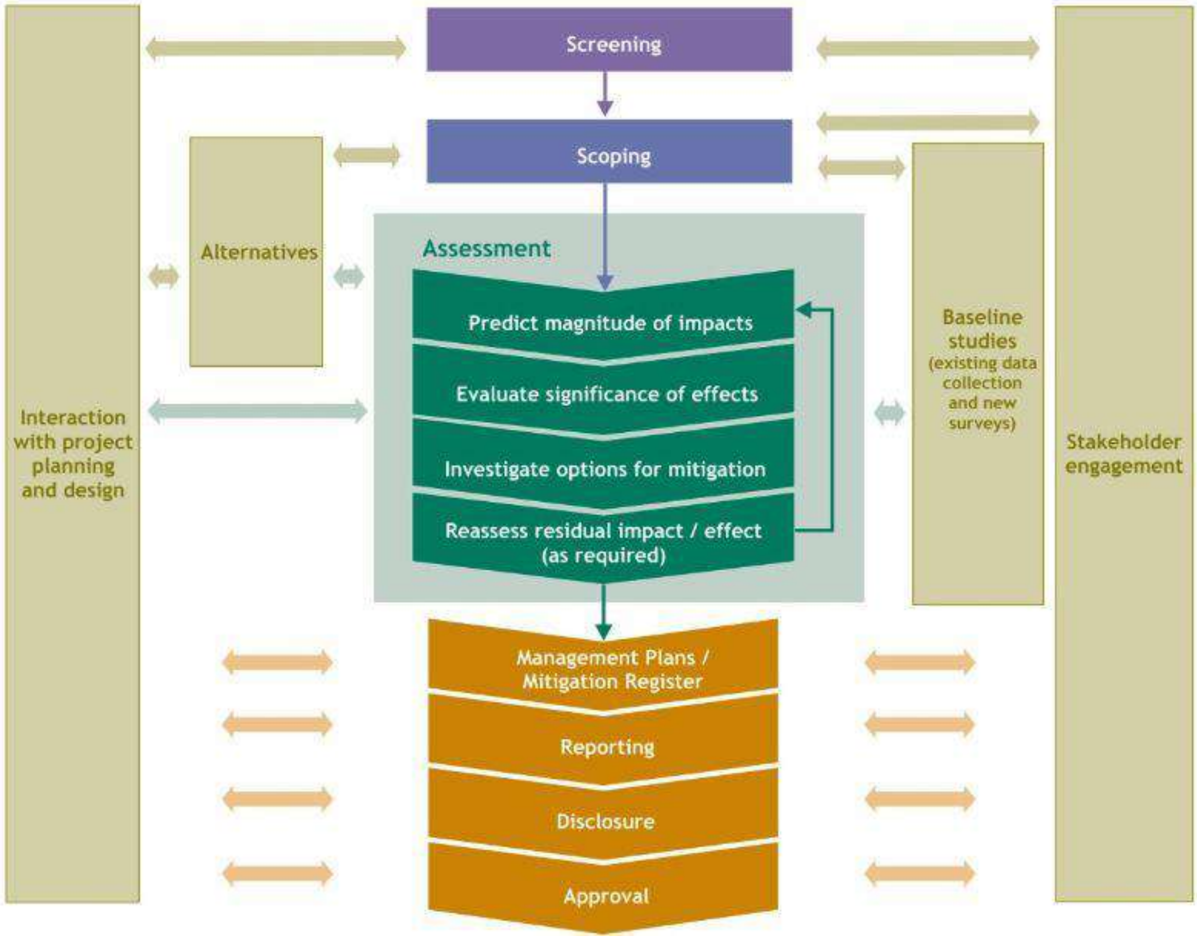
Bangladesh Water Development Board (BWDB) conduct the Environmental Impact Assessment (EIA) for this project. This EIA has been prepared in order to fulfill the requirement and conditions of the Government of Bangladesh (GoB), including those issued by DoE in the ToR. This EIA report is intended for submission to DOE to get Environmental Clearance (ECC) for the Project.

E-2 EIA Process, Approach and Methodology

Environmental Impact Assessment (EIA) is a systematic process that identifies and evaluates the potential impacts (positive and negative) that a proposed project may have on the physical, biological, and socio-economic environment. It identifies mitigation measures that need to be implemented in order to avoid, minimize, or reduce the negative impacts, and identifies measures to enhance positive impacts. The EIA is not fully a linear process, but one where several stages are carried out in parallel and where the assumptions and conclusions are revisited and modified as the project progresses. The following sections provide additional detail regarding the key stages in this EIA process.

Figure 0-1 below provides an outline of the EIA process. All steps are described in more detail in this EIA report.

Figure 0-1: Process for EIA



Source: Bangladesh Water Development Board (BWDB), 2024

E-3 Project Legal Aspects

Legal aspects of the Project are an important component of this EIA because legal aspects provide the rules, regulations and methods that should be applied to the Project and help to identify specific stakeholders. Ultimately, legal aspects also provide for the enforcement mechanisms that will regulate the Project activities and detail prescribed standards.

Relevant legislation, policies and guidelines of Bangladesh have been considered in this EIA where they apply to the proposed Project. The majority relates to aspects surrounding procedure, environmental management, and environmental performance. Analysis of the legal aspects of the Project has shown that it is a permissible activity which requires clearance by DOE. DOE has issued a ToR for conducting an EIA. This EIA report has been prepared on the basis of the terms of reference provided by DOE. Regulatory requirements are summarized as under:

- GoB Environmental Policy, Regulations, and Guidelines;
- National Environmental Policy, 1992;
- Environment Conservation Act, 1995 and subsequent amendments;
- Environment Conservation Rules, 2023;

- National Conservation Strategy, 1992;
- The EIA Guidelines for Industry, 2021;
- Relevant Other National Polices;
- Bangladesh Labor Law, 2006;
- Applicable EHS standards.

The activities of proposed project fall under the "Red‟ category according to the Bangladesh Environment Conservation Rules (ECR) 2023. All applicable national and international frameworks have been described under Chapter-2.

E-4 Project Description

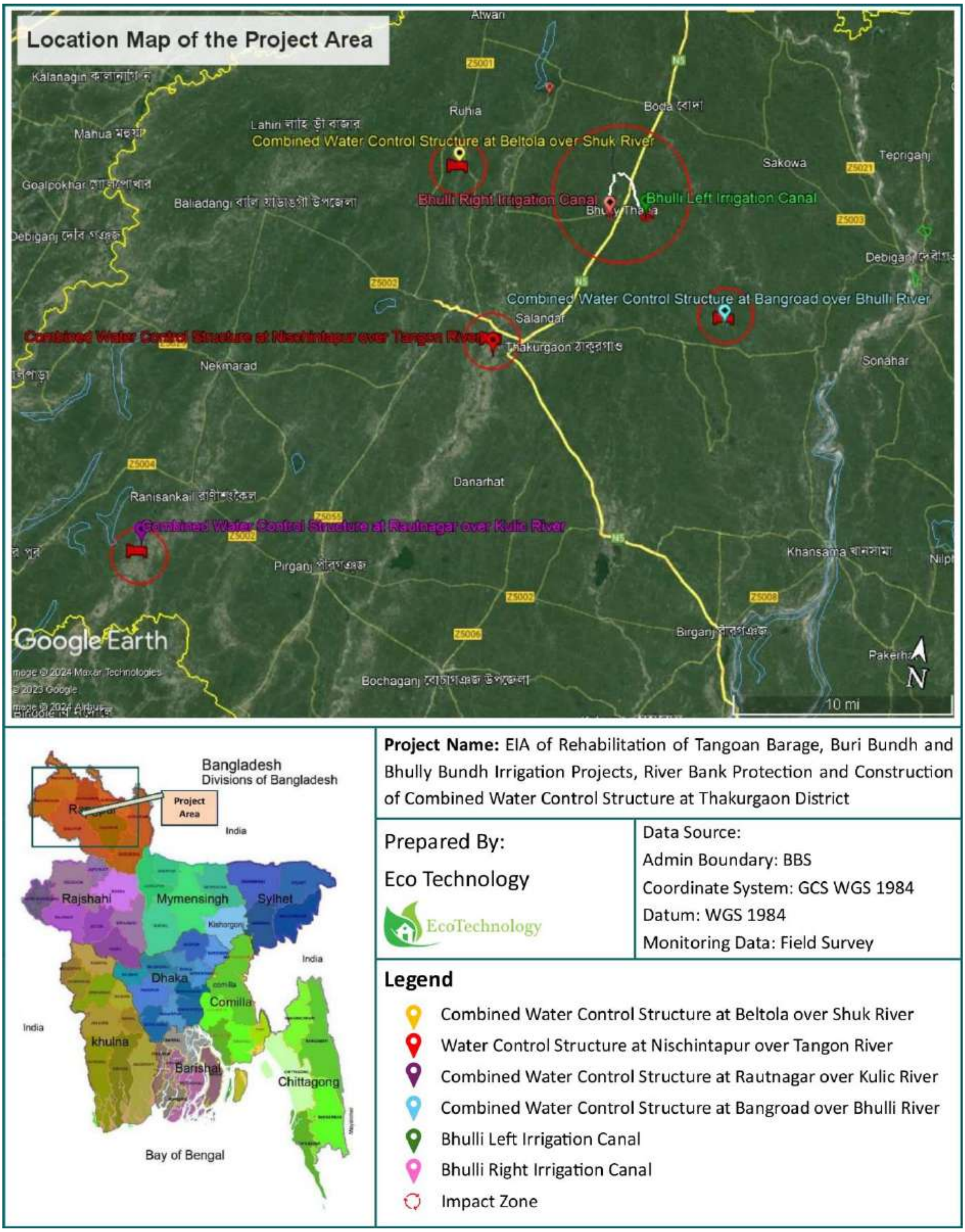
The Bangladesh Water Development Board planned to implement the Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District. The following Table 0-1 shows the basic information of the proposed project.

Table 0-1: Key Project Information

Name of the project	Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District
Sponsoring Ministry/ Division	Ministry of Water Resources
Implementing Agency	Bangladesh Water Development Board (BWDB)
Deputy Project Director	Md. Golam Zakaria
Total Project Cost	33625.13 lac Taka
Land Requirements	21.61 Acres
Project Category (Based on Environment Conservation Rules 2023)	Red
Address	Thakurgaon Thakurgaon
Project Duration	4 Years

Source: Bangladesh Water Development Board (BWDB), 2024

Figure 0-2: Location Map of Project Area



Source: Bangladesh Water Development Board (BWDB), 2024

E-5 Description of the Existing Environment

The description of the existing environment provides the baseline case against which any potential impacts of the Project can then be assessed. 2KM radius of AOI for Combined Water Control structure at Nischintapur on the Tangon River, Combined Water Control structure at Bangroad on the Bhulli River, Combined Water Control structure at Beltola on the Shuk River, Combined Water Control structure at Rautnagar on the Kulic River and 5KM radius of AOI for Extension of Left and Right Bhulli Irrigation canal from the Project site has been the main focus for assessment of the existing environment. The environmental aspects of the Project area are presented covering physical environments (i.e., soils, air quality, water quality etc.) and biological environments (i.e., flora, fauna and ecological aspects) are presented.

The baseline information was collected from both primary and secondary sources. Monitoring of ambient air and noise quality has been done and also surface and ground water samples has been collected and analyzed.

E5.1 Physical Environment

Physiography: According to the Physiography of Bangladesh, the proposed project area falls in the “Old Himalayan Piedmont Plain”and “Tista Floodplain” Physiography unit area.

Geology: According to the Geological Survey of Bangladesh (GSB), the proposed project area falls in the “Old Gravelly Sand” formations geological unit area.

Topography: Topographic features in the study area where the average elevation range is in between 18-89m.

Land Use/Cover: The predominant land use-land cover of the study area includes agricultural land, Settlement, Road Networks, Homestead Vegetation, Vacant Land, Waterbody, and Vegetation. Details of land cover has incorporated in section 4.2.1.

Soil: Soil of the study area is the Noncalcareous Brown Floodplain soils, Noncalcareous Dark Grey Floodplain Soils and Black Terrain Soils.

Hydrology and Drainage: The hydrological regime of the proposed project area is governed by the Kulik, Shuk, Tirnoi, Senua, Chhoto Senua, Aman Dhaman, Nona, and Lacchi river.

Meteorology:

Temperature: The monthly average temperature data of the last 30 years (1993-2022) shows that the maximum temperature varies from 26.99°C to 37.6°C and May is the warmest month, while the minimum temperature varies from 6.81°C to 24.50°C and January is the coldest month at Dinajpur station.

Humidity: The analysis of the Relative Humidity (RH) data for the period from 1993 to 2022 indicates that the average RH varies seasonally from a minimum of 66.70% in March to a maximum of 85.46% in September.

Rainfall: The monthly maximum and average rainfall data of the last 30 years (1993-2022) was collected, analyzed and shown in Figure 4-11. The analysis of data shows that the monthly average rainfall varies from 143.51 mm to 369.66 mm in monsoon and the area received the maximum of 1026 mm rainfall in September 1995. The historical maximum annual rainfall of this station was recorded as 2771 mm in 2020, the minimum was 921 mm in 2018, and the average annual rainfall is 1867 mm.

Wind Speed: The data of maximum wind speed of the last 30 years (1993 to 2022) shows that the monthly maximum wind speed of 64.82 km/hour occurred in May 2009. On the other hand, the average of maximum wind speed varies from 6.63 km/hour in November to 12.93 km/hour in March.

E5.2 Environmental Quality

Air Quality: Five locations, all parameters are at an acceptable limit.

Ambient Noise Levels: Seven locations, all noise levels are within an acceptable limit.

Surface Water Quality: Three samples, tested parameters are in acceptable limit. The water quality of the river water samples reveals that it is usable for all purposes as per ECR 2023-Schedule 2 (a).

Ground Water Quality: Three samples were collected from the study area. Tested parameters are in acceptable limit.

Soil Quality: Three samples, tested all parameters are to an acceptable limit.

E5.3 Biological Environment

Bio-ecological Zone: The project AOI has fallen under Himalayan Piedmont Plain Bio-Ecological Zone (IUCN, 2002).

Natural Disaster:

Climate Change: According to the climatic sub-regions of Bangladesh, the project area is in the North-Western Region. This area has no particular risk from climate change.

Floods: the proposed project area is located in the Low Flash Flooding prone area.

Earthquake: The proposed project area falls under the seismic zone of the project site is in Zone-2 means the medium vulnerable to seismic risks.

Cyclone and Storm Surges: The project site is in the North-Western part of Bangladesh which lies with the no risk zone in terms of cyclonic events.

E6 Socio-economic Environment

There are 1,381,583 people (Ref: Population and Housing Census 2011) and 318,860 households in the entire study area. Of the total population 697,021 (50.45%) are male and 684,562 (49.55%) are female, meaning that the male population is higher than the female population. The average sex ratio of males and females in these Upazilas is 101.8:100, which is higher than the national figure of 100.3:100 (BBS 2011), meaning that there are 101.8 males against 100 females. The average density of the population is 754 persons per sq. km, which is much lower than the national density of 1,015 persons per sq. km.

Table 0-2: Demographic Data of the Study Area

Upazila	HHs	Population			Sex Ratio	Population density [sq. km]	Growth Rate
		Both	Male	Female			
Baliadangi	44,941	192,613	97,536	95,078	103	686	1.38
Haripur	31,781	144,198	72,332	71,865	101	736	1.41

Pirganj	58,052	242,503	122,034	120,469	101	688	1.2
Ranisankail	50,822	221,288	111,692	109,596	102	773	1.24
Thakurgaon Sadar	133,264	580,981	293,427	287,554	102	887	1.41
Total/average	**318,860**	**1,381,583**	**697,021**	**684,562**	**101.8**	**754**	**1.33**

Source: Population and Housing Census 2011, (BBS- 2012)

All the population will be impacted indirectly as along with positive (Job opportunities, Income generation activities etc.) and negative (dust generation from transportation vehicles, road accident in the approach road etc.) consequence by the implementation of the Project.

E-7 Analysis of Potential Alternatives

The project has been considered and investigated for several alternatives to reduce the environmental and social impacts. The alternatives assessed were not limited to environmental and social aspects, but the assessment also included the technical aspects of different options.

The Project has considered alternatives in terms of site location, design, and technology options. An analysis of these alternatives has been undertaken for the proposed Project including consideration of a no-Project scenario. The no-go option, or not building the proposed project, is based on the supposition that the project won't proceed. No environmental or social repercussions would be caused by this choice of location or neighborhood. It serves as the standard against which other options are measured and will be considered throughout the report.

E-8 Impact Identification and Analysis

Table 0-3: Impact Identification Matrix for the Proposed Project

Project Activities	Potential Impacts																														
	Physical Resources												Biological Resources				Socio-economic Resources								Health and Safety						
	Air Quality	Noise	Vibration	Surface water resource	Surface water quality	Groundwater resource	Groundwater quality	Soil resources	Sediment quality	Land use	Drainage pattern	Aesthetics	Vegetation/forest cover	Wildlife	Aquatic fauna	Protected areas	Demographic (incl. Physical displacement)	Economy and livelihood	Social and cultural structure	Economic displacement	Infrastructure and service	Cultural resources	Education and skills	Agriculture/cash crops	Occupational Health and Safety	Public transportation	Communicable/non-communicable disease	Vector-borne disease	Sexually transmitted disease	Community Health	Vulnerable groups
Construction Phase																															
Site clearing and leveling	✓	✓			✓				✓																						
Transportation and storage of construction materials and equipment	✓	✓			✓			✓							✓											✓					
Civil construction activities	✓	✓	✓		✓		✓	✓	✓					✓	✓										✓						
Construction of bore wells	✓	✓				✓		✓																							
An influx of labor and the construction of temporary houses					✓	✓																					✓	✓	✓	✓	
Storage, handling, and disposal of construction debris					✓		✓	✓							✓													✓			
Generation of domestic waste and discharge					✓		✓	✓							✓															✓	
Sourcing of construction water and domestic water				✓											✓																

Project Activities	Potential Impacts																														
	Physical Resources												Biological Resources				Socio-economic Resources								Health and Safety						
	Air Quality	Noise	Vibration	Surface water resource	Surface water quality	Groundwater resource	Groundwater quality	Soil resources	Sediment quality	Land use	Drainage pattern	Aesthetics	Vegetation/forest cover	Wildlife	Aquatic fauna	Protected areas	Demographic (incl. Physical displacement)	Economy and livelihood	Social and cultural structure	Economic displacement	Infrastructure and service	Cultural resources	Education and skills	Agriculture/cash crops	Occupational Health and Safety	Public transportation	Communicable/non-communicable disease	Vector-borne disease	Sexually transmitted disease	Community Health	Vulnerable groups
Operation Phase																															
Transportation	✓	✓			✓																					✓				✓	
Maintenance (cleaning, oil change, lubrication, etc.)					✓		✓	✓							✓																
Extraction of water						✓																									
Waste generation					✓		✓	✓							✓															✓	
Domestic waste or domestic use of water					✓		✓	✓							✓															✓	

Impact evaluation due to the proposed project during the construction and operation phases has been shown in Table 0-4 and Table 0-5, respectively.

Table 0-4: Impact Significance During the Pre-construction and Construction Phase

Issues/ Components	Impacts	Scenario	Impact Nature	Geographical Extent	Duration	Scale	Probability	Significance
Air Quality	Dust generation and exhaust emissions	Without Mitigation	Direct	Local	Short-term	Medium	High	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
	Increased Vehicular Emissions	Without Mitigation	Direct	Local	Short-term	Medium	Medium	Negligible
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Water Resources	Surface water quality	Without Mitigation	Direct	Local	Short-term	Medium	High	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
	Groundwater quality	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Ambient Noise	Noise from construction activity and vehicle movement	Without Mitigation	Direct	Local	Short-term	Medium	High	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Soil Quality	Soil contamination from waste and spillage	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Drainage	Impact on Drainage System	Without Mitigation	Direct	Local	Short-term	Medium	Medium	Negligible
		With Mitigation	Direct	Project Site	Medium-term	Low	Low	Negligible
Biodiversity	Terrestrial and aquatic flora	Without Mitigation	Direct	Local	Short-term	Low	Medium	Negligible
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
	Terrestrial fauna	Without Mitigation	Direct	Local	Short-term	Medium	High	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
	Fisheries and aquatic	Without Mitigation	Direct	Local	Short-term	Medium	Low	Negligible

Issues/ Components	Impacts	Scenario	Impact Nature	Geographical Extent	Duration	Scale	Probability	Significance
	ecosystem	With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Impacts Due to Waste Generation	Soil and water pollution	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Impacts due to Increase Traffic	Traffic Condition	Without Mitigation	Direct	Local	Short-term	Low	Medium	Negligible
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Occupational Health and Safety	Worker's health, sanitation, and safety	Without Mitigation	Direct	Project site	Long-term	High	High	Minor
		With Mitigation	Direct	Project site	Short-term	Low	Low	Negligible
Community Health and Safety	• Changes in environmental quality • Transmission of infectious diseases • Traffic movement on the site approach road	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible

Table 0-5: Impact significance during the operation phase

Issues/ Components	Impacts	Scenario	Impact Nature	Geographical Extent	Duration	Scale	Probability	Significance
Air Quality	Dust generation and exhaust emissions	Without Mitigation	Direct	Local	Long-term	Low	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Insignificant	Unlikely	Negligible
	Increased Vehicular Emissions	Without Mitigation	Direct	Local	Long-term	Low	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Insignificant	Unlikely	Negligible
Water Resources	Surface water quality	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible

Issues/ Components	Impacts	Scenario	Impact Nature	Geographical Extent	Duration	Scale	Probability	Significance
	Groundwater quality	Without Mitigation	Direct	Local	Long-term	Low	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Insignificant	Low	Negligible
Ambient Noise	Noise from vehicle movement	Without Mitigation	Direct	Local	Long-term	Low	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Insignificant	Unlikely	Negligible
Soil Quality	Soil contamination from waste and spillage	Without Mitigation	Direct	Local	Long-term	Medium	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Unlikely	Negligible
Drainage	Impact on Drainage System	Without Mitigation	Direct	Local	Medium-term	Medium	High	Minor
		With Mitigation	Direct	Local	Medium-term	Low	Low	Negligible
Biodiversity	Terrestrial and aquatic flora	Without Mitigation	Direct	Local	Long-term	Medium	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
	Terrestrial fauna	Without Mitigation	Direct	Local	Long-term	Medium	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
	Fisheries and aquatic ecosystem	Without Mitigation	Direct	Local	Long-term	Medium	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
Impacts Due to Waste Generation	Soil and water pollution	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
Impacts Due to Increases in Traffic	Traffic Congestion	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
Impact on Land Environment	Soil pollution by waste and spillage of chemical (Oil)	Without Mitigation	Direct	Local	Long-term	Low	Medium	Minor
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
Occupational	Worker's health,	Without Mitigation	Direct	Project site	Long-term	Insignificant	High	Minor

Issues/ Components	Impacts	Scenario	Impact Nature	Geographical Extent	Duration	Scale	Probability	Significance
Health and Safety	sanitation, and safety	With Mitigation	Direct	Project site	Long-term	Insignificant	Low	Negligible
Community Health and Safety	Impact on community health due to environmental change	Without Mitigation	Direct	Local	Long-term	Low	Medium	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
	Impact on health due to increasing prevalence of diseases	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible

E-9 Environmental and Social Management Plan

The environment and social management plan have been developed for the proposed with an aim to avoid, reduce, mitigate or compensate for adverse environmental and social impacts and to propose enhancement measures. They are:

- Mitigation of possible adverse impacts;
- Monitoring of impacts (environmental and social) and mitigation measures during different phases (construction and operation) of the proposed project.
- Institutional capacity building and training; and
- Compliance with the legal requirements.

E9.1 Mitigation Measures

The environmental and social management plan (ESMP) has been recommended to highlight the action procedures to avoid/minimize/control the impacts arising out of different projects. The ESMP is elaborately described as a matrix in Chapter-8 of this report.

E9.2 Monitoring Plan

In accordance with the ESMP, an environmental and social monitoring plan has been developed and presented in Chapter-8.

E9.3 Institutional Setting and Implementation Arrangement

The BWDB staff, specifically the EHS team will monitor the implementation of these mitigation measures at the site. The EHS team will be responsible for the field level monitoring of the Project.

E-10 Stakeholder consultation

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

Outcomes from this consultation showed that the community was generally supportive of the proposed Project and that the community believed that Project would bring some benefits to them and the local area. Such perceived benefits included the potential for local employment relating to the Project and the potential that infrastructure investment in the local area may occur as a result of the Project.

Three public consultation meeting (PCM) was held on Bangroad, Rautnaga and Beltola project locations. The proceedings commenced at 12:30 PM on 15/05/2024 at Beltola and at 11.30AM on 16/05/2024 at Bangroad and at 2.30PM on 18/05/2024 at Rautnaga. The meeting was attended by a total of 60 people for three PCM, which represent local people, student, farmer, teacher, senior citizen and local administrative representative. The public consultation meeting minutes has been given in Table 9-2. The photographs of the public consultation meeting are shown in Figure 9-1 and the attendance sheet is given in Annex-J in this EIA report.

Four Focus Group Discussions were held with the local people at Bangroad, Rautnaga, Nischintapur and Beltola. The summary of Focus Group Discussion (FGD) is shown in Table 9-4. Photographs is shown in Figure 9-2 and attendance sheets of FGDs are shown in Annex-J.

Key concerns that government stakeholders and local people were found to have about the Project included safety aspects of the Project, the potential for pollution to occur and that there might be some damage caused to local roads or other infrastructure during construction. This EIA has addressed each stakeholder's concern with the development of specific mitigation and management measures. Details of stakeholder engagement and consultation are given in chapter 9.

E-11 Emergency Response Plan and Occupational Health and Safety

The Emergency Response Plan includes any measures that should be in place at all facilities to combat an accident resulting from fire, explosion or due to any natural calamities (e.g., Earthquake, cyclones and flood). This Emergency Response Plan has been developed to provide an organizational and procedural framework for the management of emergencies in the project. The purpose of an ERP is to facilitate and organize employer and employee actions during workplace emergencies. Well-developed emergency plans and proper employee training (such that employee understands their roles and responsibilities within the plan) will result in fewer and less severe employee injuries and less structural damage to the facility during emergencies.

The main laws related to occupational health and safety in this country is the Factory Act 1965, the Factory Rule of 1979, the Fatal Accidents Act, 1855, the Fire Resist and Extinguish Act 2003, the Fire Prevention and Protection Act, 2003, the Boiler Act 1923, and the Bangladesh Labor Law 2006, etc.

The following hazards may occur in the proposed project life cycle.

- Physical hazards
- Fire
- Explosion
- Electrocution
- Natural and manmade hazards

The general occupational health and safety aspects are as follows -

- Heating, ventilation, and light
- Falling/impact with an object
- Types of vehicles: crane, trailer, forklift, covered van, container truck, truck, etc.
- Types of storage materials: pipes, valves, cables, etc.
- Wastewater, drainage, and solid waste
- Good order, storage areas, and waste materials
- Site access, site boundaries
- Welfare facilities
- Sanitary and toilet facilities
- Washing facilities
- Rest facilities
- Standards for nutrition and food safety.

E-12 Conclusion and Recommendation

The project involves a proposal to implement Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control

Structure at Thakurgaon District under Bangladesh Water Development Board. This EIA presents a comprehensive assessment of the potential impacts associated with the project. The EIA also identifies and develops specific management and mitigation measures to address each potential impact. Residual risks have then been assessed and quantified to determine the potential effectiveness of the proposed management and mitigations, focusing on reducing the significance of the identified potential impact.

Feedback about the project from consultation with government and community stakeholders has been generally positive. Support for the Project and useful information was provided by government stakeholders and there was a consensus amongst the community that the proposed project is in the nation's interest.

This EIA has identified that there are minor negative environmental and social impacts as a result of the project. However, this EIA has also determined that if comprehensive and effective management and mitigation measures are implemented as proposed, the negative impacts should be reduced to non-significant level.

This EIA has been developed to identify and comply with relevant GoB legislation, specifically the Environment Conservation Act 1995 and the Environment Conservation Rules 2023.

Based on the analysis conducted in this environmental and social assessment, it is concluded that overall, the Project will result in positive socio-economic benefits and the negative environmental impacts that have been identified are mostly short-term and localized in nature, and can be minimized adequately through good design, appropriate application of mitigation measures, monitoring and regular supervision of implementation.

An Environmental Clearance Certificate (ECC) will be required for the Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District in favor of Bangladesh Water Development Board (BWDB).

Recommendations

The following recommendations are made based on EIA study that should be considered for achieving the goal of minimum environmental and social impact and maximum benefits:

- Findings and suggestions of the EIA study of the proposed project should be considered and implement in different stage of the project with strong monitoring.
- Income and employment opportunities for the local community and strengthen the CSR activities for the local community.
- Environmental Management Plan and Hazard and Safety Management Plan should be implemented at every suggested step of construction and operation.
- Establishing Institutional arrangement with proper logistics and training for Environment, Health and Safety in Project Management Unit during three phases of the project.
- Discharge of wastewater should be in accordance with DOE, Environment Conservation Rules 2023.

Chapter 1

Introduction

1 Introduction

1.1 Background

Thakurgaon District is located along the Bangladesh-India border in the northern region of Bangladesh. A total of 08 rivers flow through this District, namely Kulik, Shuk, Tirnoi, Senua, Chhoto Senua, Aman Dhaman, Nona, and Lacchi river.

Among the rivers, Tangon, Kulik, and Nagar are transboundary rivers. Originating in Bangladesh, both the Tangon and Kulik rivers enter India respectively through Bairchura Union of Pirganj Upazila and Batuaria Union of Haripur Upazila of Thakurgaon District. The Nagar River originates in the West Bengal state of India and enters Bangladesh through Dhamor Union of Atwari Upazila in Panchagarh District and passes through the Haripur Union of Haripur Upazila in Thakurgaon District. The river flows for about 134.45 km along the Bangladesh-India Border and then again enters India.

The characteristics of the rivers of Thakurgaon District are that the rivers possess relatively lower average depth and steeper bed slopes. Tangon, Shuk, Lacchi, Nona, Nagar, Kulik, Pathraj, and Bhulli rivers are experiencing sedimentation problems triggering bank erosion. The water storage capacity of these rivers is decreasing due to sedimentation, which causes a negative impact on the irrigation facilities of the area especially in the dry season. The Tangon Barrage Irrigation Project, Buribadh Irrigation Project, Bhulli Irrigation Project, and Rahmatpur FCDI project are totally dependent on these rivers. Therefore, the water-carrying capacity of these rivers needs to be increased. The existing flood embankment along the left bank of the Nagar.

In view of the above, the Bangladesh Water Development Board (BWDB) has plan to develop four combined water control structures and two irrigation canals in Thakurgaon District.

Bangladesh Water Development Board (BWDB) conduct the Environmental Impact Assessment (EIA) for this project. This EIA has been prepared in order to fulfill the requirement and conditions of the Government of Bangladesh (GoB), including those issued by DoE in the ToR. This EIA report is intended for submission to DOE to get Environmental Clearance (ECC) for the Project.

1.2 Brief Description

The Bangladesh Water Development Board (BWDB) has plan to develop four combined water control structures and two irrigation canals in Thakurgaon District. The Bangladesh Water Development Board (BWDB) has proposed and initiated a project named "Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District."

Name of the Four Water Control Structure are as follows:

1) Combined Water Control Structure at Nischintapur over Tangon River
2) Combined Water Control Structure at Bangroad over Bhulli River
3) Combined Water Control Structure at Beltola over Shuk River
4) Combined Water Control Structure at Rautnagar over Kulic River

Name of the Two Irrigation Canals are as follows:

1) Bhulli Left Irrigation Canal

2) Bhulli Right Irrigation Canal

The project has been split into three project stages:

- Stage 1: Pre-Construction Phase
- Stage 2: Construction Phase
- Stage 3: Operation Phase

1.3 Objectives of the EIA Study

This EIA report has been prepared keeping in view the requirement of DOE and Bangladesh Water Development Board (BWDB). The objectives of this EIA are as following:

- A review of the environmental legislative, regulatory and policy guidelines and considerations relating to the implementation of the project;
- A general description of the project and existing physical, biological and socio-economic conditions;
- Analysis of different alternatives to the project in terms of environmental and social perspectives;
- Identification and assessment of the potential impacts on the natural and human environment in the project area, from the construction of the project;
- Consultation with the locals/stakeholder involving concerned people in order to identify and act on any undocumented or perceived environmental issues;
- Identification of mitigation measures including monitoring framework in the form of an Environmental and Social Management Plan (ESMP).
- Identification of mitigation measures in the form of an Environmental and Social Management Plan (ESMP) Approach and Methodology; and
- Formulation of public and stakeholder consultation for the proposed project;
- Preparing Emergency Response Plan & Disaster Management Plan of the project
- Preparing Occupational Health and Safety Procedure,
- Recommendations and conclusions in order to operate the project works in an environmentally safe and sound manner, and
- Preparation of the EIA report based on DOE approved TOR for obtaining ECC from the DOE, Bangladesh.

1.4 Scope of EIA Study

1.4.1 Applicable Reference Framework

The main environmental regulations in Bangladesh are the Environment Conservation Act (ECA) 1995 (amended 2000, 2002, 2007 and 2010) and Environment Conservation Rules (ECR) 2023. ECA 1995 provides the requirements on environmental protection, improvement of environmental standards, and control and abatement of environmental pollution.

ECR 2023 provides for the declaration of ecologically critical areas, categorization of industries and projects and identified types of environmental assessments needed against respective categories of industries or projects. ECA 1995 and ECR 2023 outline the regulatory mechanism to protect the environment in Bangladesh.

Bangladesh Water Development Board (BWDB) in Bangladesh are working with following all the relevant national and international environmental standards and guidelines as listed below:

- Environment Conservation Act (ECA) 1995 (amended 2000, 2002, 2007 and 2010) and
- Environment Conservation Rules (ECR) 2023 of Bangladesh.
- The National Environmental Quality Standards for ambient air, Surface and ground water, industrial effluent, emission, noise level, etc.

1.4.2 Scope of Work

This report fulfills the requirements of the EIA under the ECR, 2023 and has been prepared in accordance with the approved TOR (Appendix B) by the DOE. The detailed scope of the EIA study is as outlined below:

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

1.5 Approach and Methodology

The Study has been undertaken following a systematic process that predicts and evaluates impacts the Project could have on aspects of the physical, biological, socio-economic and cultural environment. Furthermore, it identifies measures that the Project will take to avoid, minimize and reduce, mitigate, offset or compensate for adverse impacts and to enhance positive impacts where practicable. The Study methodology follows the overall impact assessment approach illustrated in Figure 1-1.

1.5.1 Approach for the EIA Study

The approach and methodology adopted for screening and scoping of the project is discussed below, while the approach and methodology for baseline data collection and assessment has been described in the beginning of the respective chapters of the Report.

The EIA of the project will follow the following processes:

Screening Study:

The proposed project falls under the "Red" Category as per the Environment Conservation Rules, 2023, therefore, would require ECC from the DOE based on EIA, carried out as per the approved terms of reference for the EIA study;

Data Collection of Environmental and Social Baseline Conditions:

Data Collection of Environmental and Social Baseline Conditions against which the assessment will be undertaken;

Stakeholder Consultation and Disclosure:

Consult with stakeholder and integrate their views into the project design and mitigation;

Impact Identification and Evaluation:

Systematically predict and evaluate the positive and negative changes in these baseline conditions. All impacts and benefits of the project should be documented and fully explained within the EIA report.

Mitigation Measure:

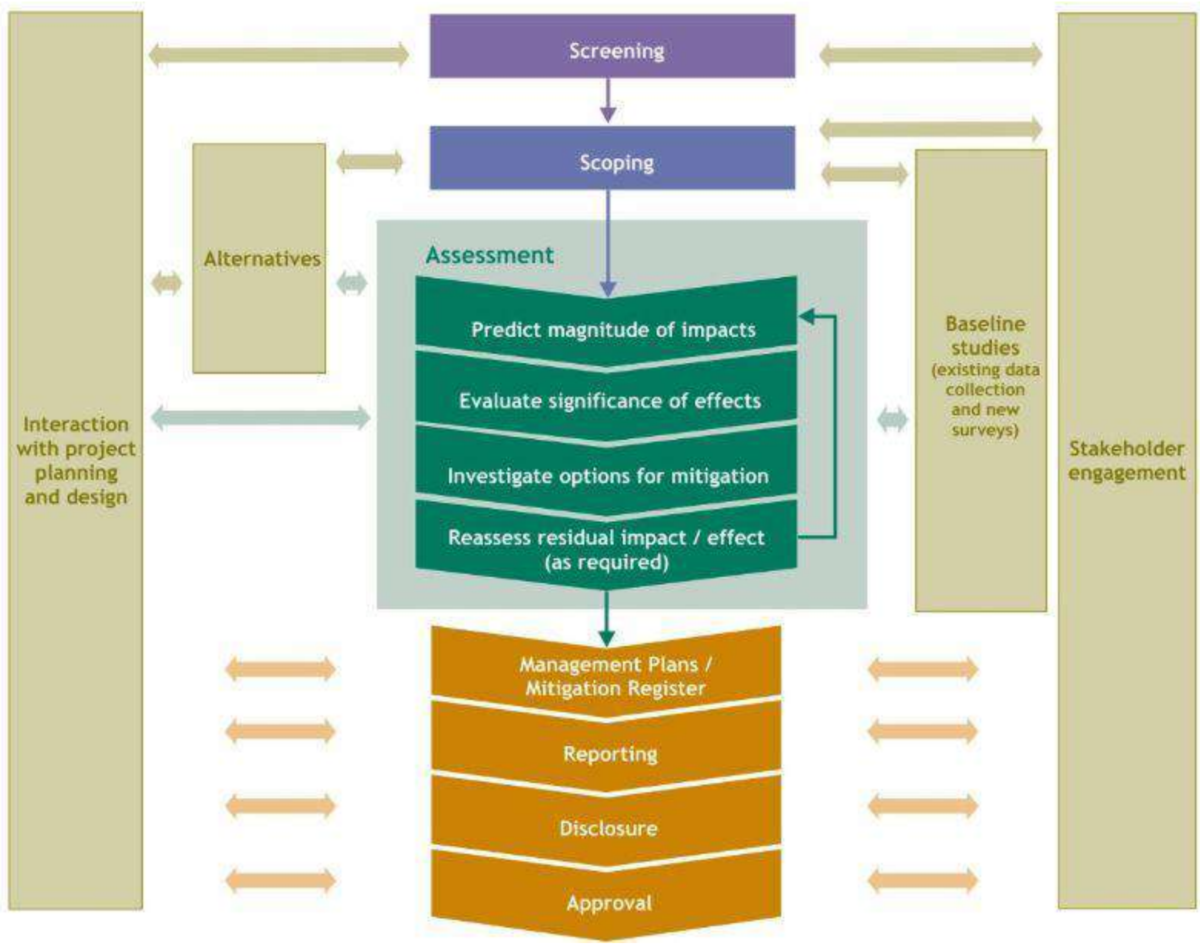
Identify the mitigation measures that the client will take to avoid, reduce, remedy offset, or compensate for adverse impacts, and to provide or enhance benefits from the project.

Develop an Environmental Management Plan (EMP):

A details EMP will develop for the project in three phases of the project.

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

Figure 1-1: Approach to the EIA Study of the Project



Source: Bangladesh Water Development Board (BWDB)

1.5.2 Methodology for the EIA Study

To attain the earlier mentioned scope of work, the EIA study was based on the collection of primary and secondary baseline information, impact assessment, and delineation of EMP. The methodology was followed to complete the EIA study for the selected project is divided into the following tasks as presented in Table 1-1 and elaborated in subsequent sections.

Table 1-1: Tasks Undertaken for the EIA Study

Tasks	Task
Task-1	Meeting with EIA Team
Task-2	Writing Project Description
Task-3	Colleting Environmental and Social Baseline Conditions
Task-4	Conducting Environmental Impact Assessment
Task-5	Development of EMP
Task-6	Preparation of Draft EIA Report
Task-7	Preparation of Final EIA Report

1.5.2.1 Task-1: Meeting with EIA Team and Team Mobilization

A kick-off meeting was held with the EIA Team and Bangladesh Water Development Board (BWDB) officials for understanding and major objectives of the project, project details, activities, current status, project milestones, legal requirements, scope, etc.

1.5.2.2 Task-2: Preparing Project Description

A section on the project description was prepared. This was developed to a level of detail needed to adequately understand potentially significant project impacts. This covered project location, size, life, schedule, implementation arrangements, and information inventories and maps using appropriate scales. Also, identify components of key environmental indicators on physical, biological, and social environments.

1.5.2.3 Task-3: Collecting Environmental and Social Baseline Conditions

The EIA team was engaged to carry out environmental and social baseline data collection during May 2024. Socio-economic data collection and consultations with the local community and other government departments were conducted at the same time. Secondary data were collected from different government departments, local bodies, and through literature review, etc. All the data were compiled and compared with applicable standards where relevant and was presented in the EIA report. Environmental baselines study the following:

- Meteorological data at the project site;
- Ambient Air Quality;
- Ambient Noise Level;
- Water Resources and Quality - both surface and groundwater;
- Soil Quality;
- Ecology - covering terrestrial and aquatic flora and fauna, habitats, and ecologically sensitive spots within the project site and surrounding areas;
- Road network and Traffic factor;
- Prevailing land use; and
- Socio-economics, Health, and Aesthetics.

1.5.2.4 Primary Baseline Data Collection

With the assistance of the client, EIA Team has identified an accredited environmental laboratory of repute which was engaged in the analysis of the collected environmental quality samples on ambient air quality, surface water quality, groundwater quality, ambient noise level, and soil quality as per aspects detailed in Table 1-2.

Table 1-2: Primary Baseline Data for the EIA Study

S/N	Environmental Attribute	Sample Number	Locations	Frequency	Remarks
1	Ambient Air Quality	5	Study Area	8 hours	Ambient air quality monitoring covering the project site
2	Ambient Noise Quality	5	Study Area	Once during the EIA Baseline survey	According to Noise Pollution (Control) Rules, 2006
3	Soil Quality	2	Study Area	Once during the EIA Baseline survey	Soil samples from the study site
4	Surface Water Quality	3	Study Area	Once during the EIA Baseline survey	Surface water from the project site
5	Groundwater Quality	3	Near Project site	Once during the EIA Baseline survey	Groundwater sample from the project site
6	Flora and Fauna		5km radius of Study area	Once during the Baseline survey	The ecological survey will be undertaken to assess the biodiversity aspects
7	Socio-economic		5Km radius of Study area	One-time survey	Mostly assessed through FGDs and available secondary information

1.5.2.4.1 Stakeholder Consultation

Extensive consultations were conducted with key stakeholders, including the local community, government departments/agencies during the field visit. Stakeholder consultation was completed with the intent of collecting baseline information on the environmental and social conditions and sensitivities, developing a better understanding of the potential impacts, informing the public of the proposed project, and to gain an understanding of the perspectives/concerns of the stakeholders. A summary of the stakeholder engagement process and the profile of the groups and their opinions have been given in Chapter 9 in the EIA report.

1.5.2.4.2 Secondary Baseline Data Collection

Secondary data were collected from the following organizations like Bangladesh Meteorological Department (BMD), Bangladesh Bureau of Statistics (BBS), Bangladesh Agricultural Research Council (BARC), Geological Survey of Bangladesh (GSB), International Union for Conservation of Nature (IUCN), Space Research and Remote Sensing Organization (SPARRSO), Department of Agricultural Extension (DAE), Bangladesh Water Development Board (BWDB), Bangladesh Inland Water Transport Authority (BIWTA), and published Journals and Books for the following aspects.

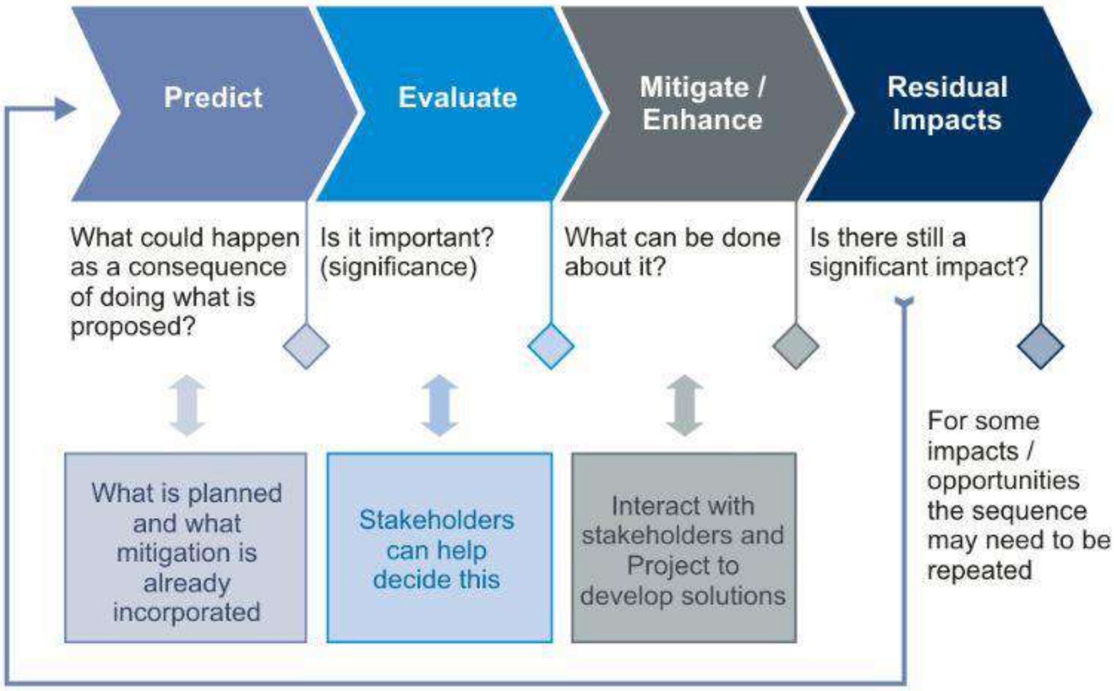
A. Physical Environment	• Regional Setting - Physiography, Geomorphology, Land Use, Geology, Drainage, Hydrology, and Soil. • Climate and Meteorology - Climatic Pattern, Ambient Temperature, Relative Humidity, Rainfall, and Regional Wind Patterns (Wind Speed and Direction). • Hazard and Risks - Natural Hazards: Floods, Seismic Activities, Seasonal Storms and Cyclones, Tidal Surges, Droughts.
B. Socio-economic Environment	• Demographic Profile • Education and Literacy • Economic Activities and Livelihood Pattern • Socio-economic Infrastructure and Indicators - Health Care Facilities, - Education Facilities, - Drinking-Water and Sanitation, - Transportation Facilities, and - Sites of Cultural/Archaeological Importance.
C. Ecology and Biodiversity	• IUCN Red List (2015) • Flora and Fauna • Biodiversity Condition • Existing Terrestrial Ecosystem • Aquatic Fauna and Vegetation

1.5.2.5 Task-4: Impact Assessment

The EIA was evaluated potential impacts using a methodology based on the evaluation of the "significance" of identified issues and impacts on baseline parameters. Analysis of the baseline results and the incremental impacts of the project were assessed in accordance with the national standards for air, water, and Noise Pollution (Control) Rules, 2006 as mentioned in the ECR, 2023, and its subsequent amendments.

The impact assessment covered the full project lifecycle, including pre-construction, construction, and operations activities. The impact assessment has involved the prediction, evaluation, and mitigation of impacts and report on impacts including residual impacts and cumulative impacts. Impact prediction was taking into account control measures that are part of the project design. Additional mitigation measures aimed at further reducing predicted impacts are proposed where necessary or appropriate.

Figure 1-2: Impact Assessment Process for the EIA Study



The impacts were identified and quantified for the intensity using matrix techniques and evaluated as very high, high, medium-high, medium-low, low, and very low impacts on the environment and communities in the study area. Aspects which were considered in the impact assessment, for the pre-construction, construction, and operation phase of the proposed project, include land acquisition/requisition, land use, indigenous population, water quality (surface and ground), noise, ecology, waste, landscape and visual, traffic, flood and other natural disaster risks, sedimentation and erosion, socio-economic, occupational and community health and safety, etc.

The principal aim of this task was to identify and assess potential impacts on various environmental and social components due to the proposed project. Based on baseline data collected in the study area, information on the type and quantity of pollutants, and surveys of the study area, the EIA team identifies and predicts potential impacts due to the proposed project on the surrounding environment during pre-construction, construction, and operation phases of the project.

The key issue, identify after collecting the baseline information. Each issue consists of components that on their own or in combination with each other, give rise to potential impacts, either positive or negative, from the project onto the environment or from the environment onto the project. In the EIA, the significance of the potential impacts will be considered before and after identifying mitigation is implemented, for direct, indirect, and cumulative impacts, in the short and long term.

1.5.2.6 Task-5: Development of EMP

Requirement and details of the mitigation measures for minimizing identified negative impacts and enhancement measures for increasing the benefit of positive impacts are suggested in the EMP for implementation by the client during the pre-construction, construction, and operation phases of the project. The EMP is comprised of the following aspects based on the impacts assessed for the project:

- Introduction to the purpose of the EMP;
- Institutional mechanism - roles and responsibilities for EMP implementation;
- Tentative cost for the implementation of the EMP;
- Summary of significant adverse impacts and potential hazards;
- Mitigation measures and control technologies, safeguards, etc. to minimize adverse impacts on air, water, noise, sediment, soil, biological and socio-economic environment, measures to minimize associated hazards and control the emergency; and
- The project monitoring program for effective implementation of the mitigation measures and ascertain the efficacy of the environmental management and hazard control systems in place.

This sets out the mitigation and management measures required during project implementation to avoid or reduce the environmental and/or social impacts, including developing the action plan in accordance with DOE requirements. A monitoring plan included here, covering the type of monitoring to be done, responsible parties, schedule, standards to be used, resources, and tentative cost. Plans that can be developed at a later stage (e.g., construction waste management plan, emergency response plan, traffic management plan, etc.) identified and provided as initial documents which will be updated before the start of construction activities by the contractor.

1.5.2.7 Tasks-6 and 7: Reporting - Draft and Final EIA Report

A draft EIA report was prepared upon completion of the above tasks as per the prescribed TOR was given by the DOE and submitted to the client for providing their comments and suggestions.

Based on one set of consolidated comments of the client, Draft EIA was finalized for submission to the DOE, Bangladesh to get an Environmental Clearance Certificate (ECC).

1.6 Limitation

This EIA report forms the key impact assessment of the proposed Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District. The followings are some of the limitations of the study:

- This study is limited to investigating and managing potential impacts associated with the construction of site and site abandonment within the Project, (the scope of which is described in Chapter 3 of this report). No assessment has been made for any future projects or activities that may arise beyond the current scope of the project as stated in this report. If or when any such developments are proposed, additional environmental (and social) impact assessment should be carried out at that stage in accordance with the legal requirements of Bangladesh.
- This study has been carried out by accessing data from a wide range of primary and secondary data. This includes reviewing literature, journals, reports and other documents, which have been supplemented with primary field data collection.

- Assessment of the Project is limited by the quantity and quality of available data. Certain provisions in this EIA report assume reliance on conceptual design and technical information.
- If the design of the Project changes from that assessed due to design development, inclusion of new information, changing motivations or any other reason, the results of any impact assessment or possible mitigation measures provided in this report may be inconsistent.

1.7 EIA Team

The composition of the EIA team is shown in Table 1-3.

Table 1-3: The EIA Team

Serial No	Name of Officers and post	Position in the committee	Position in the EIA Study	Academic Qualification	Experiences
01	Umme Mahfuza Haque Superintendent Engineer Design Circrle-06 BWDB, Dhaka	Convener	Team Leader	MSc in Water Resource Development, BUET MSc in Infrastructure project Management, Yokohama National University Japan BSc in Civil Engineering, BUET	20 Years
02	Salma Begum Deputy Chief (Sociology) Office of the Chief Water Management BWDB, Dhaka	Member	Biodiversity Expert	BSS (honors) MSS ((Sociology), Dhaka University	25 Years
03	Mohammed Ali Rubel Research Officer (Environment and forest) Office of the Chief Planning-1, BWDB, Dhaka	Member	Environment Expert	M.S. & BSc. In Geography and Environment, University of Dhaka	08 Years
04	Md. Majedul Islam Research Officer (Economics) Office of the Chief Engineer Northern Zone,	Member	Social Expert	Md. Majadul Islam BSS & MSS in Economics, Rajshahi university	13 Years

Serial No	Name of Officers and post	Position in the committee	Position in the EIA Study	Academic Qualification	Experiences
	BWDB, Rangpur				
05	Md. Rubayet Imtiaz Executive Engineer Thakurgaon Mechanical Division BWDB, Thakurgaon	Member	Bridge Expert	BSc in Mechanical Engineering From BUET	13 Years
06	Swapan Kumar Das Senior Water Resource Specialist, IWM	Member	Water Expert	MSc in Water Resource Development, BUET BSc in Civil Engineering, KUET	30 Years
07	Sanjib Sarker Shawon Research Consultant CEGIS, Bangladesh.	Member	Bridge Expert	B.Sc. in Civil Engineering from Ahsanullah University of Science and Technology (AUST), Dhaka in 2017	05 Years
08	Md. Golam Zakaria Executive Engineer Thakurgaon O & M Division, BWDB, Thakurgaon	Member-Secretary	Bridge Expert	BSc in Civil Engineering From, KUET	08 Years

1.8 Structure of the Report

The Report has been largely structured based on the ToR issued by the DoE for project. The layout of the Report has been divided into 11 sections as briefly described in. The outline of the present EIA is as under:

Table 1-4: Structure of the Report

Chapter No.	Chapter Title	Description
0	**Executive Summary**	The executive summary provides an overview of the EIA report.

Chapter No.	Chapter Title	Description
1	**Introduction**	The chapter describes the background of the study, brief description, scope of the study, approach and methodology, limitation, EIA study team combination, and structure of the report.
2	**Legislative, Regulation, and Policy Consideration**	This chapter covers all the legal provisions, including environmental and social laws, applicable to the project. The chapter also covers all the national standards applicable to the project.
3	**Project Description**	This chapter provides a detailed description of the proposed project comprising project justification, location, layout, and project components
4	**Environmental Baseline**	This chapter covers the environmental baseline parameters on the physical environment (land use, topography, geology, physiography, geomorphology, agro-ecology, soil conditions, soil quality, natural hazards, meteorology, ambient air quality, ambient noise level, hydrology, drainage systems, surface water quality, and groundwater quality), biological environment, and socio-economic environment within the study area.
5	**Social Baseline**	This chapter covers the social parameters of the study area that includes the population and demography, Economic condition of the people, social setup and relevant public utilities enjoyed by the population to understand the impact of the project.
6	**Analysis of Potential Alternative**	This chapter covers the alternatives that can be considered for the project based on its need and available resources
7	**Impact Identification and Evaluation**	This chapter covers the detailed impact of the proposed project on different environmental components during the construction and operation phase of the project.
8	**Management Plan/Procedures**	The chapter covers a comprehensive EMP including recommendations for its implementation during the pre-construction, construction, and operation phase of the project. The EMP consists of the set of mitigation,

Chapter No.	Chapter Title	Description
		management, monitoring and institutional measures to be taken during the implementation of the proposed project to eliminate adverse environmental impacts, offset them or reduce them to acceptable limits.
9	**Consultation with the Stakeholder**	This chapter presents information disclosure, consultation, and participation, comprises public consultations and disclosures conducted in the study area.
10	**Emergency Response Plan and Occupational Health and Safety**	This chapter contains information on possible natural and man-made disasters in the study area. The chapter also highlights the emergency response plan based on the project activity and in general.
11	**Conclusion and Recommendations**	This chapter presents the conclusion and recommendations of the report.

Chapter 2

Legislative, Regulation and Policy Consideration

2 Legislative, Regulation and Policy Consideration

Environmental issues in Bangladesh are legislated by different sectoral policies and law, such as those relating to land use, water and air pollution, toxic chemicals, noise, solid wastes, wildlife protection, forest conservation, environmental health and sanitation and industry. The sectoral laws dealing with different environmental issues in Bangladesh were enacted at different periods, with many now being outdated and not able to control and manage present development needs. Moreover, the environmental concerns and priorities of the country have changed considerably in recent years. For environmental management in particular, the need for updating of legislative requirements has been identified and is currently being undertaken by the DoE.

All proposed activities of Bangladesh Water Development Board (BWDB) should be undertaken in full compliance with the existing Government of Bangladesh (GoB) regulatory and legislative framework. As such, this section of the EIA report provides a review of the GoB statutory requirements most relevant to the proposed Project.

2.1 Legislative Approvals Requirements

The following set of acts and rules are essential to comply with in order to obtain a clearance certificate from the DOE.

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

Act/Rules/ Law/Ordinance	**Responsible Agency-Ministry/Authority**	**Key Features/Remarks**	**Applicability**
Environment Conservation Act, 1995, and its amendment in 2000, 2002 and 2010	Ministry of Environment, Forest, and Climate Change	• Declaration of Ecologically Critical Areas (ECAs). • Obtaining Environmental Clearance Certificate (ECC). • Regulation for vehicles emitting smoke which is harmful to the environment. • Regulation of development activities from an environmental perspective. • Promulgation of standards for quality of air, water, noise, and soil for different areas and different purposes. • Promulgation of acceptable limits for discharging and emitting waste. • Formulating environmental guidelines relating to the control and mitigation of environmental pollution, conservation, & improvement of the environment.	**Applicable** - According to the Act, "no red category project shall be established or undertaken without obtaining an ECC from the DoE." Therefore, the act's provisions apply to all project intervention phases during the project life cycle.
Environment Conservation Rules, 2023	Ministry of Environment, Forest, and Climate Change	• Categorization of industries, development projects, and other activities on the basis of actual (for existing industries/development projects/activities) and anticipated (for proposed industries/development projects/activities) pollution load. The categories are green, yellow, orange, and red. • Procedure for obtaining site clearance and environmental clearance. • Standards for surface water (inland and coastal), drinking	**Applicable** - as the Projects fall under Red Category and require site clearance/ EIA approval/ ECC from DOE, Bangladesh. Besides, it is stipulated that

Act/Rules/ Law/Ordinance	Responsible Agency- Ministry/Authority	Key Features/Remarks	Applicability
		water, sewage discharge, and industrial effluents. • Setting out guidelines for the proper disposal of industrial effluents and requiring industries to have proper effluent management systems i.e., industrial effluent treatment plant, sewerage treatment plant, and mixed effluent treatment plan in place. • Requirements for undertaking initial environmental study and environmental impact assessment as well as formulating environmental management plan according to categories of industries/development projects/activities. • Procedure for damage claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life. • Establishing the Department of Environment (DOE) as the regulatory authority responsible for enforcing the regulations and overseeing environmental protection efforts in Bangladesh. • Provision of listing of environmental consultants and specialists.	environmental quality standards and other relevant requirements shall comply during the project life cycle.
Environment Court Act, 2010 and its amendment in 2019	Ministry of Environment, Forest, and Climate Change. Judiciary	• Establishment of one or more environmental courts in each district and one or more special magistrate courts in each district. • Also provides the jurisdictions of the environment court, the penalty for violating the court's order, a trial procedure in a special magistrate court, power of entry and search, a procedure for investigation, procedure, and power of the	**Applicable** - the court has authority, under the act's provisions, over a trial for an offense or compensation under environmental law, imposing penalties for violation, etc.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		environment court, the authority of the environment court to inspect, appeal procedure and formation of the environment appeal court.	
Noise Pollution (Control) Rules, 2006	Ministry of Environment, Forest, and Climate Change	• The Rules have been established to manage noise-generating activities, which have the potential to impact the health & well-being of workers and the surrounding communities. • An area up to a radius of 100 meters around hospitals, educational institutions, offices, or similar types of institutions is designated as a silent area. The acceptable sound limit in the silent areas is 50 dB(A) for daytime and 40 dB(A) for nighttime. • Dwellings primarily occupy residential areas. The acceptable sound limit in residential areas is 55 dB(A) for daytime and 45 dB(A) for nighttime. • Mixed areas with a mix of residential, commercial & industrial land use. The acceptable sound limit in the mixed areas is 60 dB(A) for daytime and 50 dB(A) for nighttime. • Businesses and officers primarily occupy commercial areas. The acceptable sound limit in commercial areas is 70 dB(A) for daytime and 60 dB(A) for nighttime. • Industrial areas are used for industry or manufacturing. The acceptable sound limit in industrial areas is 75 dB(A) for daytime and 70 dB(A) for nighttime. • An area between 500 meters from the last limit of a residential	**Applicable** - the project will create noise within the project boundary and surroundings. Incremental noise can impact human and terrestrial faunal species. Therefore, it requires complying with these rules.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		area for construction-related activity, use of brick and stone crusher machine is prohibited, and operation of mixture machine and construction-related machinery and equipment are prohibited from 7 PM to 7 AM. • The guidelines say exceeding the maximum noise level in certain areas is a punishable offense.	
Air pollution (Control) Rules 2022	Ministry of Environment, Forest, and Climate Change	• Aiming to protect environmental health, the government has published a new rule based on section 20 of The Bangladesh Environment Conservation Act, 1995. • The main objectives of this rule are to prevent, control, and reduce air pollution. • The government will appoint a director general who will be responsible for managing and maintaining the environmental issue. • The Rule specified several types of pollution such as pollution caused by factories, vehicles, construction, garbage, etc. • According to the new rule, there will be a committee that will impose damages and punishment for such pollution. • As stated by the rule, the government will give rewards to those who will protest against pollution and not cause any type of pollution.	**Applicable** – During the construction phase of the project activities will create air pollution within the project boundary and surroundings. Air pollution can impact human and terrestrial faunal species.
Ecologically Critical	Ministry of	• The ECA Management Rule, 2016 has enabled the government	**Not Applicable** – As the project

Act/Rules/ Law/Ordinance	**Responsible Agency-Ministry/Authority**	**Key Features/Remarks**	**Applicability**
Areas (ECAs) Management Rules, 2016	Environment, Forest, and Climate Change	to form a "National Committee" headed by the Secretary of MoEFCC. • To implement the decision of the Directorate, the District and Upazila committee may be formed. For the conservation and development of the ecologically critical area, one or more teams may be formed. The team's responsibility would be to implement the decision and planning of the Government to improve the Environment for Ecology. • The Rule also prohibited many activities and processes which are detrimental to the natural condition of habitat, tranquility, biodiversity, etc.	area does not fall under any ecologically critical area.
Biodiversity Act, 2017	Ministry of Environment, Forest, and Climate Change	• The Act has enabled the government to form a "National Committee on Biodiversity." The functions of the committee are to conserve biodiversity, genetic biodiversity, identification of biodiversity-related important areas, heritage, etc. • In consultation with local communities and bodies and in coordination with concerned ministries or departments, the government is empowered to declare any place or area significant for its biological heritage as a "Biodiversity Heritage Site." • Prohibiting the taking of activities that may have an adverse effect on endangered animals or organisms, etc. No person shall take any such activity, viz (a) adversely affect, or may affect endangered species; (b) adversely affect or may affect	**Not Applicable** – as no gazetted endangered species is present in the project influence area.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		the environmental characteristics of the endangered ecological community; or (c) In accordance with the Ramsar Convention, the wetland may adversely affect or affect the environment and environmental characteristics of the declared area.	
Forests Act, 1927 and its amendment in 1982, 1989, 2000 and 2018	Ministry of Environment, Forest, and Climate Change	• The government can prohibit certain activities in the declared Reserved Forest area, causing any damage by negligence in felling any tree or cutting or dragging any timber, etc. • The act makes various provisions for the conservation of forests. • It defines the procedure to be followed for declaring an area to be a Reserved Forest, a Protected Forest, or a Village Forest. • It defines what a forest offense is, what acts are prohibited inside an RF, and penalties leviable on violation of the provisions of the act. • The act gives the government power to make any relevant rules to protect forests. • Guidelines for social forestry practice; and • Control and collection of timber and other forest products, and duties on those.	**Not Applicable** – Within 5KM radius there is no forest area.
Wildlife (Conservation and Security) Act, 2012	Ministry of Environment, Forest, and Climate Change	• Prohibition is related to capturing, killing, shooting, or trapping wildlife. No person shall hunt any wild animal without a license. • Determination of threatened flora and fauna in four (4)	**Not Applicable** - There are no protected areas within the project site and within a 5 km

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		schedules. • Prohibitions, entry, and declaration procedure of protected areas (sanctuary, national park, community conservation area, safari park, eco-park, botanical garden, wild animal breeding center, landscape zone or corridor, buffer zone, core zone, special biodiversity conservation area, national heritage, memorial tree, sacred tree, and kunjaban, etc.). • No person, institution, or company shall establish or operate any industrial factory or brick field within 2 (two) kilometers from the boundary of a sanctuary.	radius.
Protected Area Management Rules, 2017	Ministry of Environment, Forest, and Climate Change	• The legal basis for the management and co-management of forest-protected areas. • Structures, functions, and obligations of management of some of the protected areas, excluding safari-park, zoos, botanical gardens, private parks, and wildlife fertility centers from their application. • The Rules have 33 sections and provide for a participatory co-management model consisting of forest-dependent communities, forest departments, civil administration, and civil society organizations. • The rules provide for financial benefits and income incentives to shareholders through participatory social forestry programs to be planted in buffer and landscape areas and eco-tourism.	**Not Applicable** – There is no Protected Area in 5KM radius the Project

Act/Rules/ Law/Ordinance	**Responsible Agency-Ministry/Authority**	**Key Features/Remarks**	**Applicability**
Bangladesh Water Act, 2013	Ministry of Water Resources	• Any infrastructure or landfilling activities over any natural watercourses, stopping the natural flow or creating obstacles, or diverting or attempting to divert the direction is strictly prohibited. • According to the provision of section 43, all the costs may be incurred for the removal of infrastructure or landfilling materials from the person liable for making infrastructure or carrying on landfilling activities. • Any area or any part of any land connected with water resources can be declared as a Water Stress Area. • Ensuring safe abstraction of water from aquifers & executive authority may subject to the lowest safe yield of surface and groundwater. • Any infrastructure shall not be established in the immediate premises of the flood control embankment and ensure the sustainability and protection of the control structure. • No person shall not store, preserve, or divert the water of any water source in any natural or artificial reservoir.	**Applicable** – as the project will use both surface and groundwater.
Bangladesh Water Rules, 2018	Ministry of Water Resources	• Provision of No Objection Certificate for the establishment of projects related to flood control and management project; surface water extraction, supply and use related project and part of the project; irrigation project using surface water; construction of hydraulic structures; water conservation	**Applicable** – as the project will use both surface and groundwater for various purpose.

Act/Rules/ Law/Ordinance	**Responsible Agency-Ministry/Authority**	**Key Features/Remarks**	**Applicability**
		project; flood-affected plain land and wetland development project; groundwater for industrial use; riverbank protection and river control; river excavation and dredging project; canal excavation and re-excavation project; fisheries development in surface water project; groundwater extraction, supply, & use related project & part of the project; and others project; • According to Clause-16 of the rules, a NOC should be taken from the DG of WARPO, District Committee/DC, Upazila Committee/UNO, and Union Committee/Chairman based on the total investment of the specific project.	
National River Protection Commission Act, 2013	Ministry of Water Resources	• An act to establish a Commission for preventing illegal occupation of rivers, pollution of water and environment, pollution of rivers caused by industrial factories, illegal constructions, and various irregularities and ensuring multidimensional use of rivers for socio-economic development including restoration of the normal flow of rivers, proper maintenance thereof and making them navigable.	**Applicable** – TH project activities involved with river system
Protection and Conservation of Fish Act, 1950, and its amendment in 1982 and Rules, 1985	Ministry of Fisheries and Livestock	• The act was enacted to provide for the protection and conservation of fish. Under the Act, the Protection and Conservation of Fish Rules were adopted in 1985. • No person shall destroy or attempt to destroy any fish with explosives, gun, bow, and arrow in inland or coastal waters. During the Project intervention, it should be noted that if waste effluent is not treated, then it may cause significant damage to	**Applicable** - Fishing zone close to the project site and physical intervention in the river by this project.

Act/Rules/ Law/Ordinance	**Responsible Agency-Ministry/Authority**	**Key Features/Remarks**	**Applicability**
		the local fishery and thus violate the provision of the law. • No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters; and • Protection and conservation of fish in government-owned water bodies.	
Electricity Act, 2018	Ministry of Power, Energy, and Mineral Resources	• If the land acquisition is required for the establishment of a power generation plant or sub-station, it shall be deemed to have been necessary for the public interest, and the existing laws and regulations on the acquisition of land shall have to be followed. • If any private company holding a license requires any land for constructing any connection line with the power station. Sub-station or grid substation, the licensee may purchase or acquire such land from the concerned landowner in accordance with the existing laws and regulations regarding land acquisition. • No licensee shall harm or obstruct or interfere with railways, highways, airports, waterways, canals, docks, piers and jetties, and pipes during power generation, transmission, supply, or distribution. • The licensee shall take all logical precautions during the construction of power supply lines and doing civil works so as not to harm the communication system of the telegraph, telephone, or electromagnetic signal-emitting lines by induction	**Applicable** - Project needs electricity from national grid

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		or any other means.	
Acquisition and Requisition of Immovable Property Act (ARIPA), 2017	Ministry of Land	• Current GoB Act, relating to acquisition and requisition of land. • According to the law, the affected person will get an additional 200% of the assessed value for land and an additional 100% for structures, trees, crops, and other assets. • This law deals with the social and economic impacts of land acquisition.	**Not Applicable** -as the proposed project does not have any immovable property.
Fatal Accidents Act, 1855	Ministry of Law, Justice, and Parliamentary Affairs	• Provide compensation to families for loss occasioned by the death of a person caused by actionable wrong. It is mentioned in s.1 that whenever a wrongful act shall cause the death of a person, neglect or default, and the act, neglect or default is such as would (if death had not ensued) have entitled the party injured to maintain an action and recover damages in respect thereof, the party who would have been liable if death had not ensued shall be liable to an action or suit for damages, notwithstanding the death of the person injured, and although the death shall have been caused under such circumstances as an amount in law to a felony or other crime.	**Applicable** - as the proposed project has a provision for unlikely and accidental events that may cause fatal accidents.
The Penal Code, 1860	Ministry of Law, Justice, and Parliamentary Affairs	• Valid provisions related to pollution management, environment protection, and health and safety protection. Chapter XIV of the Penal Code provides offenses effective public health, safety, convenience, decency, and morals:	**Applicable** - The proposed project has a provision for pollution impact on the surrounding environment.

Act/Rules/ Law/Ordinance	**Responsible Agency-Ministry/Authority**	**Key Features/Remarks**	**Applicability**
		• Section 277: Falling Water or Public Spring or Reservoir. • Section 278: Making Atmosphere Noxious to Health. • Section 284: Negligent Conduct concerning Poisonous Substance. • Section 285: Negligent Conduct concerning Fire or Combustible Matter; and • Section 286: Negligent Conduct concerning Explosive Substance.	
Fire Prevention & Extinguish Act, 2003 and Rules, 2014	Ministry of Home Affairs	• Regulatory enactments regarding the prevention, the successful extinguishing of fire, and reduction of damages and consequences of fire. • States to obtain a license from the Director-General of Fire Service and Civil Defense in case of any warehouse.	**Applicable** – as the proposed project may have faced fire-related hazards.
The Factories Act, 1965, and the Factories Rules, 1979 Bangladesh Labor Act, 2006 and amendments 2009, 2010, 2013 and 2018	Department of Labor/Department for Inspection of Factories and Establishment/ Ministry of Labor and Employment	• Pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions. • Provides health, safety, and well-being to the workforce during the project life cycle. • Children under 18 years are not allowed to be employed during the project life cycle. • Safety precautions regarding explosive or inflammable	**Applicable** - as it provides the workforce's health, safety, and well-being during the project life cycle. Besides, it also stipulated that child under 18 years are not allowed to be employed during the project life cycle; therefore, this law must be complied with.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
Bangladesh Labor Rules, 2015		dust/gas, protection of eyes, protection against fire, work with cranes and other lifting machinery, and lifting of excessive weight. • Safety measures like appliances of first aid, maintenance of safety record books, rooms for children, housing facilities, medical care, group insurance, etc. • No building, wall, chimney, bridge, tunnel, road, gallery, stairway, ramp, floor, platform, staging, or other structure, whether a permanent or temporary character, shall be constructed, situated, or maintained in any factory in such a manner as to cause risk of bodily injury (Rule 38) of factory rules 1979, etc.	
EIA Guideline for the Industry 2021	Department of Environment	• The EIA Guidelines for Industry, 2021, introduced by the Department of Environment, Bangladesh, is the only guideline for conducting an Environmental Impact Assessment in Bangladesh. It is not only for industries but also for all types of development works. It includes EIA procedures, methodology, guidelines for impact identification, forecasting, and evaluation, plans for mitigation measures, and monitoring programs.	**Applicable** -The project activities can create environmental, social, and ecological impacts during the construction and operation phases. EIA Guideline for Industries 2021 is the only guideline for conducting an Environmental Impact Assessment in Bangladesh that includes guidelines for impact identification, prediction, and

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
			evaluation, plans for mitigation measures, and monitoring programs.
National 3R Strategy for Waste Management, 2010	Department of Environment	• The concept of this strategy is minimizing waste impacts in terms of quantity or ill effects by reducing the number of waste products with simple treatments and recycling the waste by using them as resources to produce the same or modified products. The principle of "3R" is stated as reducing waste, reusing, and recycling resources and products. • Reducing means choosing to use items with care to reduce the amount of waste generated. • Reusing involves the repeated use of items or parts of items that still have usable aspects. • Recycling means the use of waste itself as a resource. • It suggests ISO 14001 or any other EMS structure which is significant for developing strategies relevant to the industry and its social and environmental setting. ISO 14001 is increasingly important in international trade.	**Applicable** - This strategy is applicable for the project for the management of waste (i.e., solid waste) to minimize/reduce environmental, social, and economic problems.
Solid Waste Management Rules 2021	Department of Environment	• When recovering resources from waste, the principles of management that consider the waste hierarchy, such as the 3Rs, segregation, and reduction, must be followed at all stages from waste generation to the final disposal.	**Applicable** - This rule is applicable for the project for the management of waste (i.e., solid wastes) to minimize/reduce

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		• Responsibilities of waste generators, consumers, and users: Dispose of waste in accordance with the regulations of authorities including local government; Dispose of waste separately; Do not dump, store, or burn waste outdoors. • Responsibilities of manufacturers (*not defined) and importers of products: Collect non-biodegradable products such as glass, plastic, polyethylene, multi-layered packaging, bottles, and cans from consumers and recycle or dispose of them if appropriate; Determine work plans and implementation procedures for recycling and disposal; Ensure that Extended Producer Responsibility (EPR) is properly implemented; Submit an annual report to the Department of Environment (DoE) on the amount of plastic recycled; Raise public awareness of proper waste management. • Any violation of the above provisions shall be subject to imprisonment for not more than two years or a fine not exceeding 200,000 Taka (BDT), or both. The Regulations also include provisions for the treatment of solid waste such as composting and energy recovery.	environmental, social, and economic problems.
Antiquities Act, 1968 and Antiquities Preservation Rules, 1986	Department of Archaeology, Ministry of Cultural Affairs	• No person shall deal in antiquities except under and in accordance with a license granted by the Director. • No person shall remove any object of the immovable protected antiquity. • No person shall damage, alter, deface, or imperil immovable	**Not Applicable** - No archaeological and cultural sites are on the project site.

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
		protected antiquity. • Any person preserving or storing any kind of movable antiquity without a license shall produce it to the Director on demand for verification of the source of its possession.	
The Environment Court Act, 2010 and amendment in 2019	Ministry of Environment, Forest, and Climate Change Judiciary	• The highest priority is accorded to environment pollution. • Completion of environment-related legal proceedings effectively.	**Applicable.** for completing environmental legal requirements effectively
The Draft Clean Air act, 2019	Ministry of Environment, Forest, and Climate Change	• Establishment of the National Air Quality Management Plan. The plan may set some national standards for the emission of PM, CO, NO_X, SO_2, etc. • The government may declare an area as "critical" if air quality deteriorates or if it needs specific attention to deal with the situation. The sources of pollution may be marked along with critical areas. • A maximum of 10 years' imprisonment or fine or both for violating any provision of this law by any person, private or public agency. • If an offense is committed by any government agency, its head will be considered guilty of violating the law, and liable to face punishment accordingly.	**Applicable.** As the project has significant pollution sources i.e., earthworks, operation of construction machinery, and movement of vessels, it will be under the obligation of this act.
Public Procurement Rules, 2008	Central Procurement and Technical Unit, Ministry of Planning	• Requires contractors to provide adequate measures regarding the "Safety, Security, and Protection of the Environment" in the construction works.	**Applicable**

Act/Rules/ Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features/Remarks	Applicability
The Building Construction Act 1952 and subsequent amendments	Ministry of Works	• This act provides for the prevention of haphazard construction of buildings and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh	**Applicable**
The Bangladesh National Building Code, 1993, and subsequent amendments	Ministry of Housing and Public Works	• This act provides for the prevention of haphazard construction of buildings and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh. • Before the commencement of a particular which may affect any structure having historical association and antiquity, the owner of that building should obtain special permission from the relevant authority.	**Applicable-** as the proposed project will develop structure**.**

Source: Different Laws and Regulations of GoB

2.1.1 Relevant Policies

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

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

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
National Environment Policy, 2018	Ministry of Environment, Forest, and Climate Change	• Encourage collection and promotion of low carbon emission technology in the country. • Identifying and controlling all types of environmental pollution and degradation activities.	**Applicable** - as the proposed project has the likeliness of having an impact on the surrounding environment

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
		• Ensure sustainable, long-term, and environmentally friendly use of all-natural resources. • To take PPP for the development of the environment. • Maintain and streamline environmental policies and strategies, among other policy strategies, in the interest of sustainable development. • Ensure the EIA and SEA are in all necessary sectors. • Act to reduce poverty through environmental protection. • Strengthen observations on proper compliance with environmental laws and regulations.	
Bangladesh Climate Change Strategy and Action Plan, 2009	Ministry of Environment, Forest, and Climate Change	• Food security, social protection, and health. • Comprehensive disaster management. • Infrastructure. • Research and Knowledge management. • Mitigation and low carbon development. • Capacity building and institutional strengthening.	**Applicable** - As the project has the potential to generate pollutants in the air and GHG emissions.
National Forest Policy, 2016	Bangladesh Forest Department/ Ministry of Environment, Forest, and Climate Change	• Manage all existing forests, wildlife, and other forestry resources, adhering to the principles of sustainable management and climate resilience. • Enrich degraded forest areas and enhance land areas under	**Not Applicable** – as there is no designated forest in the 5 KM buffer of the project boundary.

Policy/Plans	**Responsible Agency-Ministry/Authority**	**Key Features**	**Applicability**
		forest/ tree cover. • Produce various goods and ecosystem services to benefit Bangladesh's present and future generations.	
National Water Policy, 1999	Ministry of Water Resources	• Protection and prevention of the natural environment for ensuring sustainable development. • Minimize disruption to the natural aquatic environment in streams and water channels. • Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding. • Water development projects should cause minimal disruption to navigation and, where necessary, adequate mitigation measures should be taken. • Full consideration of environmental protection, restoration, and enhancement measures consistent with NEMAP and the NWMP. • Ensure adequate upland flow in water channels to preserve the coastal estuary ecosystem threatened by the intrusion of salinity from the sea.	**Applicable** – The project proponent should minimize water pollution and minimize disruption of the aquatic environment and navigation system in the adjacent water body.
National Fisheries Policy, 1999	Ministry of Fisheries and Livestock	• Provide provisions for the protection and conservation of fish in freshwater and brackish water bodies. • Preservation, management, and exploitation of fisheries	**Not Applicable** - the proposed project site is not a designated fishing zone. Fish capture and

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
		resources in inland open water. • Fish cultivation and management in inland closed water. • Prawn and fish cultivation in coastal areas. • Preservation, management, and exploitation of sea fishery resources. • Conserve fish breeding grounds and habitats, and • promote fisheries development and conservation in all water bodies.	culture are absent from the project site.
National Agriculture Policy, 2018	Ministry of Agriculture	• Ensure food security and socio-economic development through the productivity of crops, boosting production and raising farmers' income, diversifying crops, producing safe foods, and developing a marketing system, profitable agriculture & use of natural resources. • Increasing food availability, rights, and purchasing power by increasing crop productiveness and production. • Discourage the use of agricultural land for non-agricultural work to ensure sustainable food security. • Soil, water, flora, fauna, and overall environmental conservation and effective use initiative adoption;	**Not Applicable** - the project will be established in the forest area.
National Land Use Policy, 2001	Ministry of Land	• Resisting the current trend of alarmingly declining, total amount of agricultural land used to produce adequate food for	**Applicable** - As the proposed project is going to be

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
		a growing population for a variety of reasons. • To prevent arbitrary use of land. • To formulate guidelines for the maximum use of land according to the natural differences in different parts of the country. • In the case of land acquisition for urbanization and development projects or any other purpose, to ensure its best use by acquiring the least amount of land and to avoid the acquisition of excess land as required. • Arranging for the preservation of such lands, especially government Khas lands, which may be required in the future for various development activities. • To ensure that the use of land is compatible with the natural environment. • Making the best use of land to alleviate poverty and increase employment; and • To play a helpful role in preventing the increase in the number of landless.	established on government acquired land.
National Energy Policy, 1995	Ministry of Power, Energy, and Mineral Resources	• Utilization of energy for sustainable economic growth, supply to different zones of the country, development of indigenous energy sources & environmentally sound sustainable energy development programs. • It highlights the importance of protecting the environment.	**Applicable-** Project needs electricity from National Grid

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
		• EIA should be made mandatory and should constitute an integral part of any new energy development project. • Use of economically viable environment-friendly technology. • Public awareness regarding environmental conservation; and • Ensure environmentally sound sustainable energy development programs cause minimum damage to the environment.	
National Industry Policy, 2016	Ministry of Industries	• The policy emphasized green productivity and the use of green technology, thereby protecting the environment; setting up of ETPs, and CETPs would be encouraged by the government. • Advocates for setting up the Clean Development Mechanism or CDM in the industries. • Adoption of the 3R principle (Reduce, Reuse, Recycle) strategy would be encouraged for all industries; and • Discourages activities that use agricultural land for industrial purposes.	**Applicable** – This rule is applicable for the project for the management of waste (i.e., solid wastes) to minimize /reduce
National Occupational Health and Safety Policy, 2013	Department for Inspection of Factories and Establishment/ Ministry of Labor and Employment	• Necessary measures to ensure workplace safety and health protection considering international Conventions/Declarations/ Recommendations/ Instruments. • Review and updating of all laws relating to Occupational Health and Safety (OHS). • Inclusion of OHS issues in the policies and programs of all	**Applicable -** as the policy pertains to the occupational rights and safety of workers and has the provision of a comfortable work environment and reasonable working

Policy/Plans	**Responsible Agency-Ministry/Authority**	**Key Features**	**Applicability**
		related Ministries and agencies. • Establish labor courts in the industrial zone so the workers and trade unions can have easy access to the courts for implementing the mandatory provisions of OHS. • Impose mandatory terms and conditions upon construction agencies to follow the OHS policies during govt. Run construction works; and • To ensure maximum safety standards during construction and implement all standards and regulations in an internal safety environment.	conditions for all employees.
Explosives Act (1884)		• The Government may for any part of Bangladesh, make rules consistent with this Act to regulate or prohibit, except under and in accordance with the conditions of a license granted as provided by those rules, the manufacture, possession, use, sale, transport and importation of explosives or any specified class of explosives. • Any person manufacturing, possessing, using, selling, transporting or importing an explosive in contravention of a notification issued shall be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine which may extend to fifty thousand BDT, in default of which with a further imprisonment for a term which may extend to one year and in the case of importation by water or land, the owner and master of the	**Not Applicability**:

Policy/Plans	Responsible Agency-Ministry/Authority	Key Features	Applicability
		vessel or carriage in which the explosive is imported shall, in the absence of reasonable excuse, each be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine with a further imprisonment for a term which may extend to one year.	
Mines and Minerals (Control and Development) Act (1992) and Mines and Minerals Rules (1968)		• The Mines and Minerals (Control and Development) Act provides a framework for the control and development of mines and mineral resources in Bangladesh, with natural gas exploration and extraction also being included within this framework. Under the Act and in accordance with the Rules, the Bangladesh Government grants prospecting licenses, mining leases or facilities to preserve and develop mineral resources in the country. A "prospecting license" is required to prospect on any site for minerals or mineral resources for the purpose of developing these resources through mining / extraction. The power to grant mining leases and licenses is vested in the Bangladesh Bureau of Mineral Development (BMD).	**Not Applicability**
The Explosives Rules (2004)		• All the Explosive related policies are described in the Explosives Rules, 2004 that includes categorization of explosive, import of explosive, transportation of explosive, storage of explosive etc. Without obtaining the licenses from the authority no one is permitted to import, transport and store of explosive.	**Not Applicability**:

2.2 International Agreements and Obligations

Bangladesh is a signatory to a number of international conventions of environmental importance, a number of which have some relevance to the Project.

2.2.1 Agenda 21 of the Rio Convention

Under Principle 17 of the Rio Convention, developments should be subjected to an environmental impact assessment. The Project complies within this Convention by providing detailed impact assessment for the proposed survey.

2.2.2 The Convention on Biodiversity (1992)

The signatories of this convention have made a commitment to protect biodiversity through funding and appropriate management. The main objectives are the conservation of biological diversity, the sustainable use of the components of biological diversity, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Mitigation measures will be recommended to reduce any potential impacts on biodiversity as a result of the proposed survey, in line with the requirements of this convention.

2.2.3 The Convention on the Conservation of Migratory Species of Wild Animals (1979)

Also known as the Bonn Convention, this agreement aims to conserve terrestrial, marine and avian migratory species throughout their range. Bonn Parties strive towards strictly protecting these animals, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them. The detailed impact assessment will identify the presence of any migratory species and proposed mitigation strategies to reduce potential impacts, if any, on such species, as a result of the proposed works.

2.2.4 Ramsar Convention on Wetlands (1971)

This agreement is an intergovernmental treaty that certifies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance as well as to plan for the "wise use", or sustainable management, of all of the wetlands in their territories. A large wetland, listed as a Ramsar wetland under this convention – Hail Hoar. No major wetland falls within the catchment area.

2.2.5 The United Nations Framework for Convention on Climate Change (1992)

Also known as the Kyoto Protocol, this convention aims for the "stabilization and reconstruction of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”. Bangladesh is a signatory to the Protocol and thus the Project is being undertaken in line with the Bangladesh Government’s strategies for greenhouse gas planning for the country.

2.3 Administrative Setup related to Environment in Bangladesh

The MoEFCC is the nodal agency in the administrative structure of the GoB, for overseeing all environmental matters relating to national environmental policy and regulatory issues in the country. The MoEF oversees the activities of the following technical/ implementing agencies:

- Department of Environment (DoE);
- Forest Department (FD);
- Water Resources and Planning Organization (WARPO);
- Bangladesh Inland Water Transport Authority (BIWTA);
- Ministry of Fisheries and Livestock (MOFL);
- Bangladesh Power Development Board (BPDB);
- Bangladesh Energy Regulatory Commission (BERC);
- Ministry of Labour and Employment (MOLE);
- Ministry of Law and Parliamentary Affairs;
- Ministry of Land;
- Board of Investment (BOI), Bangladesh; and
- City Corporation/Union Parishad.

2.3.1 Department of Environment (DOE)

The DoE has been placed under the MoEF as its technical wing and is statutorily responsible for the implementation of the ECA, 1995. The principal activities of the DoE are:

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

2.3.2 Procedure for obtaining ECC from DOE, Bangladesh

The applicability of environmental clearance and the process in Bangladesh is described in Figure 2-1 and Figure 2-2. The EIA process consists of three stages, screening and project description, approval of TOR, and detailed EIA:

- Projects categorized as Green and Yellow require no IEE or EIA but need a project description. However, the proponent has to submit an application in a prescribed format along with specified documents.
- Projects categorized as Orange require IEE for environmental clearance and in some cases, EIA may require. IEE to be submitted to the DOE along with an application in a prescribed format and other specified documents; and
- Red category projects require EIA. A project description is required for the TOR approval. An EIA required for location clearance and for the environmental clearance.

According to the Schedule-1 of ECR 2023, the proposed Project components fall under the following categories.

Table 2-3: Project Components Fall Under the Following Categories

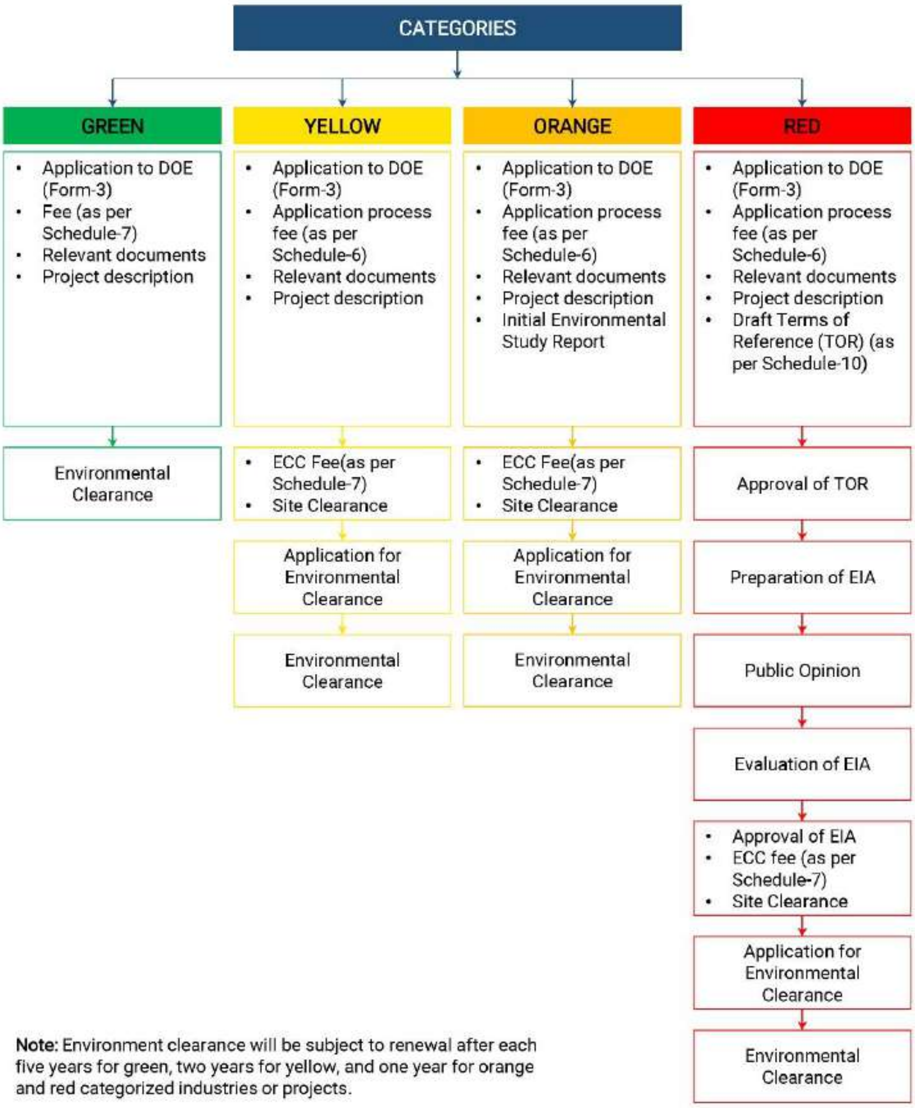
Components	Length	Category	Reference	Requirement
Combined Water Control Structure at Nischintapur over Tangon River	120 M	Orange	Schedule -1 (Sl. 22 under orange category)	Initial Environmental Examination (IEE)
Combined Water Control Structure at Bangroad over Bhulli River	36.5 m	--	--	Project Description
Combined Water Control Structure at Beltola over Shuk River	36.5 m	--	--	Project Description
Combined Water Control Structure at Rautnagar over Kulic River	60 m	--	--	Project Description
Bhulli Left Irrigation Canal	700 m	Red	Schedule -1 (Sl. 60 under red category)	Environmental Impact Assessment (EIA)
Bhulli Right Irrigation Canal	1600 m	Red	Schedule -1 (Sl. 60 under red category)	Environmental Impact Assessment (EIA)

- As per the previous experience, the project category can be considered as Red which requires Environmental Impact Assessment (EIA).

As per Schedule-1 of ECR 2023, the project falls under the Red Category as a combined of the category. So, this project needs EIA for location clearance and environmental clearance.

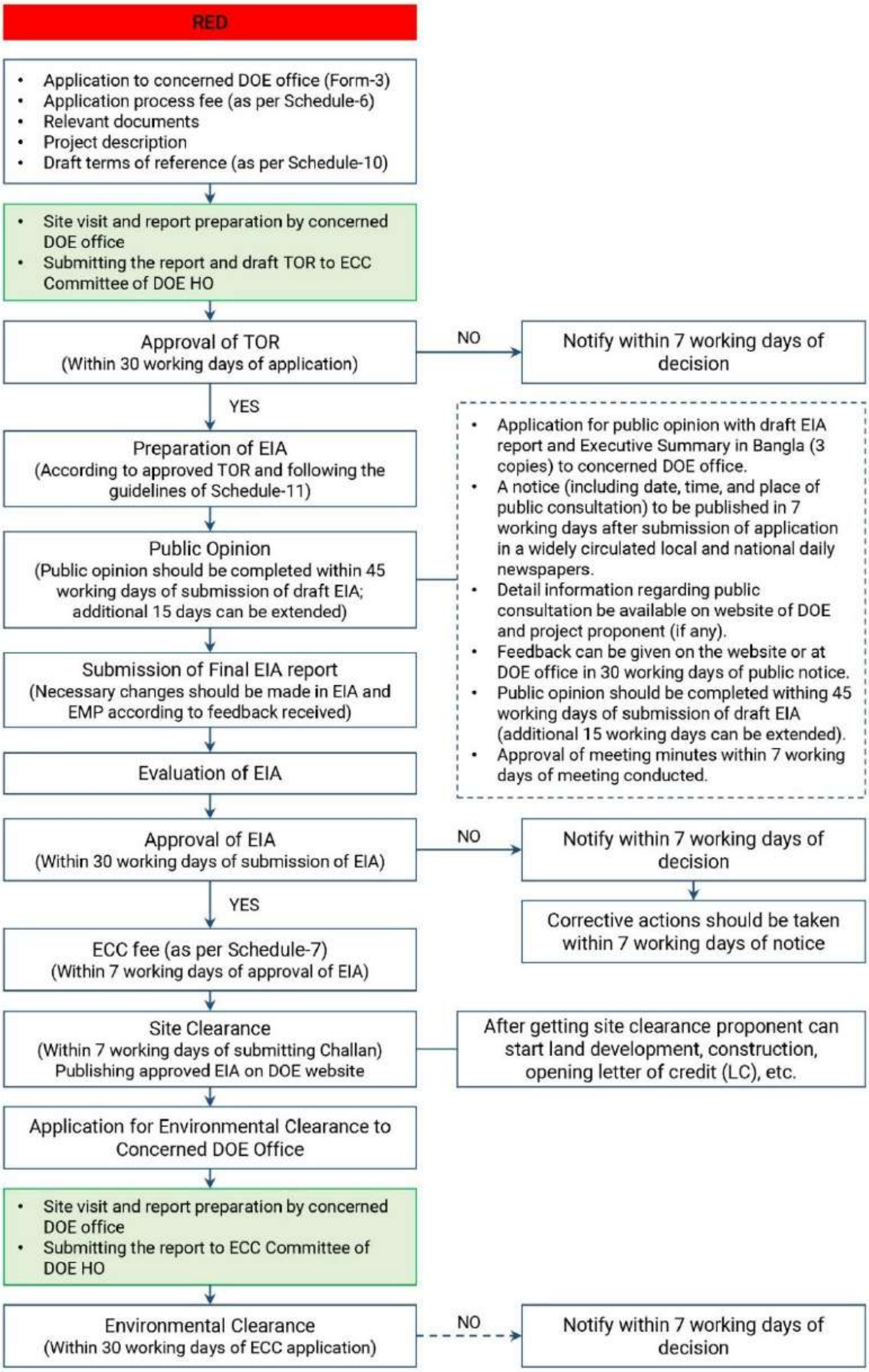
The process of obtaining an Environmental Clearance Certificate for the proposed project is outlined in Figure 2-1 and Figure 2-2.

Figure 2-1: DOE Environmental Clearance Applicability and Procedure (As per ECR, 2023)



Source: Department of Environment (DOE), Bangladesh

Figure 2-2: DOE Environmental Clearance Procedure for Red Category (As per ECR, 2023)



Source: Department of Environment (DOE), Bangladesh

Chapter 3

Project Description

3 Project Description

This chapter describes the detail of proposed project proponent, project description including location and area, technology selection, process flow chart, infrastructure facilities, activities, project schedule, resources and utility demand for the proposed project. The proposed project is Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District. The total cost of the project is expected to be around 33625.13 lac Taka BDT.

3.1 Project Location and Land Requirements

Bangladesh Water Development Board (BWDB) has plan to develop four combined water control structures and two irrigation canals in Thakurgaon District. The Bangladesh Water Development Board (BWDB) has proposed and initiated a project named "Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District."

Name of the Four Water Control Structure are as follows:

1) Combined Water Control Structure at Nischintapur over Tangon River
2) Combined Water Control Structure at Bangroad over Bhulli River
3) Combined Water Control Structure at Beltola over Shuk River
4) Combined Water Control Structure at Rautnagar over Kulic River

Name of the Two Irrigation Canals are as follows:

5) Bhulli Left Irrigation Canal
6) Bhulli Right Irrigation Canal

Combined Water Control structure at Nischintapur on the Tangon River

Location: 26.0261245 N, 88.4548858 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Nischintapur

Combined Water Control structure at Bangroad on the Bhulli River

Location: 26.0590162 N, 88.6217261 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Shukanpukuri

Combined Water Control structure at Beltola on the Shuk River

Location: 26.126198 N, 88.410720 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Dholarhat

Combined Water Control structure at Rautnagar on the Kulic River

Location: 25.8447759 N, 88.2249694 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Dholarhat

Extension of Left and Right Bhulli Irrigation canal

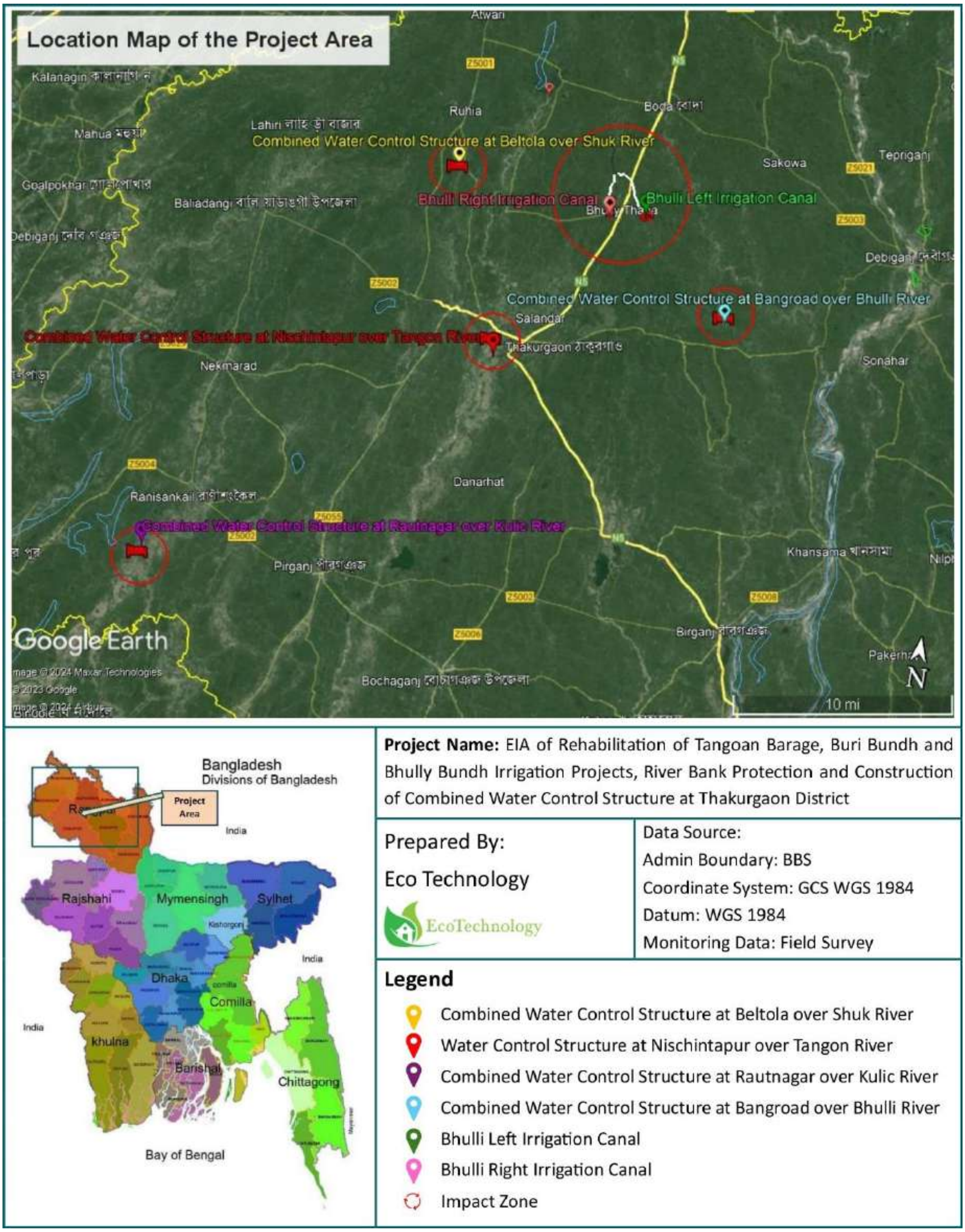
Location: 26.123308 N, 88.549589 E (Left Irrigation canal proposed extension starting)

26.119476 N, 88.524311 E (Right Irrigation canal proposed extension starting)

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Auliapur, Balia

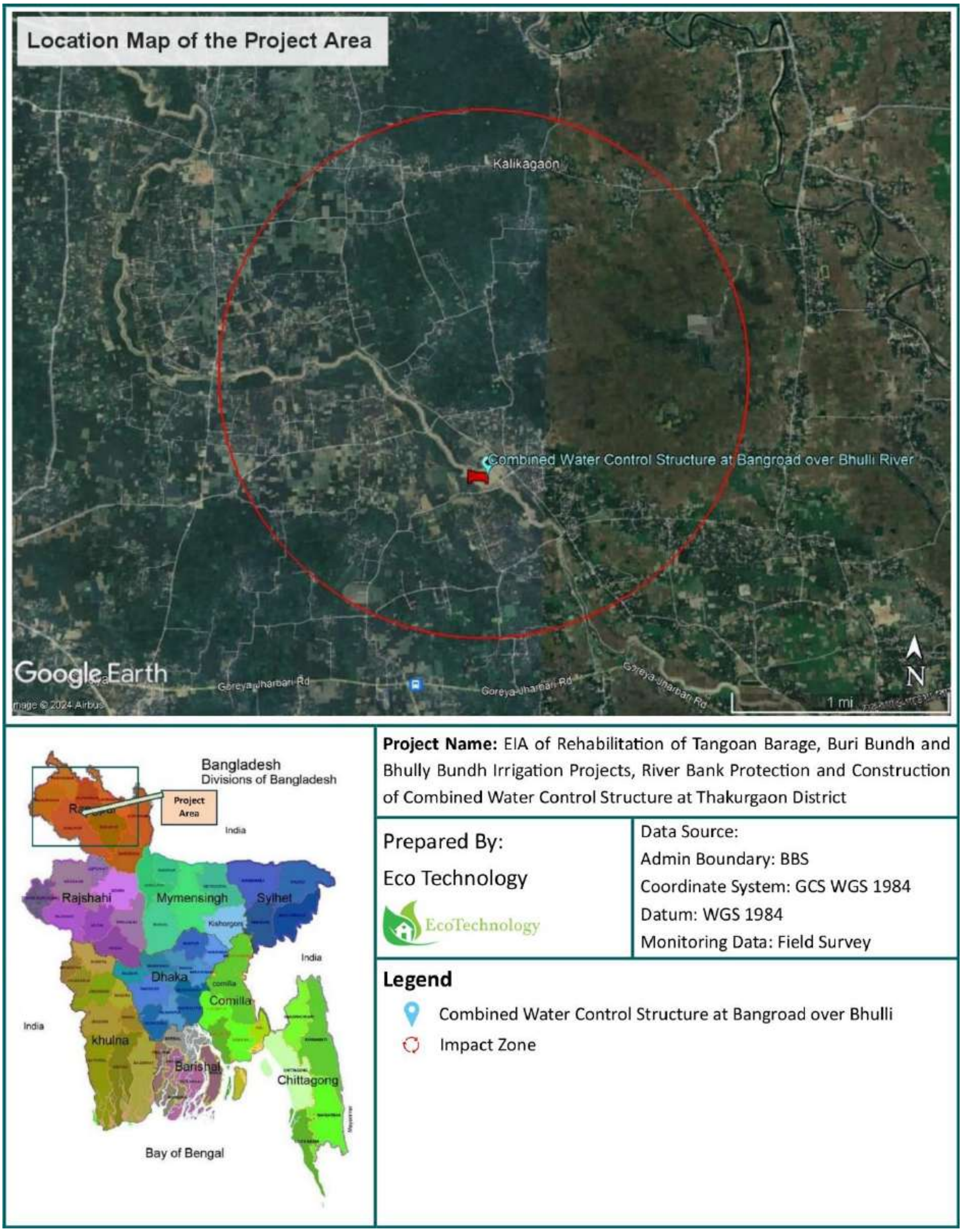
The following Figure 3-1, Figure 3-2, Figure 3-3, Figure 3-4, Figure 3-5 and Figure 3-6 shows the project location of the proposed project.

Figure 3-1: Location Map of the Proposed Project (Six Structures)



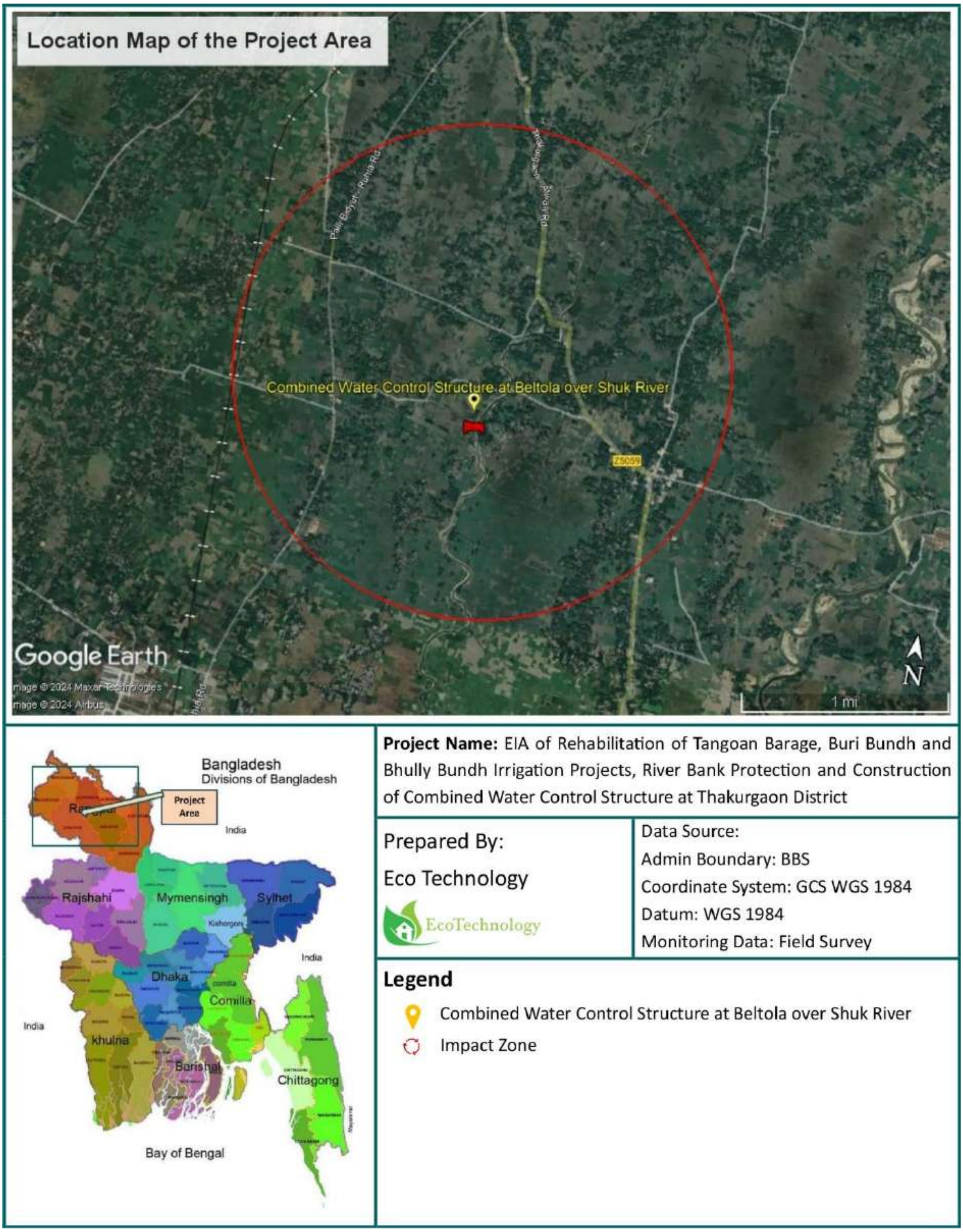
Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-2: Location Map of Combined Water Control Structure at Bangroad over Bhulli River (AOI 2KM Radius)



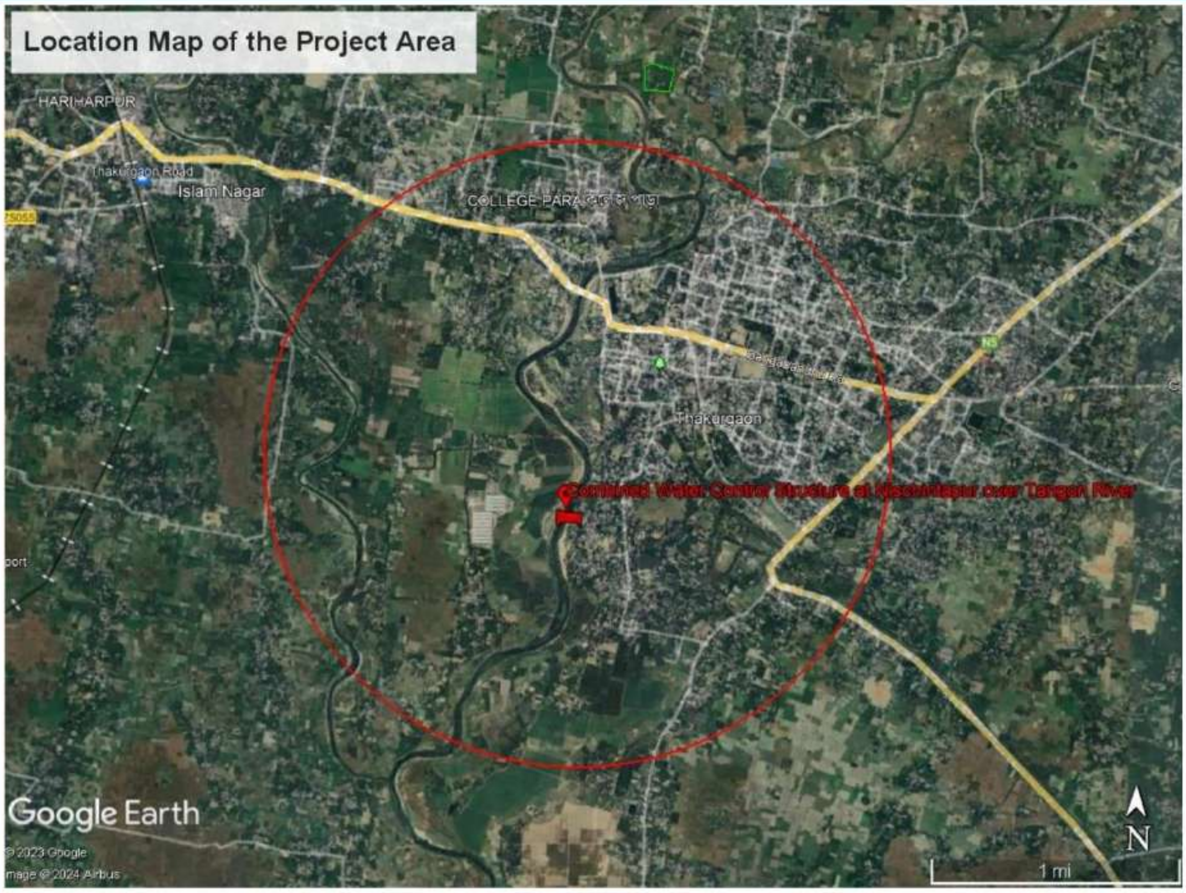
Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-3: Location Map of Combined Water Control Structure at Beltola over Shuk River (AOI 2KM Radius)



Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-4: Location Map of Combined Water Control Structure at Nischintapur over Tangon River (AOI 2KM Radius)



Project Name: EIA of Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District

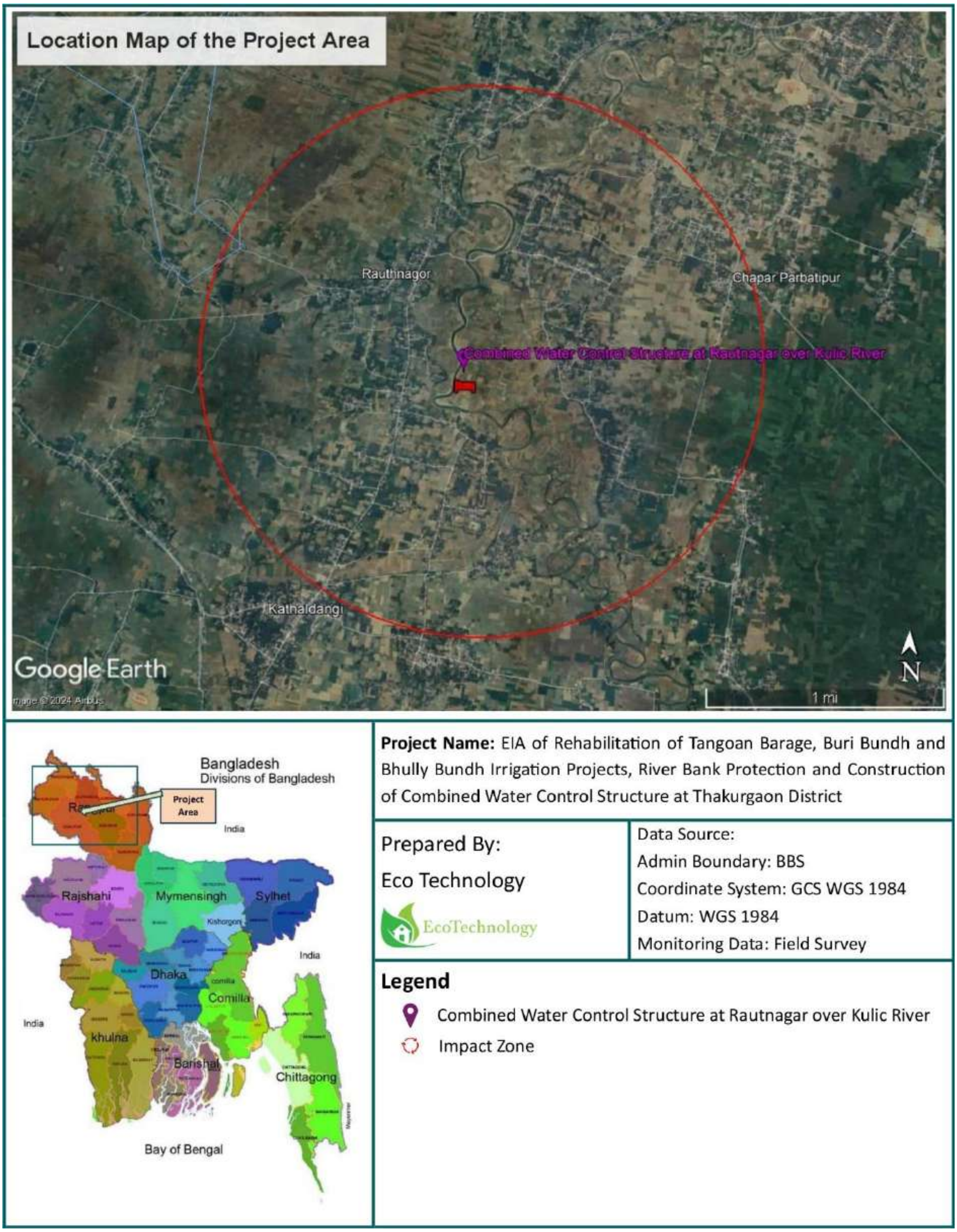
Prepared By: Eco Technology	Data Source: Admin Boundary: BBS Coordinate System: GCS WGS 1984 Datum: WGS 1984 Monitoring Data: Field Survey

Legend

- Combined Water Control Structure at Nischintapur over Tangon River
- Impact Zone

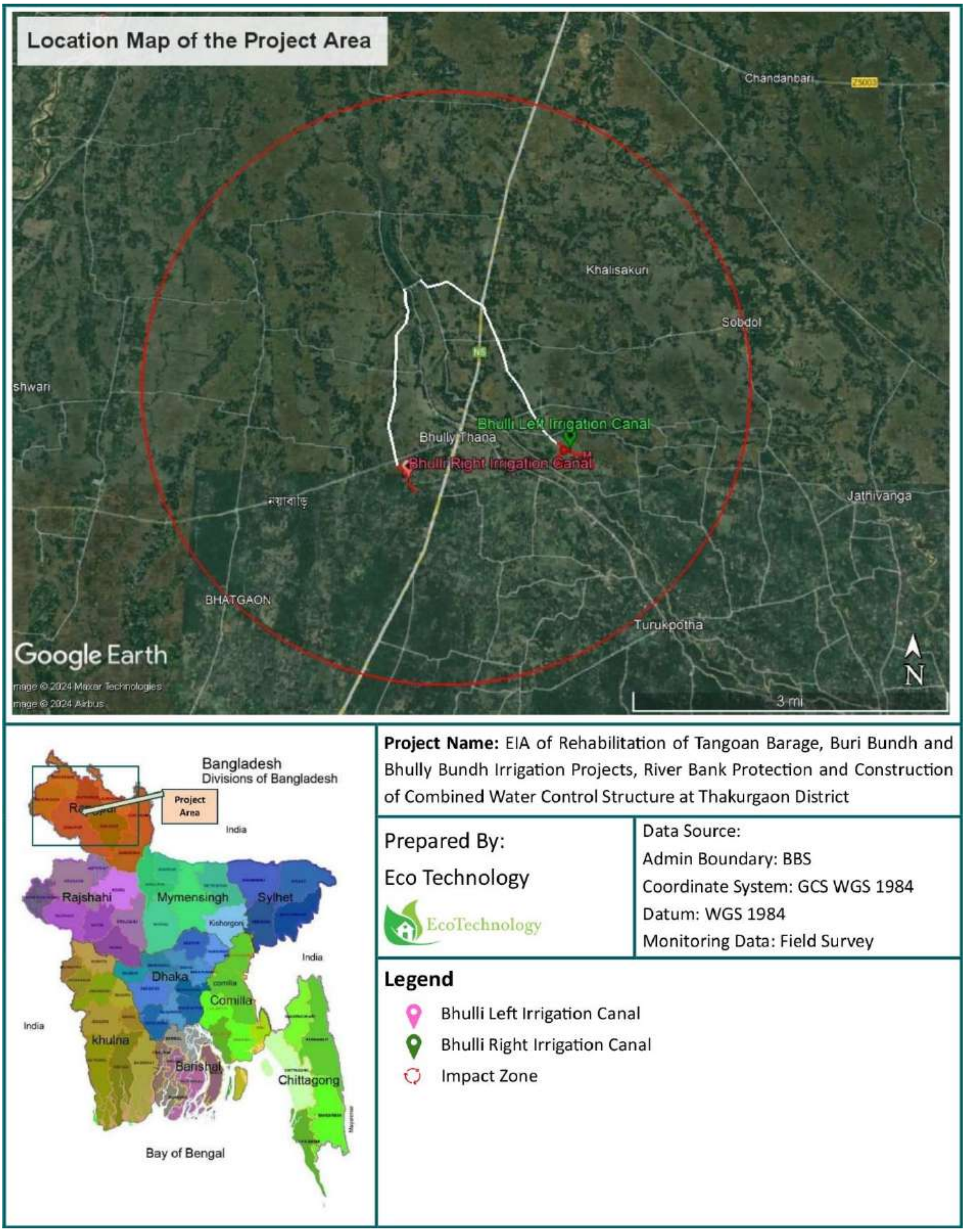
Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-5: Location Map of Combined Water Control Structure at Rautnagar over Kulic River (AOI 2KM Radius)



Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-6: Location Map of Bhulli Left Irrigation Canal and Bhulli Right Irrigation Canal (AOI 5KM Radius)



Source: Bangladesh Water Development Board (BWDB), 2024

The following Figure 3-7, Figure 3-8 , Figure 3-9, Figure 3-10, Figure 3-11 and Figure 3-12 shows the present condition of the project area of Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District.

Figure 3-7: The Project Area of Combined Water Control Structure at Nischintapur over Tangon River

Combined Water Control Structure at Nischintapur over Tangon River

Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-8: The Project Area of Combined Water Control Structure at Bangroad over Bhulli River

Combined Water Control Structure at Bangroad over Bhulli River

Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-9: The Project Area of Combined Water Control Structure at Beltola Over Shuk River

Combined Water Control Structure at Beltola over Shuk River

Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-10: The Project Area of Combined Water Control Structure at Rautnagar over Kulic River

Combined Water Control Structure at Rautnagar over Kulic River

Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-11: The Project Area of Bhulli Left Irrigation Canal

Bhulli Left Irrigation Canal

Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-12: The Project Area of Bhulli Right Irrigation Canal

Bhulli Right Irrigation Canal

Source: Bangladesh Water Development Board (BWDB), 2024

3.2 Land Requirements for the Proposed Project

The proposed project requires 21.61 Acres of lands from six location in Thakurgaon District.

<u>Combined Water Control structure at Nischintapur on the Tangon River</u>

Location: 26.0261245 N, 88.4548858 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Nischintapur

<u>Combined Water Control structure at Bangroad on the Bhulli River</u>

Location: 26.0590162 N, 88.6217261 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Shukanpukuri

<u>Combined Water Control structure at Beltola on the Shuk River</u>

Location: 26.126198 N, 88.410720 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Dholarhat

<u>Combined Water Control structure at Rautnagar on the Kulic River</u>

Location: 25.8447759 N, 88.2249694 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Dholarhat

<u>Extension of Left and Right Bhulli Irrigation canal</u>

Location: 26.123308 N, 88.549589 E (Left Irrigation canal proposed extension starting)

26.119476 N, 88.524311 E (Right Irrigation canal proposed extension starting)

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Auliapur, Balia

3.3 Brief Description of the Project

The Bangladesh Water Development Board planned to implement the Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District. The following **Error! Reference source not found.** shows the basic information of the proposed project.

Table 3-1: Basic Information of the Proposed Project

Name of the project	Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District
Sponsoring Ministry/ Division	Ministry of Water Resources
Implementing Agency	Bangladesh Water Development Board (BWDB)
Deputy Project Director	Md. Golam Zakaria
Total Project Cost	33625.13 lac Taka
Land Requirements	21.61 Acres
Project Category (Based on Environment Conservation Rules 2023)	Red
Address	Thakurgaon Thakurgaon
Project Duration	4 Years

Source: Bangladesh Water Development Board (BWDB), 2024

3.3.1 At a Glance of the Project

Table 3-2: Summary of the Project

1	**Name of the Four Water Control Structure:**	1) Combined Water Control Structure at Nischintapur over Tangon River 2) Combined Water Control Structure at Bangroad over Bhulli River 3) Combined Water Control Structure at Beltola over Shuk River 4) Combined Water Control Structure at Rautnagar over Kulic River
2	**Name of the Two Irrigation Canal:**	1) Bhulli left Irrigation Canal 2) Bhulli Right Irrigation Canal
3	**Details of Each Water Control Structure:** Length, width, height, approach road of both side, coordinates of these structure, required land,	**1) Combined Water Control Structure at Nischintapur over Tangon River** • Length-120 m • Width 30.30 m • Hight-6.5 to 7.70 m

	water reserve capacity, water flow capacity, approach road coordinates, process flow of the water control structure, activities involved in the project	• Approach road of both side (existing) • Coordinates of these structure (26.0261245 N, 88.4548858 E) • Required Land (3.05 acre) • Water Reservoir Capacity (2.5 m over 13 km) • Approach road coordinates (26.026051 N, 88.454233 E and 26.026495 N, 88.455346 E • Process flow of the water control structure-N/A • Activities involved in the project- Construction of weir cum bridge cum regulator **2) Combined Water Control Structure at Bangroad over Bhulli River** • Length-36.5 m • Width 30.30 m • Hight-6.5 to 7.70 m • approach road of both side (existing) • coordinates of these structure (26.0590162 N, 88.6217261 E) • Required Land (4.70 acre) • Water Reservoir Capacity (2.5 m over 11 km) • approach road coordinates (26.059364°N, 88.621975°E and 26.058610° N, 88.621497°E) • process flow of the water control structure-N/A • activities involved in the project- Construction of weir cum bridge cum regulator **3) Combined Water Control Structure at Beltola over Shuk River** • Length-36.5 m • Width-30.3 m • Hight-6.5 to 7.70 m • approach road of both side (existing) • coordinates of these structure (26.126198 N, 88.410720 E) • Required Land (2.90 acre) • Water Reservoir Capacity (2.5 m over 12 km) • approach road coordinates (26.127309 N, 88.411037° E and 26.127247° N, 88.411778° E) • process flow of the water control structure-N/A • activities involved in the project- Construction of weir cum bridge cum regulator **4) Combined Water Control Structure at Rautnagar over**

4		**Kulic River** • Length-60 m • Width-30.30 m • Hight-7.00 to 8.5 m • approach road of both side (existing) • coordinates of these structure (25.8447759 N, 88.2249694 E) • Required Land (5.42 acre) • Water Reservoir Capacity (2.5 m over 12 km) • approach road coordinates (25.843798°N, 88.224522° E and 25.844830° N, 88.225065° E) • process flow of the water control structure-N/A • activities involved in the project- Construction of weir cum bridge cum regulator
4	**Details of Each Irrigation Channel: Any documents** Length, width, depth, coordinates, required land, water reserve capacity, water flow capacity, estimated land for irrigation coverage, duration of irrigation, number culvert proposed in the irrigation channel, number of trees proposed for plantation in both side of the channel, vertical diagram of irrigation channel, cross section diagram of the irrigation channel, any diagram of the irrigation channel, process flow of the irrigation channel, activities involved in the project etc.	**1) Bhulli Left Irrigation Canal** • Length-700 m • Width-24 m • Hight-2 m • Approach road of both side (N/A) • Coordinates of these structure • 26.123308 N, 88.549589 E – • Left Irrigation canal proposed extension starting • Required Land (2.77 acre) • Water Reservoir Capacity (1.7 m all through the length) • Approach road coordinates-N/A • Process flow of the water control structure-N/A • Activities involved in the project- Construction of irrigation canal **2) Construction of Bhulli Right Irrigation Canal** • Length-1600 m • Width-7 m • Hight-1 m • Approach road of both side (N/A) • Coordinates of these structure 26.119476 N, 88.524311 E- • Right Irrigation canal proposed extension starting • Required Land (2.77 acre) • Water Reservoir Capacity (0.7 m all through the canal) • Approach road coordinates -N/A • Process flow of the water control structure-N/A • Activities involved in the project- Construction of Irrigation canal

3.4 Reason for the Construction of the Project

1. Combined Water Control structure at Nischintapur on the Tangon River

Location: 26.0261245 N, 88.4548858 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Nischintapur

The reason for the construction of the structure at that place:

- In 2016, a proposal was sent to the Deputy Commissioner's Conference to construct an infrastructure to store water in Thakurgaon town over Tangon River. Then the consent letter for land acquisition was given by the Deputy Commissioner via Office Memorandum of Office of the Deputy Commissioner, Thakurgaon. -05.55.9400.016.00.096.20-06/1, Date-11th January, 2021.
- Local public representative Ramesh Chandra Sen, MP, Thakurgaon-1 and Chairman of the Standing Committee of the Ministry of Water Resources urged the Water Development Board, Thakurgaon to build a water control structure at the place repeatedly mentioned on the basis of the demand of the people.
- According to the recommendations of the feasibility committee formed via, Office Memorandum No. of Board Secretariat – বাপাউবো (সচি)/ পরি-১/ বিবিধ-৩/ ২০১৯ (১ম খন্ড)/৬২ Date: 24-03-2019 AD. provision was made for the construction of Combined Water Control Structure in the DPP.
- According to the Office Memorandum No. 42.00.0000.041.14.027.19-126 of the Ministry of Water Resources, Planning Section-3, Date-25-10-23, the accuracy of the selection of location of the site of the construction of the combined water control structure included in the DPP has been verified.

2. Combined Water Control structure at Bangroad on the Bhulli River

Location: 26.0590162 N, 88.6217261 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Shukanpukuri

The reason for the construction of the structure at that place:

- During the dry season, the water of the Bhulli river dries up, if the structure is constructed, it will be possible to hold and store the water during monsoon season and maintain the natural characteristics of the river.
- Local public representative Ramesh Chandra Sen, MP, Thakurgaon-1 and Chairman of the Standing Committee of the Ministry of Water Resources urged the Water Development Board, Thakurgaon to build a water control structure at the place repeatedly mentioned on the basis of the demand of the people.
- According to the recommendations of the feasibility committee formed via, Office Memorandum No. of Board Secretariat – বাপাউবো (সচি)/ পরি-১/ বিবিধ-৩/ ২০১৯ (১ম খন্ড)/৬২ Date: 24-03-2019 AD. provision was made for the construction of Combined Water Control Structure in the DPP.
- According to the Office Memorandum No. 42.00.0000.041.14.027.19-126 of the Ministry of Water Resources, Planning Section-3, Date-25-10-23, the accuracy of the selection of

location of the site of the construction of the combined water control structure included in the DPP has been verified.

3. **Combined Water Control structure at Beltola on the Shuk River**

Location: 26.126198 N, 88.410720 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Dholarhat

The reason for the construction of the structure at that place:

- During the dry season, the water of the Shuk river dries up, if the structure is constructed, it will be possible to hold and store the water during monsoon season and maintain the natural characteristics of the river.
- Local public representative Ramesh Chandra Sen, MP, Thakurgaon-1 and Chairman of the Standing Committee of the Ministry of Water Resources urged the Water Development Board, Thakurgaon to build a water control structure at the place repeatedly mentioned on the basis of the demand of the people.
- According to the recommendations of the feasibility committee formed via, Office Memorandum No. of Board Secretariat – বাপাউবো (সচি)/ পরি-১/ বিবিধ-৩/ ২০১৯ (১ম খন্ড)/৬২ Date: 24-03-2019 AD. provision was made for the construction of Combined Water Control Structure in the DPP.
- According to the Office Memorandum No. 42.00.0000.041.14.027.19-126 of the Ministry of Water Resources, Planning Section-3, Date-25-10-23, the accuracy of the selection of location of the site of the construction of the combined water control structure included in the DPP has been verified.

4. **Combined Water Control structure at Rautnagar on the Kulic River**

Location: 25.8447759 N, 88.2249694 E

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Dholarhat

The reason for the construction of the structure at that place:

- During the dry season, the water of the Kulic river dries up, if the structure is constructed, it will be possible to hold and store the water during monsoon season and maintain the natural characteristics of the river.
- Local public representative urged the Water Development Board, Thakurgaon to build a water control structure at the place repeatedly mentioned on the basis of the demand of the people.
- According to the recommendations of the feasibility committee formed via, Office Memorandum No. of Board Secretariat – বাপাউবো (সচি)/ পরি-১/ বিবিধ-৩/ ২০১৯ (১ম খন্ড)/৬২ Date: 24-03-2019 AD. provision was made for the construction of Combined Water Control Structure in the DPP.
- According to the Office Memorandum No. 42.00.0000.041.14.027.19-126 of the Ministry of Water Resources, Planning Section-3, Date-25-10-23, the accuracy of the selection of location of the site of the construction of the combined water control structure included in the DPP has been verified.

- The Kulik River Protection Committee has been raising repeated demands for the construction of a water control structure over the Kulic river.

5. <u>Extension of Left and Right Bhulli Irrigation canal</u>

Location: 26.123308 N, 88.549589 E (Left Irrigation canal proposed extension starting)

26.119476 N, 88.524311 E (Right Irrigation canal proposed extension starting)

District: Thakurgaon, Upazila: Thakurgaon Sadar, Union: Auliapur, Balia

The reason for the construction of the structure at that place:

- There is an urged to extend the existing irrigation canal from the stockholders.
- According to the recommendations of the feasibility committee formed via, Office Memorandum No. of Board Secretariat – বাপাউবো (সচি)/ পরি-১/ বিবিধ-৩/ ২০১৯ (১ম খন্ড)/৬২ Date: 24-03-2019 AD. provision was made for the construction of Combined Water Control Structure in the DPP.

3.5 Relevant Activities

There are different types of activities involved in the establishment of Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District. The project has been split into three project stages:

- Stage 1: Pre-Construction.
- Stage 2: Construction Phase.
- Stage 3: Operation Phase.

3.5.1 Project Stage 1: Pre-Construction

The following activities are involved for setting up a construction site to comply with all required safety and health standards.

- **Site Clearance and Demolition:** Clearing the site is the very first step in site preparation. The entire site must be in a graded and clear condition. The case involves the demolishing of buildings, the removal of trees, shrubs, vegetation, grass, and debris depending on the existing area finishing and eliminating any underground infrastructures.
- **Site Utilities:** The utility lines are drainage lines (Storm water and sewer lines), portable water, electricity, fire hydrant, power lines (can be over head), communication lines (e.g. Fiber lines), gas lines and steam lines depending on the structure. In some areas the pipes for the different utilities are color coded for ease of identification.
- **Protecting the Public:** Site demarcation using hoardings, signage, detours, overhead protection, and site control access can be used to protect the public. Areas should be clearly demarcated on Site for walkways, vehicular access and material and equipment storage.
- Heavy equipment and machinery operation in the project site.
- Maintenance and replacement of vehicles and equipment.
- Landfilling and levelling; and.

- Land preparation for the proposed project.

3.5.2 Project Stage 2: Construction Phase

Once the site establishment stage is complete, works can begin in preparation for the main construction of the Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District. The major activities carried out during construction phase of the proposed project include the following:

- Mobilization of personnel, material, and equipment (including establishment of project office and labor shed, etc.)
- Earth excavation works with shore protection measures for the basement construction.
- Construction of basements with ramps.
- Heavy equipment and machinery operation in the construction site.
- Maintenance and replacement of vehicles and equipment.
- Use of utilities like land, power, water, fuel etc.
- Solid and liquid waste generation from the labor camp and construction site and disposal.
- Monitoring of mitigation measures for Environmental and Social Impact.
- Access Road construction.
- Security system, traffic, and pedestrian management system.
- Landscaping/tree plantation, etc.
- Overall project construction and management.

The following systems will be installed in the construction phase with other major systems.

3.5.3 Project Stage 3: Operation Phase

Main activities of the Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District in operation phase are as follows:

- Manpower requirements for the operation
- Management Training / Operation.
- Use of utilities for the project and worker's facilities.
- Maintenance of the continuous power supply system.
- Commercial operation of the irrigation canal and combined water structure
- Maintenance and replacement of equipment.
- Implementation of CSR activity; and.
- Monitoring of EMP, DMP and HSE.
- Waste Management

3.6 Utilities Requirements

3.6.1 Water Supply

Mainly the contractors will responsible regarding supply of water. In terms of water, contractors may carry water in truck to the project site from other available water sources. The water demand will be met through water deep tube wells.

3.6.2 Electricity Supply

Mainly the contractors will responsible regarding supply of electricity. For electricity supply they may use generators for the production of electricity in pre-construction and construction phase. For the electrical power supply in operation phase, national power grid will be used.

3.6.3 Waste Management

Solid waste will be generated in terms of dirt due to digging the soil surface for irrigation canal and combined water structure. Apart from this, in pre-construction phase some solid trash will be generated during clearing the right of way.

During the construction phase, different types of solid and non-hazardous wastes can be generated, including dredging materials, paper and cardboard, plastic containers, waste chemicals, woods including timber wastes, scrap metals, and sanitary wastes, etc.

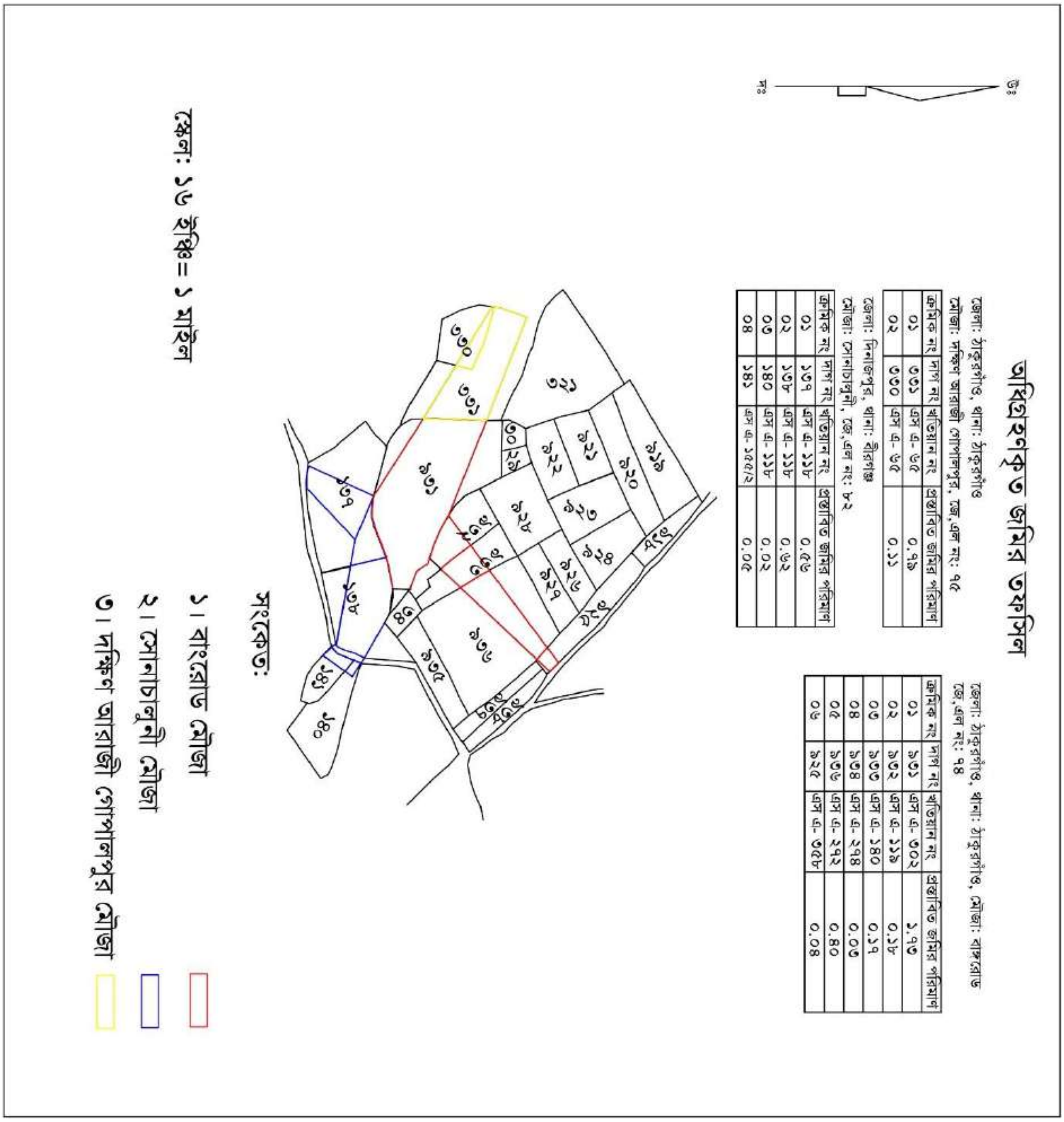
3.6.4 Man Power Requitements

Man Power of the project is not fixed. In the different stages of the project will require different skilled map power. Bangladesh Water Development Board (BWDB) will employ them on project basis as per required.

3.7 Project Layout

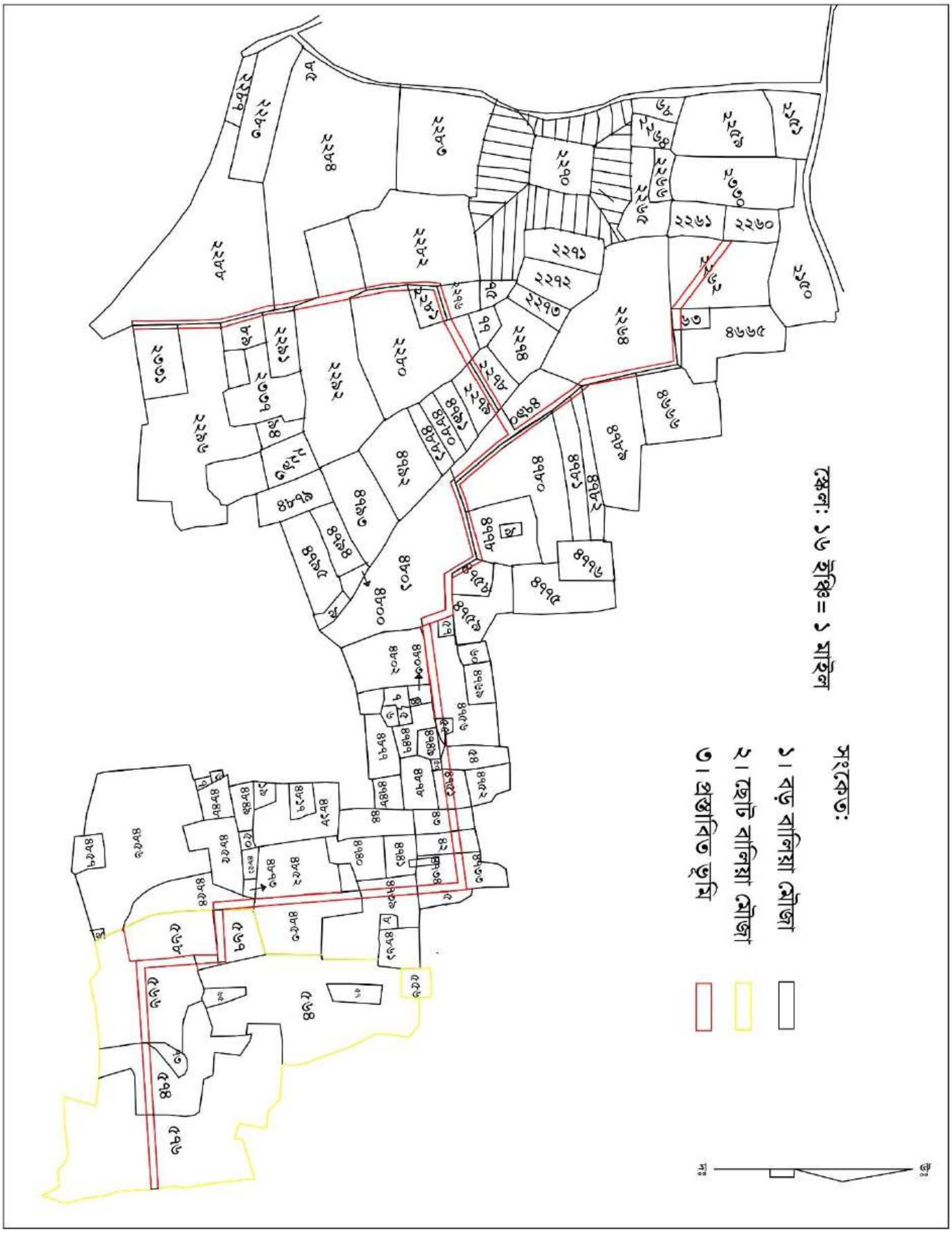
Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District. The following Figure 3-13, Figure 3-14, Figure 3-15, Figure 3-16 and Figure 3-17 is the layout map of the proposed project.

Figure 3-13: Layout Plan of the Project Area



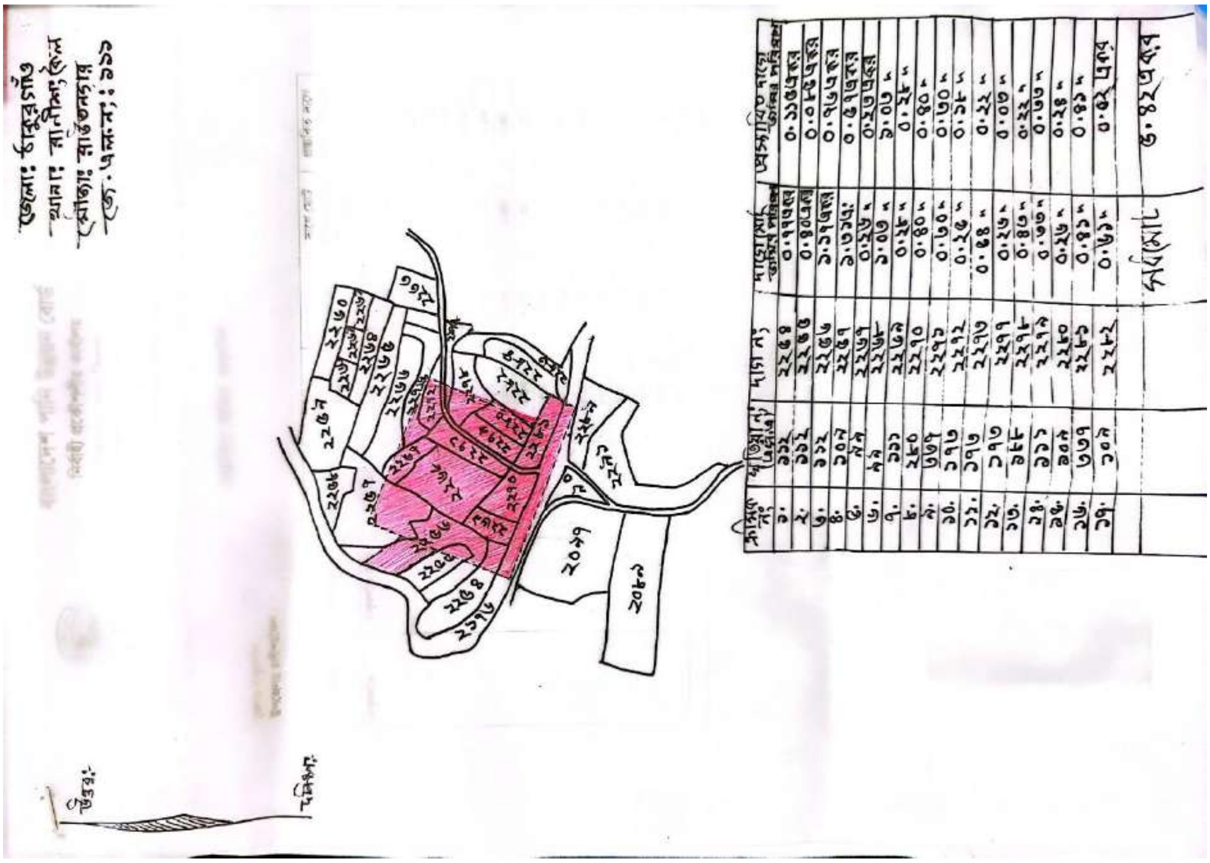
Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-14: Layout Plan of the Project Area



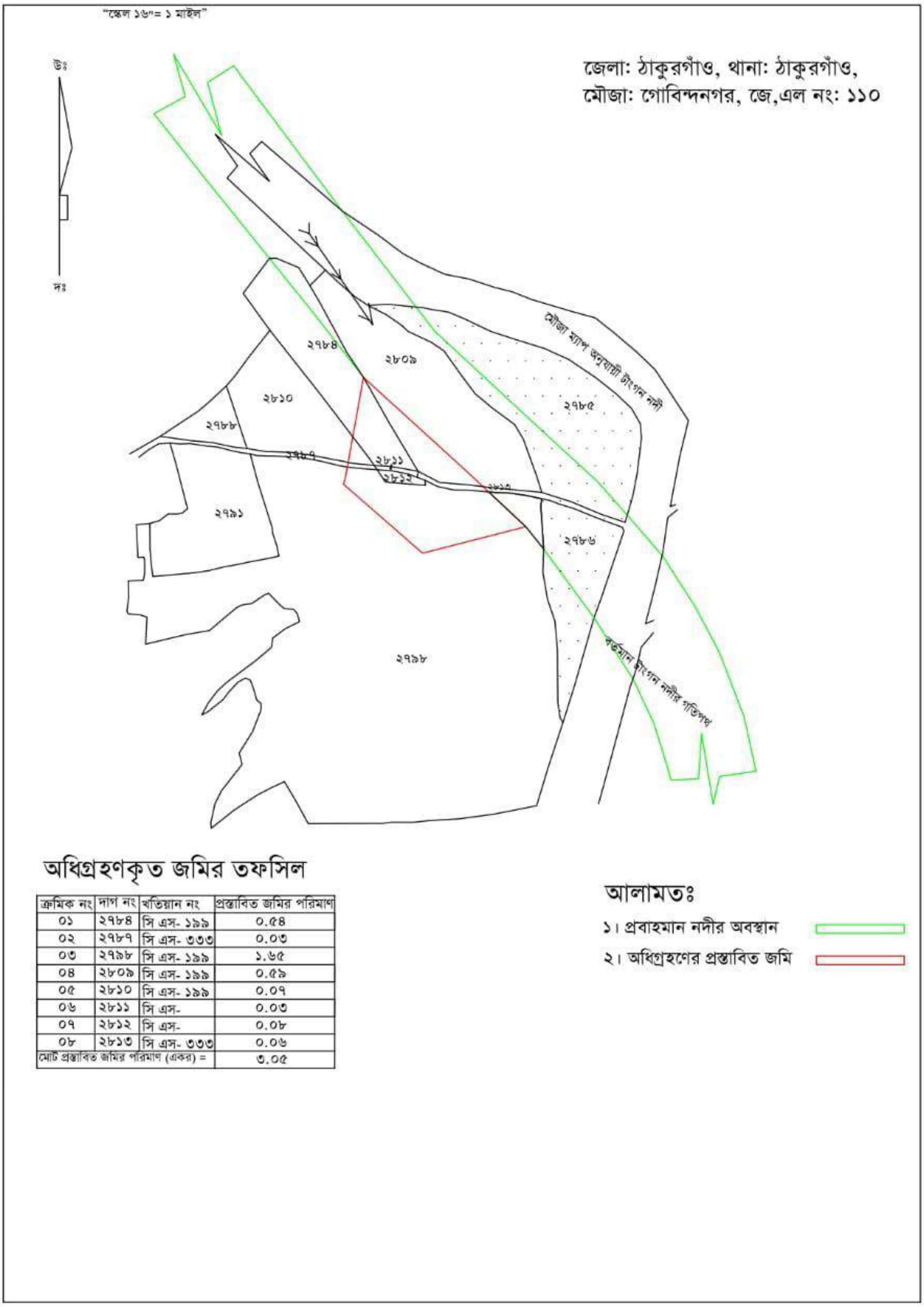
Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-15: Layout Plan of the Project Area



Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-16: Layout Plan of the Project Area

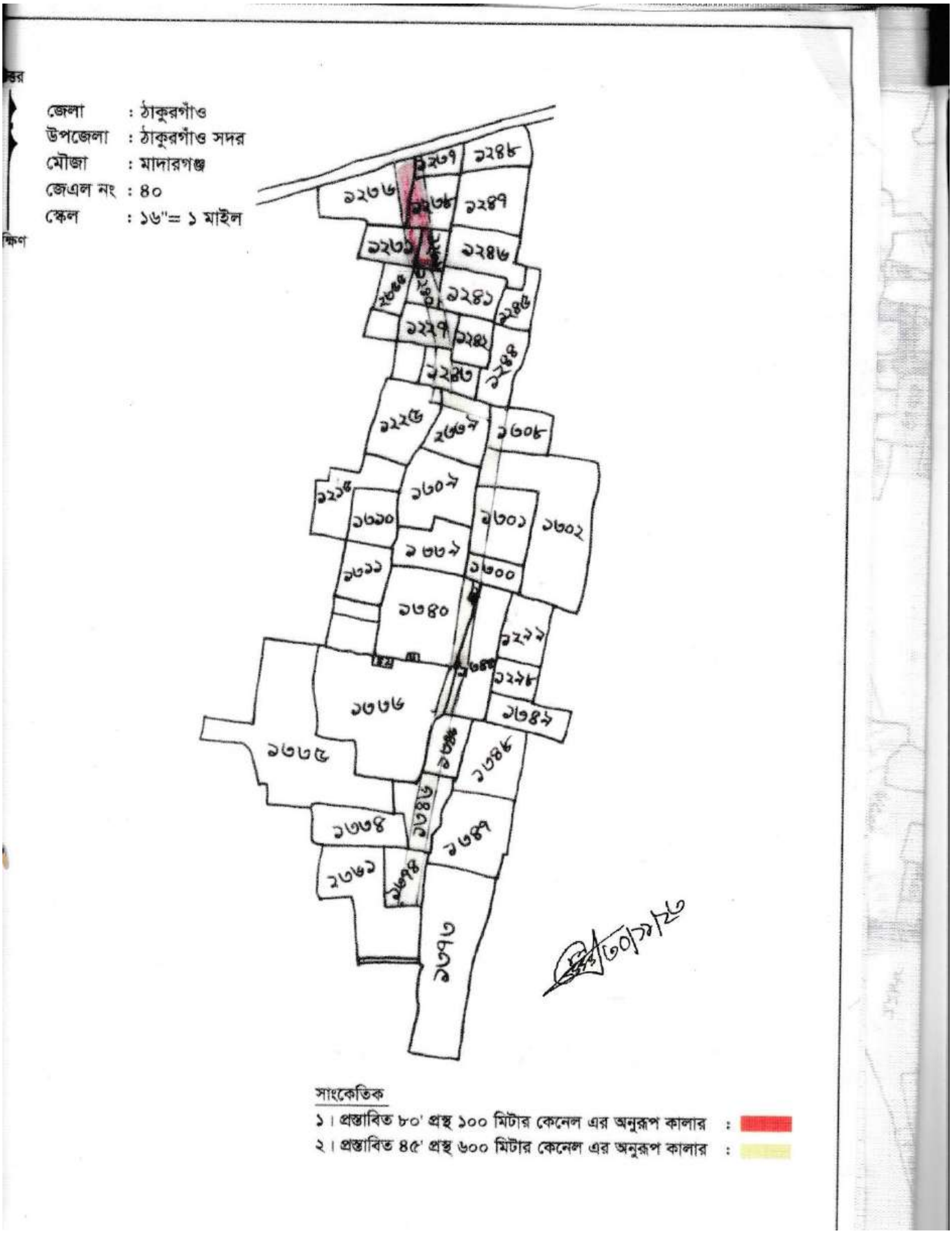


অধিগ্রহণকৃত জমির তফসিল

ক্রমিক নং	দাগ নং	খতিয়ান নং	প্রস্তাবিত জমির পরিমাণ
০১	২৭৮৪	সি এস- ১৯৯	০.৫৪
০২	২৭৮৭	সি এস- ৩৩৩	০.০৩
০৩	২৭৯৮	সি এস- ১৯৯	১.৬৫
০৪	২৮০৯	সি এস- ১৯৯	০.৫৯
০৫	২৮১০	সি এস- ১৯৯	০.০৭
০৬	২৮১১	সি এস-	০.০৩
০৭	২৮১২	সি এস-	০.০৮
০৮	২৮১৩	সি এস- ৩৩৩	০.০৬
মোট প্রস্তাবিত জমির পরিমাণ (একর) =			৩.০৫

Source: Bangladesh Water Development Board (BWDB), 2024

Figure 3-17: Layout Plan of the Project Area



Source: Bangladesh Water Development Board (BWDB), 2024

3.8 Equipment

The following equipment will generally be required to deliver the Project:

- Generators;
- Cranes;
- Excavators;
- Tractors;
- Water Pumps;
- Trucks and trailers;
- Dozers;
- Rollers;
- Waste treatment facilities;
- Concrete batching plant;
- Generators air compressors;
- Fuel tankers;
- Forklifts; and
- Others machineries' for excavating the irrigation canal and development of combined water structure.

3.9 Organogram

Organogram of the project and Institutional setup for environmental management for the proposed project are shown in Table 3-3.

Table 3-3: Human Resource and Administrative Support for EMP

Serial No	Name of Officers and post	Position in the committee
01	Umme Mahfuza Haque Superintendent Engineer Design Circrle-06 BWDB, Dhaka	Convener
02	Salma Begum Deputy Chief (Sociology) Office of the Chief Water Management BWDB, Dhaka	Member
03	Mohhammed Ali Rubel Research Officer (Environment and forest) Office of the Chief Planning-1 BWDB, Dhaka	Member
04	Md. Majedul Islam Research Officer (Economics) Office of the Chief Engineer Northern Zone, BWDB, Rangpur	Member
05	Md. Rubayet Imtiaz	Member

	Executive Engineer Thakurgaon Mechanical Division BWDB, Thakurgaon	
06	Swapan Kumar Das Senior Water Resource Specialist, IWM	Member
07	Sanjib Sarker Shawon Research Consultant CEGIS, Bangladesh.	Member
08	Md. Golam Zakaria Executive Engineer Thakurgaon O & M Division BWDB, Thakurgaon	Member-Secretary

Source: Bangladesh Water Development Board, 2024

3.10 Project Schedule

Bangladesh Water Development Board (BWDB) has started the project activities from 01-07-2021 and will finish 31-12-2024. The following Table 3-4 shows the project schedule of the proposed project.

Table 3-4: Tentative Project Implementation Schedule of Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District

Chapter 4

Environmental Baseline

4 Environmental Baseline

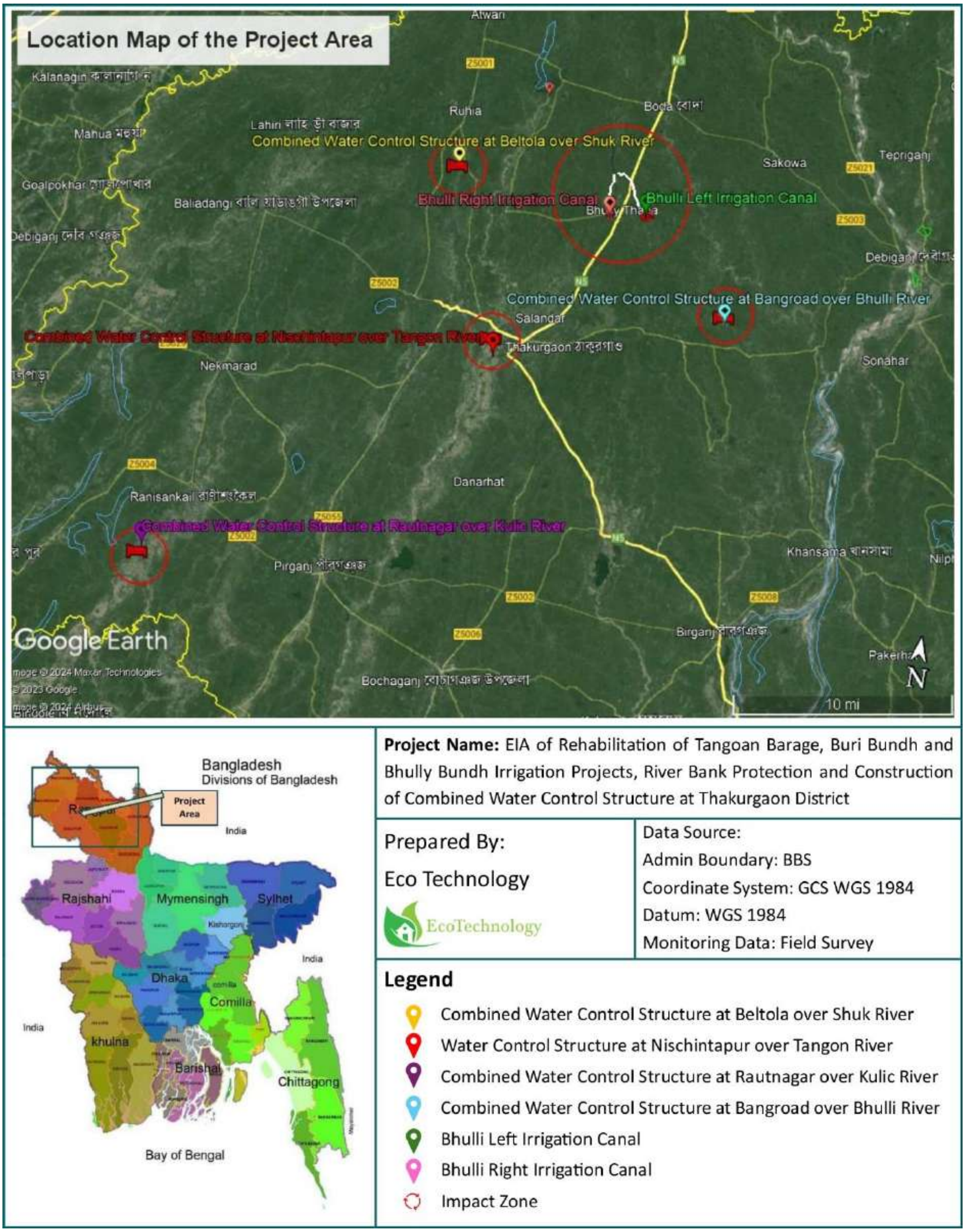
4.1 Study Area and Methodology

Before the start of the project, it is desirable to measure the levels of the appropriate environmental and social parameters which could be significantly affected as a result of implementation of the proposed project. The environmental baseline data covered important features on the land e.g. sensitive habitats, settlements cultural sites, fishing habitat and other places of environmental and social significance. This chapter describes the existing environmental and social baseline setting of the study area. The study area map is shown in the following Figure 4-1

4.1.1 Area of Influence (AOI)

2KM radius of AOI for Combined Water Control structure at Nischintapur on the Tangon River, Combined Water Control structure at Bangroad on the Bhulli River, Combined Water Control structure at Beltola on the Shuk River, Combined Water Control structure at Rautnagar on the Kulic River and 5KM radius of AOI for Extension of Left and Right Bhulli Irrigation canal. The following Figure 4-1 shows the AOI of project area.

Figure 4-1: AOI of the Study Area Map (Six Project Locations)



Source: Eco Technology GIS Team, 2024

4.1.2 Methodology

The baseline data were collected through field investigations and collection of available secondary data, review of existing documents/publications pertaining to the study area. The baseline data collection for different environmental and socio-economic components viz. meteorology, ambient air quality, noise environment, ground water quality, surface water quality, soil quality, land use, ecology (terrestrial and aquatic), fisheries, risk and vulnerabilities and socio-economic was carried out by Eco Technology through a well-developed field study covering data collection during May 2024 from primary as well as secondary sources. Data was collected at the project site and 2KM radius of AOI for Combined Water Control structure at Nischintapur on the Tangon River, Combined Water Control structure at Bangroad on the Bhulli River, Combined Water Control structure at Beltola on the Shuk River, Combined Water Control structure at Rautnagar on the Kulic River and 5KM radius of AOI for Extension of Left and Right Bhulli Irrigation canal under Thakurgaon District.

4.2 Land Use

Land use inventories are an essential component in land resource evaluation and environmental studies due to the changing nature of land use patterns. The land use study for the proposed project locations and 2KM radius for Combined Water Control structure at Nischintapur on the Tangon River, Combined Water Control structure at Bangroad on the Bhulli River, Combined Water Control structure at Beltola on the Shuk River, Combined Water Control structure at Rautnagar on the Kulic River and 5KM for Extension of Left and Right Bhulli Irrigation canal and its 2 km and 5 km buffer areas was undertaken with the following objectives:

- To study the land use in the 2km and 5 km radius areas of the proposed project site and provide inputs for environmental planning of the proposed project by analyzing the existing land use scenario; and
- To establish the existing base line scenario using a GIS database for incorporation of thematic information on the different physical features including water bodies, homestead vegetation, agricultural land etc.

4.2.1 Land Use Interpretation of the Study Area

The predominant land use-land cover of the study area includes agricultural land, Settlement, Road Networks, Homestead Vegetation, Vacant Land, Waterbody, and Vegetation. The land use of the study area is presented in Table 4-1, Table 4-2, Table 4-3, Table 4-4, Table 4-5 and

Combined Water Control Structure at at Rautnagar over Kulic River (2 km Radius)		
Land Use	**Area (sq.km.)**	**Percentage (%)**
Agriculture	8.72	66.89
Road Network	0.14	1.11
Settlement	3.71	28.48
Vegetation	0.19	1.44
Waterbody	0.27	2.09

Total	13.04	100.00

Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

Table 4-2: Land Use Pattern of the Combined Water Control Structure at Nischintapur over Tangon River

Combined Water Control Structure at Nischintapur over Tangon River (2 km Radius)		
Land Use	**Area (sq.km.)**	**Percentage (%)**
Agriculture	2.92	22.67
Homestead Vegetation	2.72	21.08
Road Network	0.26	2.03
Settlement	5.32	41.31
Vacant Land	0.01	0.11
Vegetation	1.17	9.04
Waterbody	0.49	3.77
Total	**12.89**	**100.00**

Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

Table 4-3: Land Use Pattern of the Combined Water Control Structure at Bangroad over Bhulli River

Combined Water Control Structure at Bangroad over Bhulli River (2 km Radius)		
Land Use	**Area (sq.km.)**	**Percentage (%)**
Agriculture	5.99	65.09
Homestead Vegetation	2.31	25.14
Road Network	0.13	1.43
Settlement	0.38	4.13
Vegetation	0.14	1.47
Waterbody	0.25	2.73
Total	**9.20**	**100.00**

Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

Table 4-4: Land Use Pattern of the Bhulli Right & Left Irrigation Canal (5 km Radius)

Bhulli Right & Left Irrigation Canal (5 km Radius)		
Land Use	**Area (sq.km.)**	**Percentage (%)**
Agriculture	8.68	68.69

Homestead Vegetation	2.94	23.29
Road Network	0.26	2.07
Settlement	0.20	1.59
Vegetation	0.11	0.89
Waterbody	0.44	3.46
Total	**12.64**	**100.00**

Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

Table 4-5: Land Use Pattern of the Combined Water Control Structure at Beltola over Shuk River (2 km Radius)

Combined Water Control Structure at Beltola over Shuk River (2 km Radius)		
Land Use	**Area (sq.km.)**	**Percentage (%)**
Agriculture	8.56	67.53
Commercial	0.04	0.29
Homestead Vegetation	3.49	27.54
Road Network	0.22	1.77
Vegetation	0.19	1.52
Waterbody	0.17	1.35
Total	**12.68**	**100.00**

Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

Figure 4-2 .

Table 4-1: Land Use Pattern of the Combined Water Control Structure at at Rautnagar over Kulic River

Combined Water Control Structure at at Rautnagar over Kulic River (2 km Radius)		
Land Use	**Area (sq.km.)**	**Percentage (%)**
Agriculture	8.72	66.89
Road Network	0.14	1.11
Settlement	3.71	28.48
Vegetation	0.19	1.44
Waterbody	0.27	2.09
Total	**13.04**	**100.00**

Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

Table 4-2: Land Use Pattern of the Combined Water Control Structure at Nischintapur over Tangon River

Combined Water Control Structure at Nischintapur over Tangon River (2 km Radius)		
Land Use	**Area (sq.km.)**	**Percentage (%)**
Agriculture	2.92	22.67
Homestead Vegetation	2.72	21.08
Road Network	0.26	2.03
Settlement	5.32	41.31
Vacant Land	0.01	0.11
Vegetation	1.17	9.04
Waterbody	0.49	3.77
Total	**12.89**	**100.00**

Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

Table 4-3: Land Use Pattern of the Combined Water Control Structure at Bangroad over Bhulli River

Combined Water Control Structure at Bangroad over Bhulli River (2 km Radius)		
Land Use	**Area (sq.km.)**	**Percentage (%)**
Agriculture	5.99	65.09
Homestead Vegetation	2.31	25.14
Road Network	0.13	1.43
Settlement	0.38	4.13
Vegetation	0.14	1.47
Waterbody	0.25	2.73
Total	**9.20**	**100.00**

Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

Table 4-4: Land Use Pattern of the Bhulli Right & Left Irrigation Canal (5 km Radius)

Bhulli Right & Left Irrigation Canal (5 km Radius)		
Land Use	**Area (sq.km.)**	**Percentage (%)**
Agriculture	8.68	68.69
Homestead Vegetation	2.94	23.29
Road Network	0.26	2.07

Settlement	0.20	1.59
Vegetation	0.11	0.89
Waterbody	0.44	3.46
Total	**12.64**	**100.00**

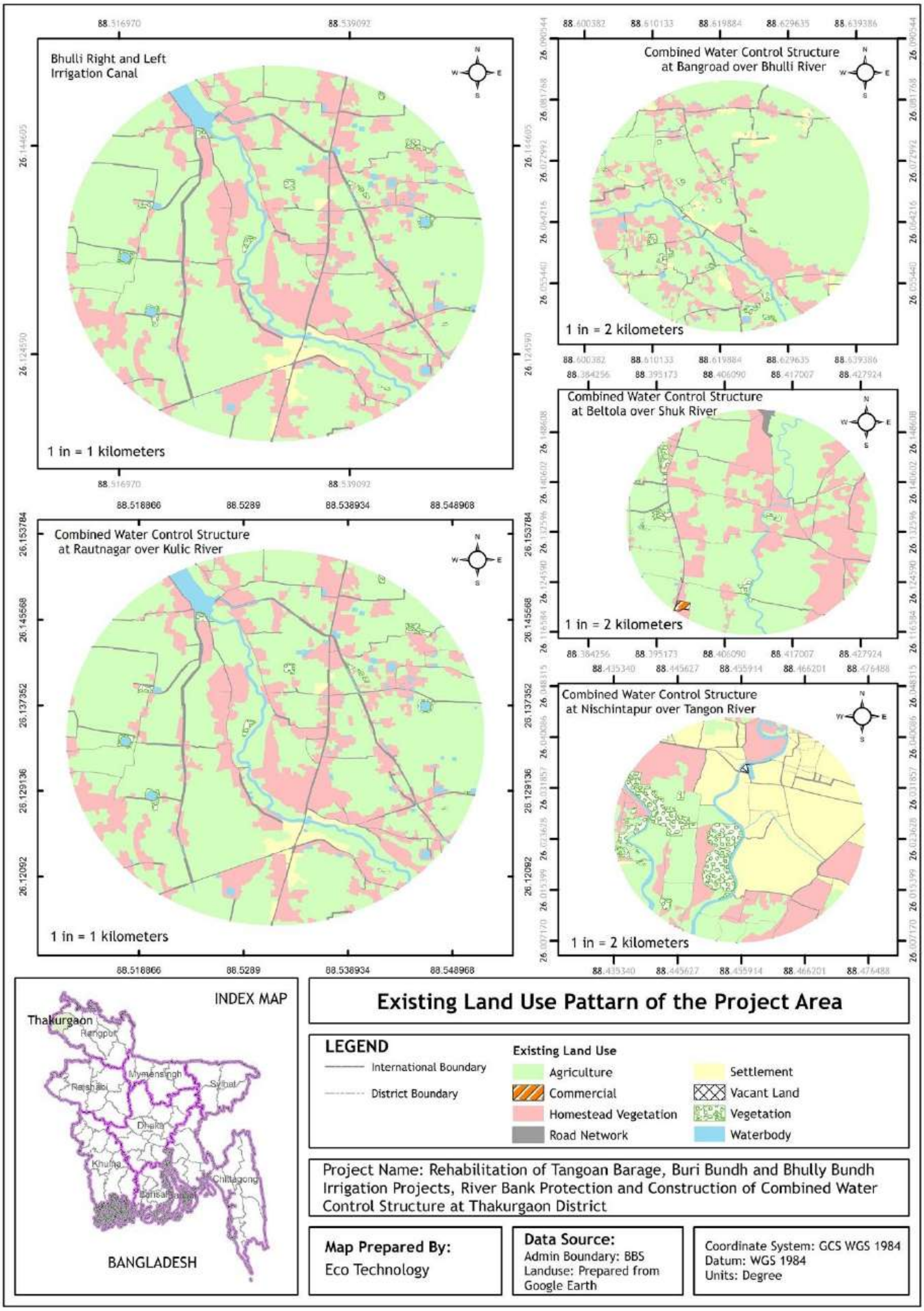
Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

Table 4-5: Land Use Pattern of the Combined Water Control Structure at Beltola over Shuk River (2 km Radius)

Combined Water Control Structure at Beltola over Shuk River (2 km Radius)		
Land Use	**Area (sq.km.)**	**Percentage (%)**
Agriculture	8.56	67.53
Commercial	0.04	0.29
Homestead Vegetation	3.49	27.54
Road Network	0.22	1.77
Vegetation	0.19	1.52
Waterbody	0.17	1.35
Total	**12.68**	**100.00**

Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

Figure 4-2: Land Use Map of the Study Area



Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

4.3 Physical Environment

4.3.1 Geology

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

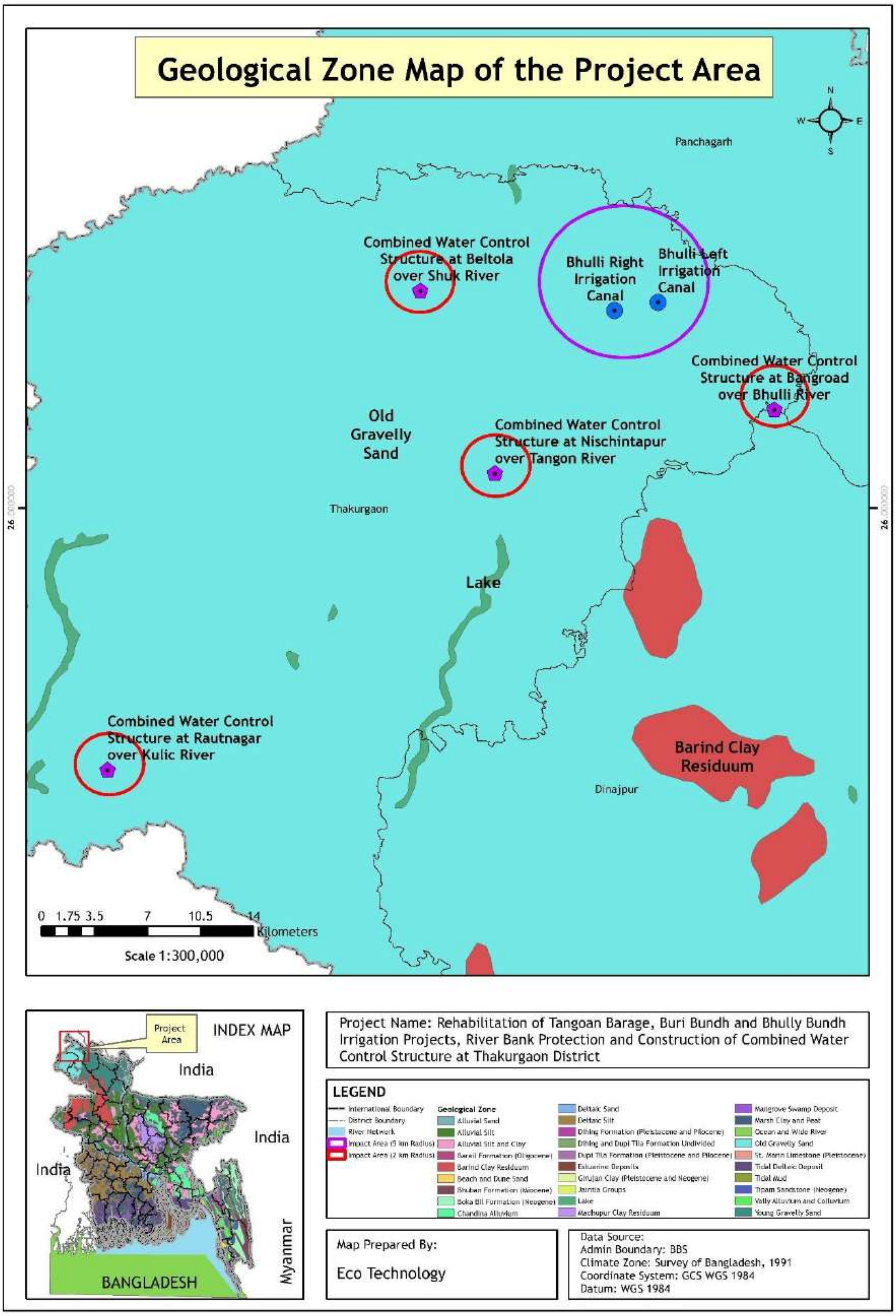
The geology of Bangladesh can be divided into three distinct regions, each having distinguishing characteristics of their own:

- **Stable Precambrian Platform in the North-west** characterized by limited to moderate thickness of sedimentary rocks above a Precambrian igneous and metamorphic basement.
- **Geo-Synclinal Basin in the south-east** Characterized by the huge thickness of clastic sedimentary rocks, mostly sandstone and shale of tertiary age. The basin is further subdivided into two parts, i.e., a fold belt in east and a foredeep to the west. As the intensity of the folding decreases towards the west, the fold belts unit merges with the foredeep unit, which is characterized by only mild or no folding. Therefore, the sedimentary layers are mostly horizontal to sub-horizontal and free from major tectonic deformation in the foredeep area covering the central part of the basin and this is depressed as River to delta plain topography of the land.
- **Hinge Zone**: A 25 km wide northeast-southwest zone that separates the Precambrian platform in the northwest from the geosyncline basin to the southeast. It is also known as the Eocene hinge zone.

Geology of the Study Area

The geology of the project site area is, 2KM radius for Combined Water Control structure at Nischintapur on the Tangon River, Combined Water Control structure at Bangroad on the Bhulli River, Combined Water Control structure at Beltola on the Shuk River, Combined Water Control structure at Rautnagar on the Kulic River and 5KM for Extension of Left and Right Bhulli Irrigation canal, Old Gravelly Sand formations have been found. The geological formations of the project study area shown in **Figure 4-3**.

Figure 4-3: Geology of the Study Area



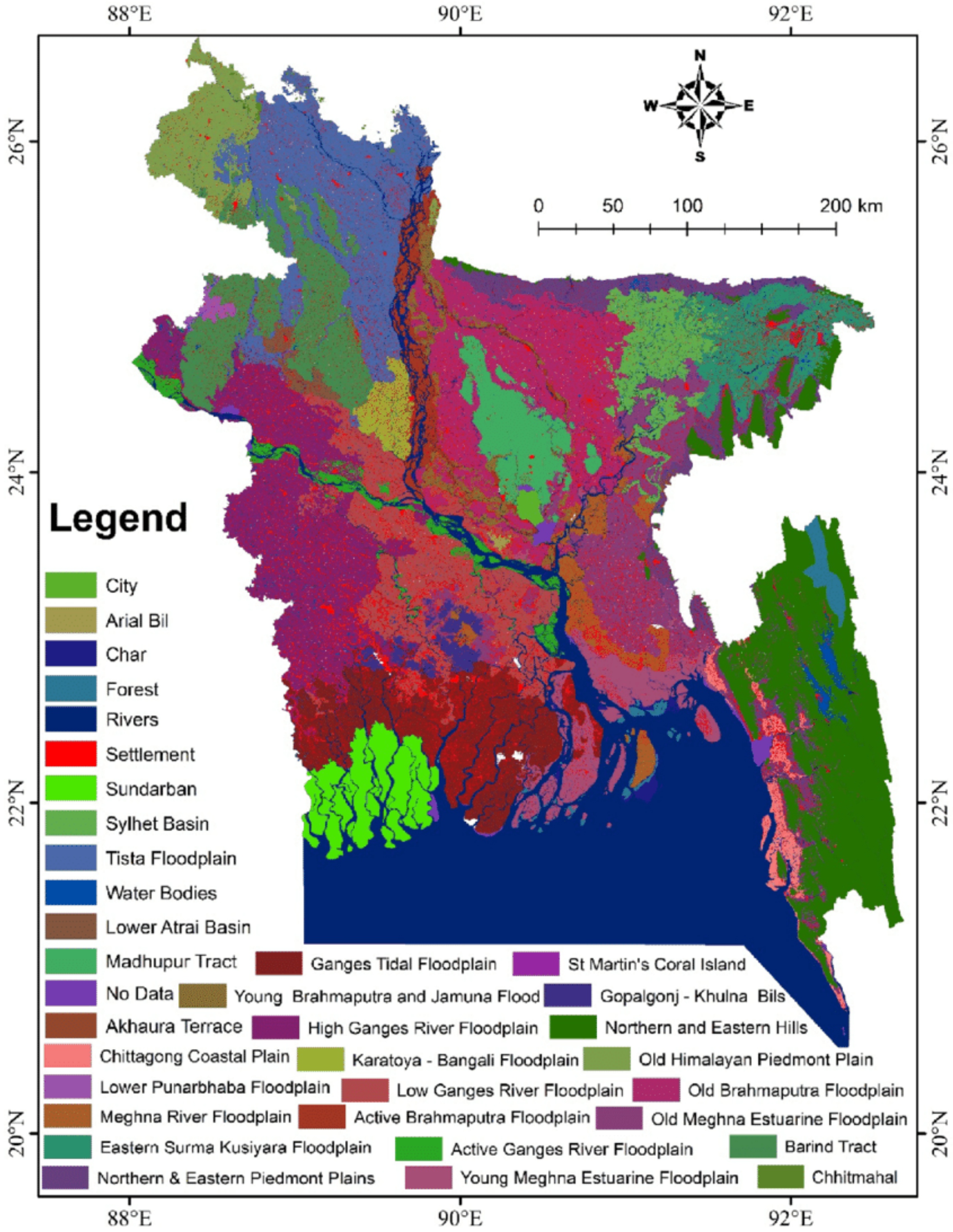
Source: GSB, 1991

4.3.2 Physiography

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

The Project study area occurs both Old Himalayan Piedmont Plain and Tista Floodplain and within 2KM radius for Combined Water Control structure at Nischintapur on the Tangon River, Combined Water Control structure at Bangroad on the Bhulli River, Combined Water Control structure at Beltola on the Shuk River, Combined Water Control structure at Rautnagar on the Kulic River and 5KM for Extension of Left and Right Bhulli Irrigation canal study area they also covered. The physiographic sub-region is shown in **Figure 4-4**. Details of the physiographic sub-region are described below.

Figure 4-4: Physiography of the Study Area



Source: Rashid, 1991

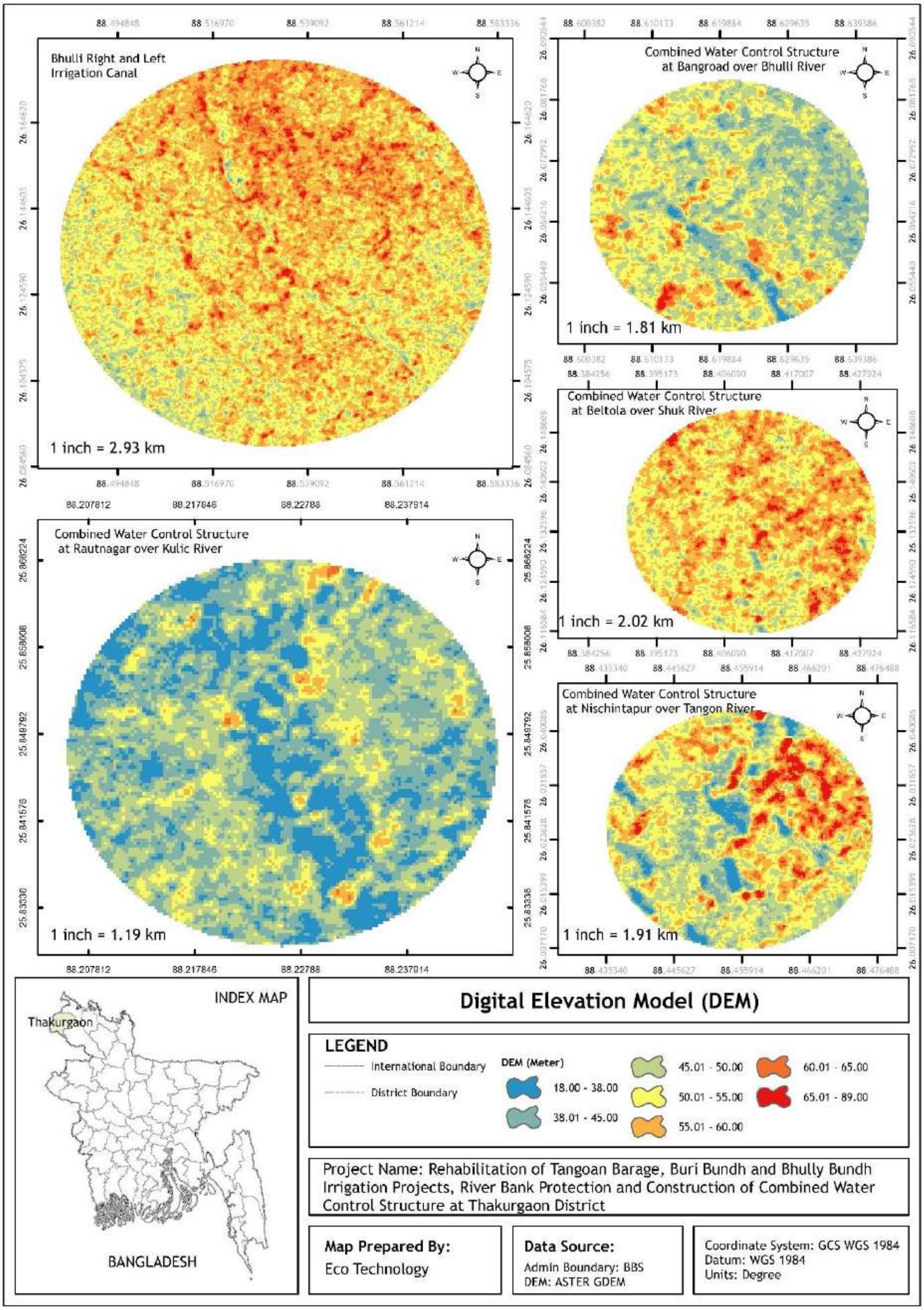
4.3.3 Topography

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

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

The study area falls in the North-western part of Bangladesh. Below **Figure 4-5** shows the detailed topographic features in the study area where the average elevation range is in between 18-89 m.

Figure 4-5: Topography of the Study Area



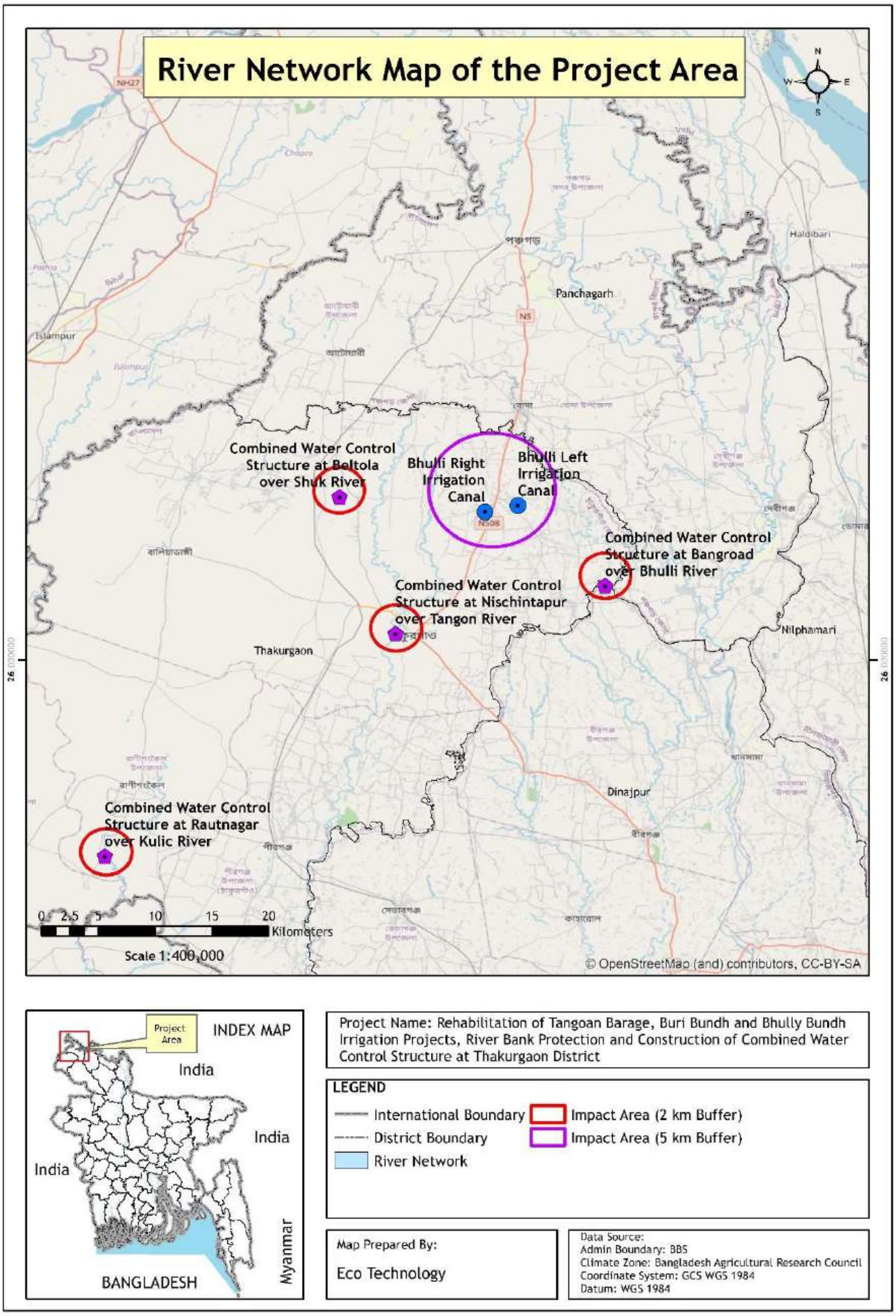
Source: USGS Earth Explorer

4.3.4 Hydrology and River Network

The project site has some surface water bodies within 2KM radius for Combined Water Control structure at Nischintapur on the Tangon River, Combined Water Control structure at Bangroad on the Bhulli River, Combined Water Control structure at Beltola on the Shuk River, Combined Water Control structure at Rautnagar on the Kulic River and 5KM for Extension of Left and Right Bhulli Irrigation canal buffer area. The rivers of Tangan, Kulik and Nagar are generally flowing from north to south. Although not throughout the year, the rivers regain their youth during the rainy season. Extreme levels of flood danger were announced in at least two places. However, the region is especially flooded during the monsoon. Pirganj, Haripur and Sadar upazilas have low water bodies. However, in the dry season, they remain completely dry. The course of the river is slowly shrinking due to siltation. Apart from rivers, there are many canals in this area. There is enough water in the canal beel during the monsoon season. However, most of the canals dry up during the dry season. Only some of the larger bills contain water.

Tangan River: The Tangan River originates from the lower waters of Atwari upazila of Panchagarh district bordering India and Bangladesh and flows southwards through Bochaganj upazila of Dinajpur. The river then enters Balurghat in India and re-enters Bangladesh and joins the Punarbhara river at Chapai Nawabganj. Eventually this combined current merged into the Mahananda river near Rohanpur. Thakurgaon Sadar is located on the left bank of this river. From Tangan and other major rivers, tributaries and tributaries named Shuk, Senua, Mara Pathraj and Charalban have originated. The following Figure 4-6 shows the map of the Hydrology and Drainage of the study area.

Figure 4-6: Hydrology and River Network of the Study Area



Source: GIS Mapping and Interpretation of Satellite imagery by Eco Technology

4.3.5 Soils

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

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

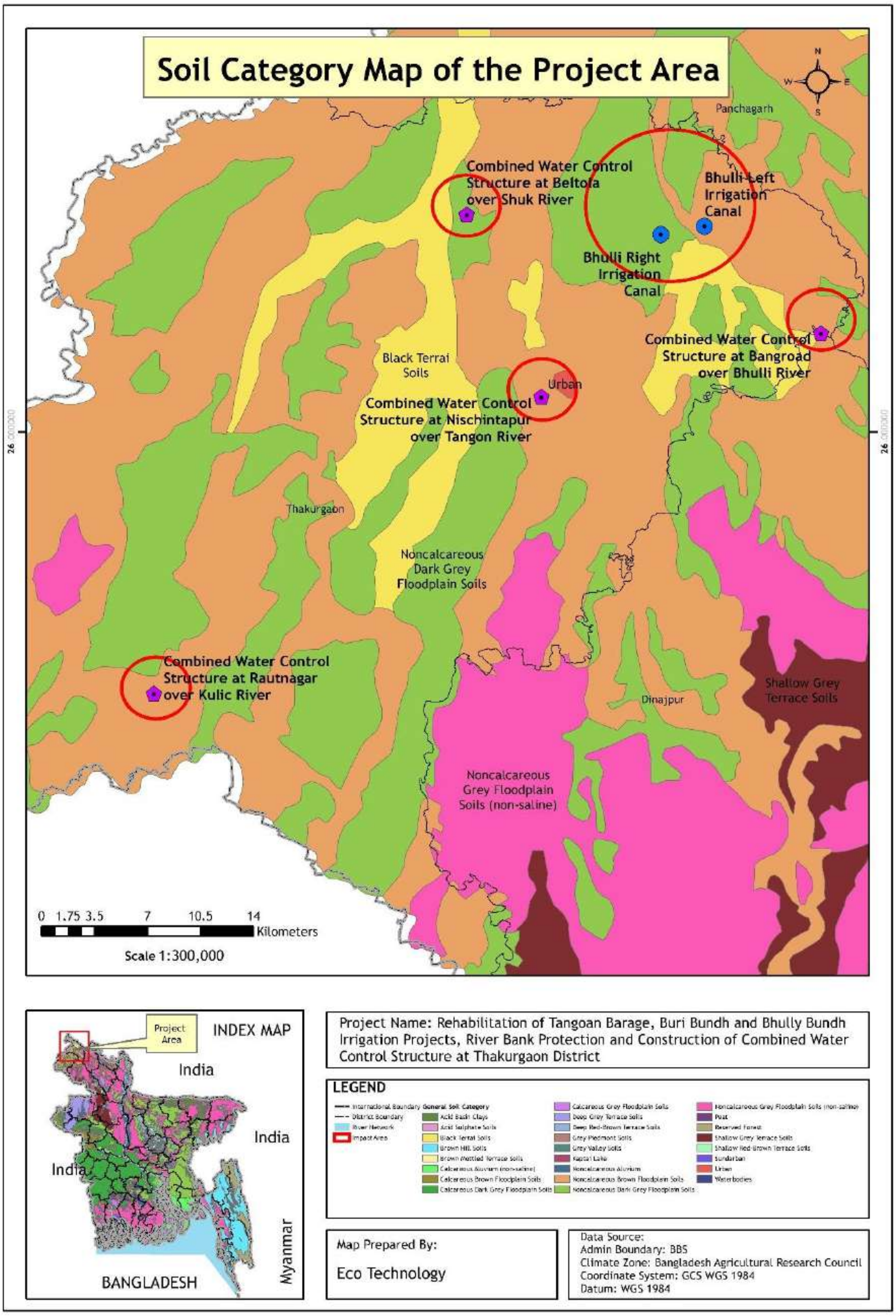
- Moderately fertile to fertile.
- Clay to loam structure (including sandy loams).
- Slightly to moderately acidic; and
- Relatively deep (often around 4 km including underlying shale/sandstone layers)

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

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

The project site can be classified as Mainly Noncalcareous Brown Floodplain soils, Noncalcareous Dark Grey Floodplain Soils and Black Terrain Soils which is described below. The 2KM radius for Combined Water Control structure at Nischintapur on the Tangon River, Combined Water Control structure at Bangroad on the Bhulli River, Combined Water Control structure at Beltola on the Shuk River, Combined Water Control structure at Rautnagar on the Kulic River and 5KM for Extension of Left and Right Bhulli Irrigation canal buffer area is also classified as the which are depicted in **Figure 4-7**.

Figure 4-7: Soil Category Map of the Study Area



Source: SRDI

4.3.6 Meteorology

Bangladesh is located in the tropical monsoon region and its climate is characterized by high temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations. From the climatic point of view, four distinct seasons[1] can be recognized in Bangladesh.

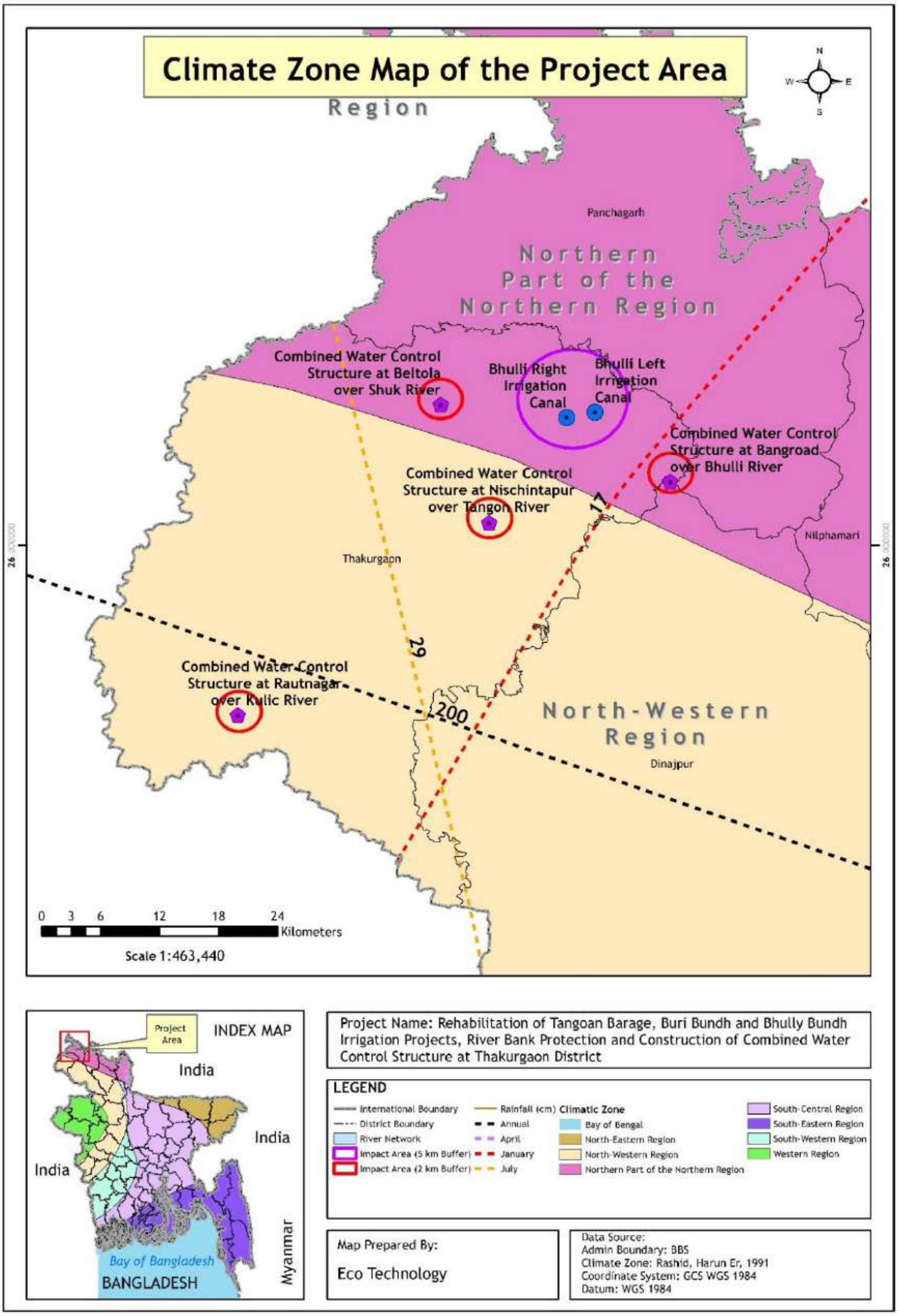
- Pre-Monsoon Hot Season (March to May) – Characterized by the highest temperatures of the year–up to 36°C. Certain rainfall may occur, with tropical cyclones occasionally affecting coastal areas;
- Rainy Monsoon Season (June to September) – Period of highest rainfall (up to 80% of the annual rainfall),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

Despite the general predictability of the seasons in Bangladesh, local conditions may still vary widely across the country. As such, Bangladesh can be divided into seven climatic sub-zones based on differences in a range of factors including rainfall, temperature, evapotranspiration, and local seasonality (Rashid, 1991). According to the climatic sub-regions of Bangladesh, the proposed project area is located in the North Western Region and Northern Part of the Northern Region. The climatic sub-regions of the study area are shown in **Figure 4-8**. The climatic data for the study area was obtained from the Bangladesh Meteorological Department (BMD).[2]

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

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

Figure 4-8: Climatic Sub-regions of the Study Area



Source: Data from Rashid, H. E. 1991[3] and map prepared by Eco Technology

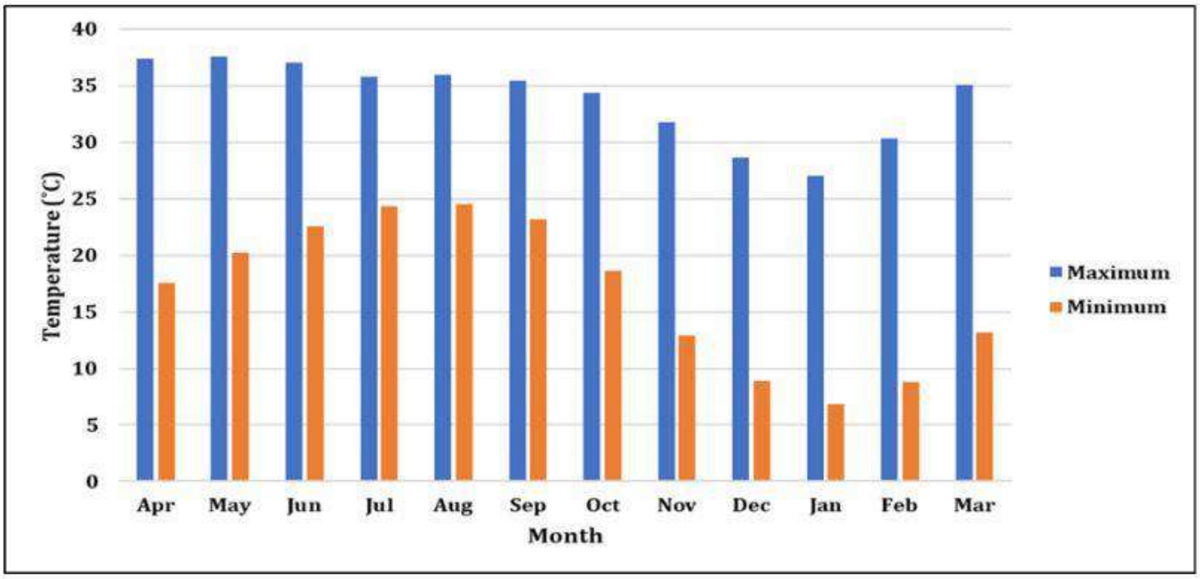
[3] Rashid, H. E. (1991). *Geography of Bangladesh*. University Press Limited, Dhaka.

Climatological information in terms of Rainfall, Temperature, Relative Humidity, Wind speed, Sunshine Hour, Evaporation, and Evapotranspiration of the BMD station at Dinajpur (ID: 10120). This is the nearest station of the study area and represents the meteorological condition of the area. Summary of the analyses of metrological parameters are given in the following sections:

4.3.6.1 Temperature

The monthly average temperature data of the last 30 years (1993-2022) shows that the maximum temperature varies from 26.99°C to 37.6°C and May is the warmest month, while the minimum temperature varies from 6.81°C to 24.50°C and January is the coldest month. The monthly average of the maximum and minimum temperatures of Dinajpur station are shown in **Figure 4-9**.

Figure 4-9: Monthly Temperature (°C) at Dinajpur BMD Station (1993-2022)

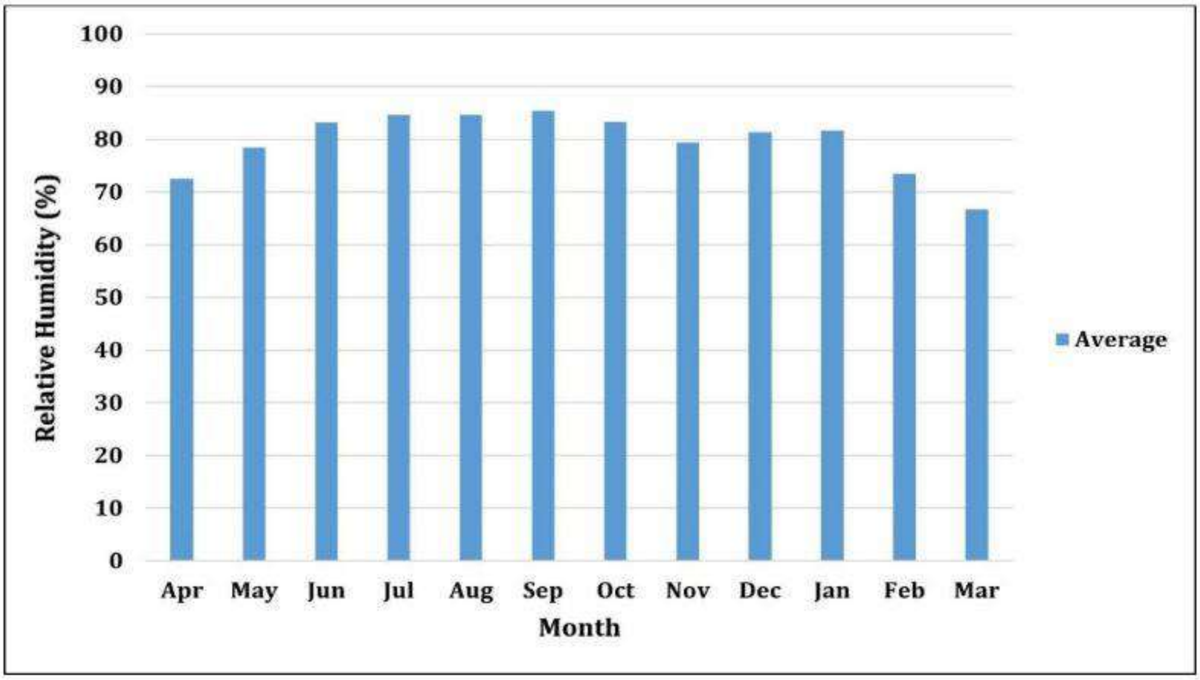


Source: Bangladesh Meteorological Department (BMD)

4.3.6.2 Humidity

The analysis of the Relative Humidity (RH) data for the period from 1993 to 2022 indicates that the average RH varies seasonally from a minimum of 66.70% in March to a maximum of 85.46% in September. The variation of mean monthly RH during the abovementioned period is shown in **Figure 4-10**.

Figure 4-10: Monthly Average Relative Humidity

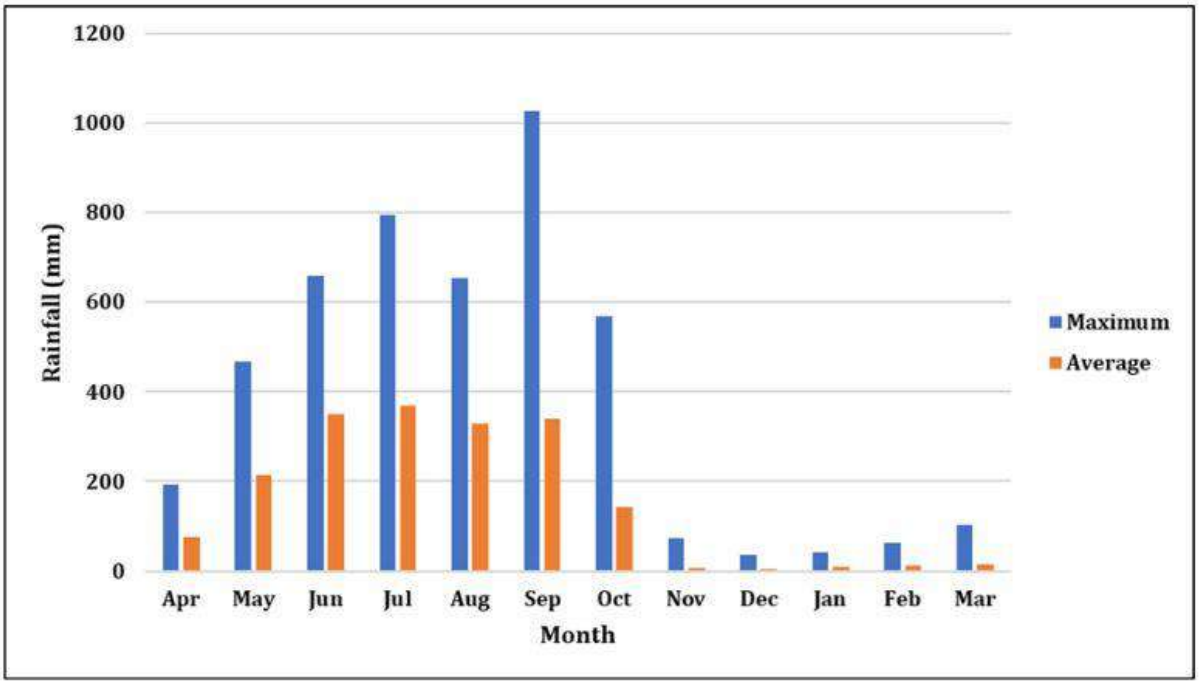


Source: Bangladesh Meteorological Department (BMD)

4.3.6.3 Rainfall

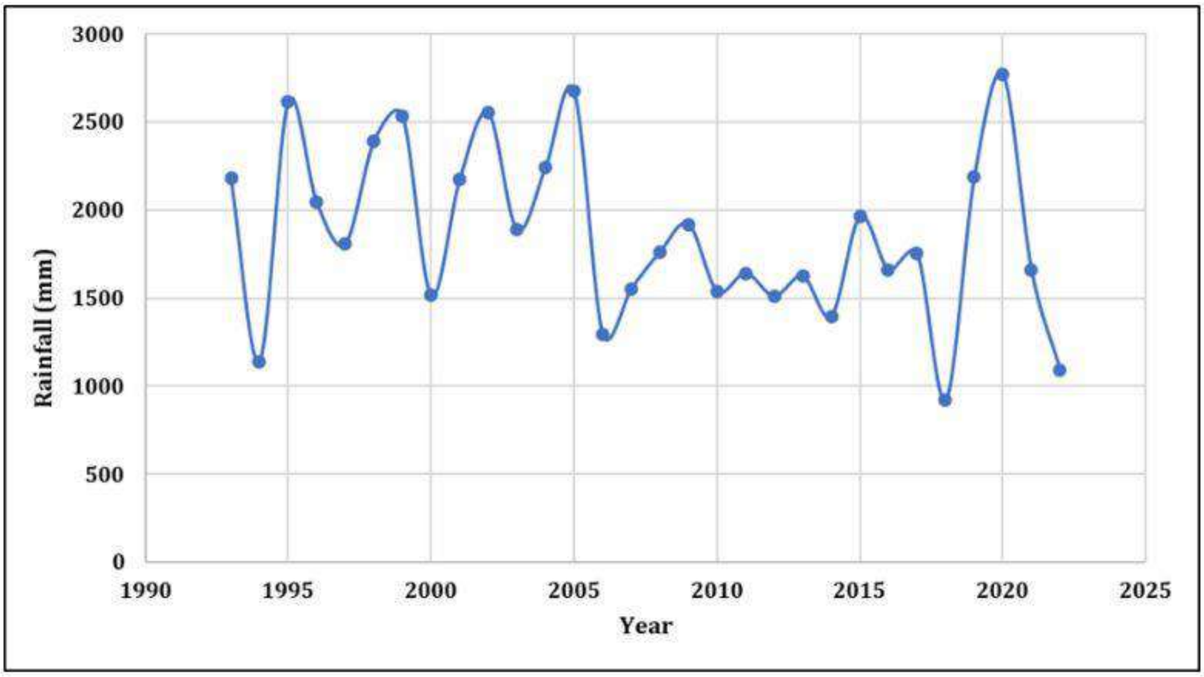
The monthly maximum and average rainfall data of the last 30 years (1993-2022) was collected, analyzed and shown in Figure 4-11. The analysis of data shows that the monthly average rainfall varies from 143.51 mm to 369.66 mm in monsoon and the area received the maximum of 1026 mm rainfall in September 1995. The historical maximum annual rainfall of this station was recorded as 2771 mm in 2020, the minimum was 921 mm in 2018, and the average annual rainfall is 1867 mm. The annual rainfall of this period is shown in Figure 4-11 and Figure 4-12

Figure 4-11: Monthly Maximum and Average Rainfall at Dinajpur BMD Station (1993-2022)



Source: Bangladesh Meteorological Department (BMD)

Figure 4-12: Annual Rainfall at Dinajpur BMD Station (1993-2022)

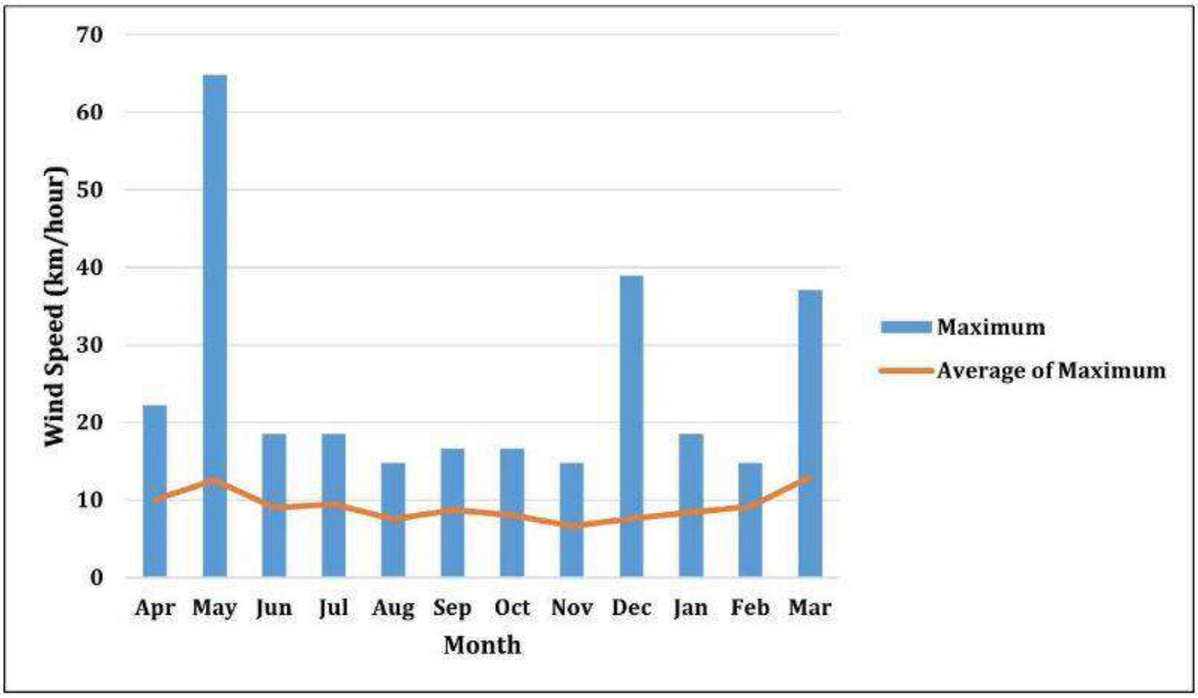


Source: Bangladesh Meteorological Department (BMD)

4.3.6.4 Wind Speed

The data of maximum wind speed of the last 30 years (1993 to 2022) shows that the monthly maximum wind speed of 64.82 km/hour occurred in May 2009. On the other hand, the average of maximum wind speed varies from 6.63 km/hour in November to 12.93 km/hour in March. The monthly maximum and average of the maximum of wind speed are shown in Figure 4-13.

Figure 4-13: Monthly Maximum and Average Wind Speed at Dinajpur BMD Station



Source: Bangladesh Meteorological Department (BMD)

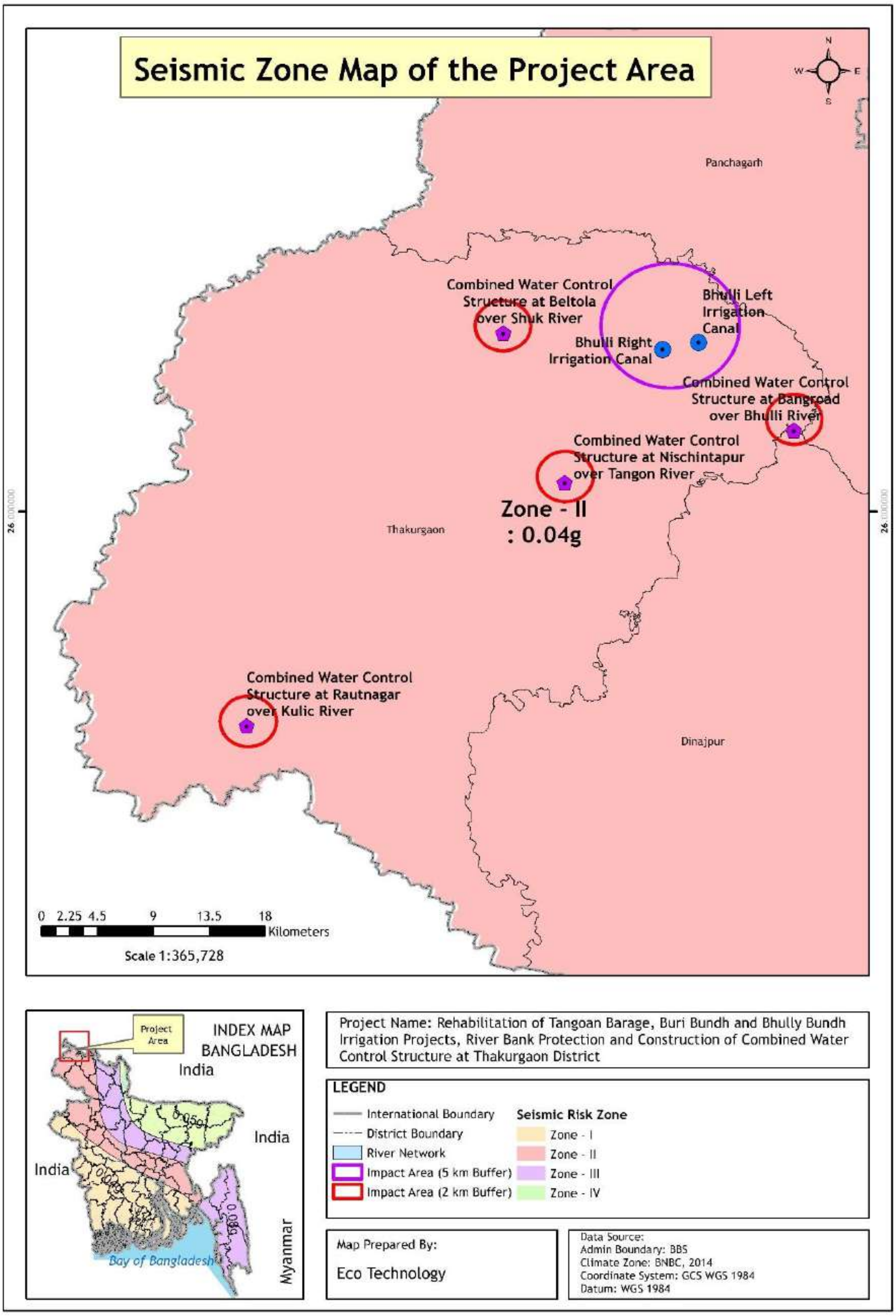
4.4 Natural Hazards/Disaster

4.4.1 Earthquake and Seismic Activity

A region's seismic zone indicates how vulnerable it is to earthquakes, both now and in the past and into the future. Greater seismicity is seen in areas where huge earthquakes happen more frequently than in areas where smaller earthquakes happen less frequently. Bangladesh is located on the northeast junction of Indian plate and Eurasian plate, so it will be affected by the medium to intense seismic activities. It has suffered from the earthquakes above Grade 7.0 in the past 150 years, and the epicenter is in Bangladesh. The seismic distribution in Bangladesh is shown in **Figure 4-14**.

Based on the distribution of earthquake epicenters and morphotectonic behavior of different tectonic blocks Bangladesh has been divided into four seismic zones. The northeastern part of the county, which includes Mymensingh, Sylhet, and a part of the greater districts of Rangpur are in the zone - 4. The seismic coefficient of this zone is 0.36. Zone – 3 consists of the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur and the greater districts of Dinajpur and Chittagong having seismic coefficient 0.28. The greater districts of Rajshahi, Dhaka and Cumilla lie in Zone-2 with the seismic coefficient of 0.02. The Southern part of the county is the least active region, where the seismic coefficient of not more than 0.12 is in Zone-1. With a seismic coefficient of 0.02, the seismic zone of the project site is in Zone-2.

Figure 4-14: Seismic Zone Map of the Project Study Area



Data source: Bangladesh National Building Code (BNBC)

The strongest earthquake in Bangladesh happened on 06/02/1988 in the Sylhet; India (Tipura-Assam) region with a magnitude of 5.8 on the Richter scale. The shifting of tectonic plates in a depth of 45 km resulted in 2 deaths. Moheshkhali island experienced earthquake on 22/07/1999 with a magnitude of 4.2 on the Richter scale which resulted in 6 deaths. **Table 4-6** shows major earthquakes in Bangladesh.

Table 4-6: Major Earthquakes of Bangladesh

Date	Region	Depth	Magnitude	Deaths
10-09-2010	Narayanganj	16 km	4.8	0
12-01-2008	Rangamati, Bangladesh	47 km	5.0	0
07-11-2007	Chittagong, Bandarban, Rangamati	21 km	5.1	0
26-07-2003	Rangamati	17 km	5.7	2
20-06-2002	Rangpur, Thakurgaon, Almanagar	43 km	4.5	0
19-12-2001	Dhaka	7 km	4.5	0
22-07-1999	Maheshkhali Island, Cox's Bazaar	11 km	4.2	6
12-06-1989	Banaripara	9 km	5.1	1
06-02-1988	Sylhet; India (Tipura-Assam)	45 km	5.8	2

Source: WorldData.info (statistics are based on data from the National Geophysical Data Center / World Data Service)

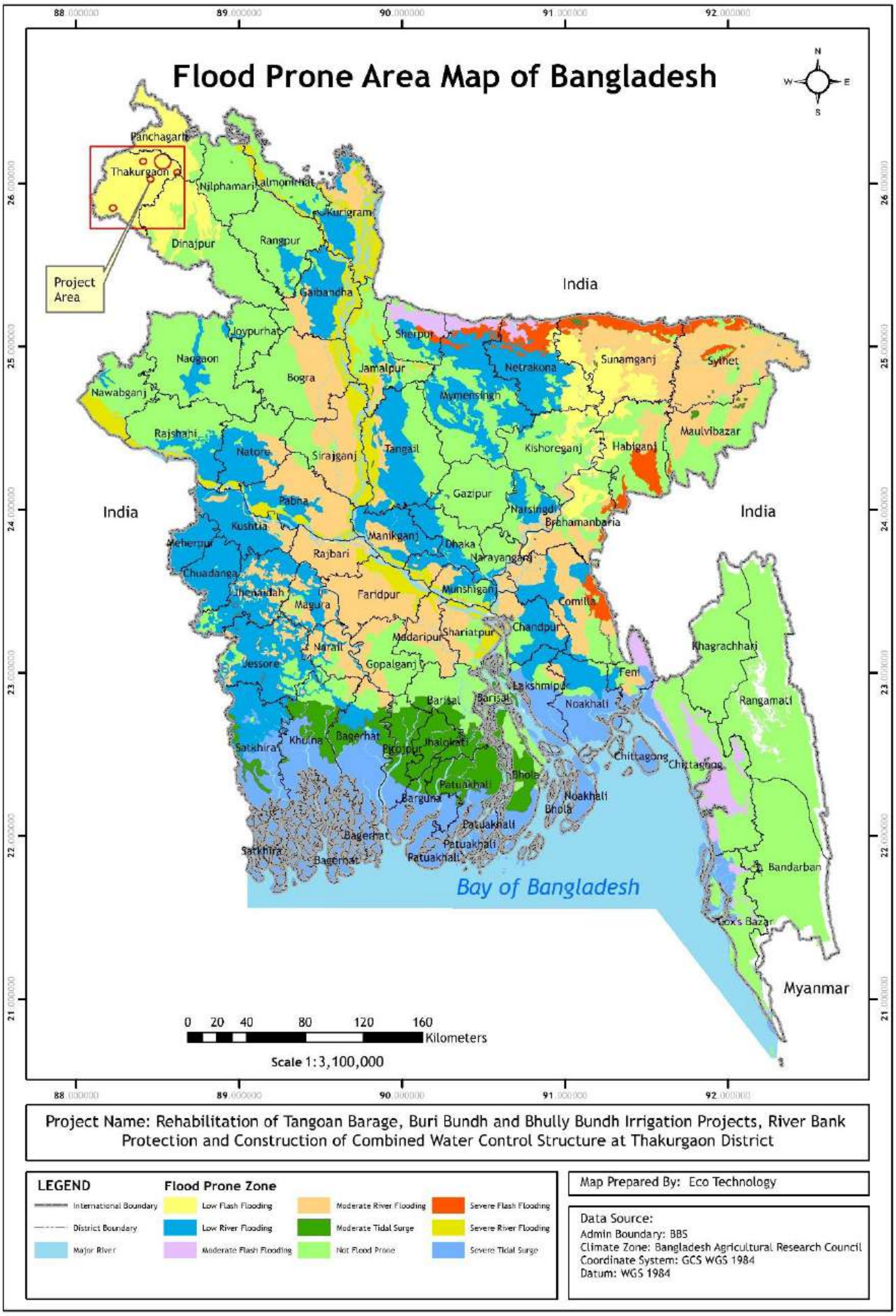
4.4.2 Floods

Every year about one-fifth of Bangladesh undergoes flooding during the monsoon season. A flood season in Bangladesh may start as early as May and can continue until November.

Flood in Bangladesh can be divided into three categories; (i) monsoon flood – seasonal, increases slowly and decreases slowly, inundate vast areas, and causes huge loss to the life and property; (ii) flash flood- from sudden torrential flows, following a brief intense rainstorm or the bursting of natural or manmade dam or level; and (iii) tidal flood – duration, is generally 3-6 m, prevents inland flood drainage.

The following **Figure 4-15** shows the flood affected areas of Bangladesh. According to this, the project area is Low Flash Flooding prone.

Figure 4-15: Flood Map of Bangladesh showing the project study area



Source: BARC

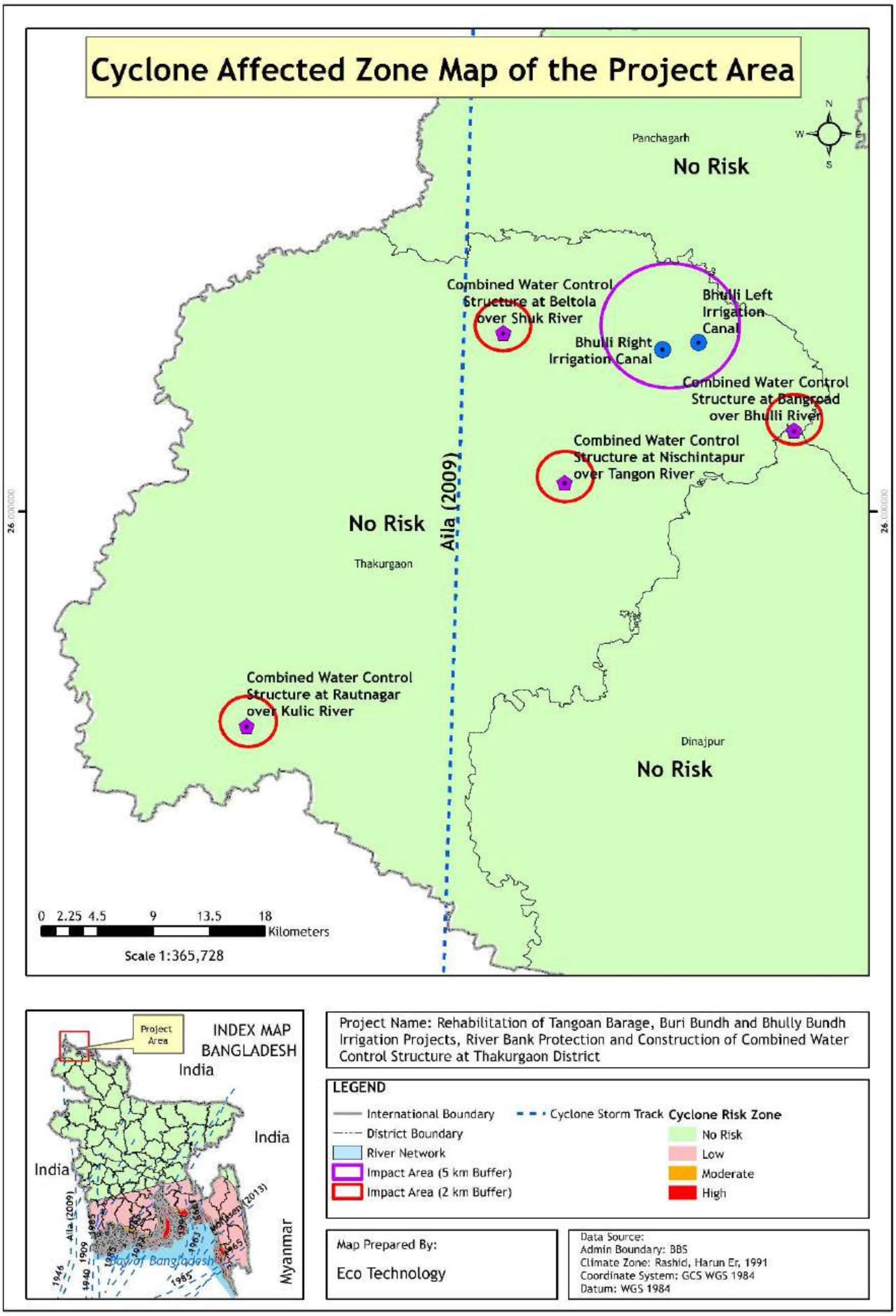
4.4.3 Cyclone and Storm Surges

Cyclones in Bangladesh are presently classified according to their intensity and the following nomenclature is in use:

- Depression (winds up to 62 km/hr).
- Cyclonic storm (winds from 63 to 87 km/hr);
- Severe cyclonic storm (winds from 88 to 118 km/hr); and
- Very severe cyclonic storm of hurricane intensity (winds above 118 km/hr).

The project site is in the North-Western part of Bangladesh which lies with the no risk zone in terms of cyclonic events. Cyclone affected areas in Bangladesh have been shown in **Figure 4-16**.

Figure 4-16: Cyclone Affected Zone of the Project Study Area



Source: SPARRSO

4.5 Environmental Quality

4.5.1 Ambient Air Quality

The objective of the ambient air quality monitoring program was to establish the baseline ambient air quality in the study area. The study area resembles a pre-dominantly rural landscape with villages interspersed between homestead plantation, agricultural lands, and forest vegetation. The are no major emission sources in the study area. Mainly road dust, black smoke from diesel engine vehicles, domestic heating and cooking, etc. are the sources of air emission.

4.5.1.1 Monitoring Parameter

The air quality monitoring parameters were Particulate Matter (SPM, PM_{10} and $PM_{2.5}$), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), Carbon Monoxide (CO). The ambient air parameters were monitored for 8 hours and compared with the Bangladesh Standards.

4.5.1.2 Monitoring Location

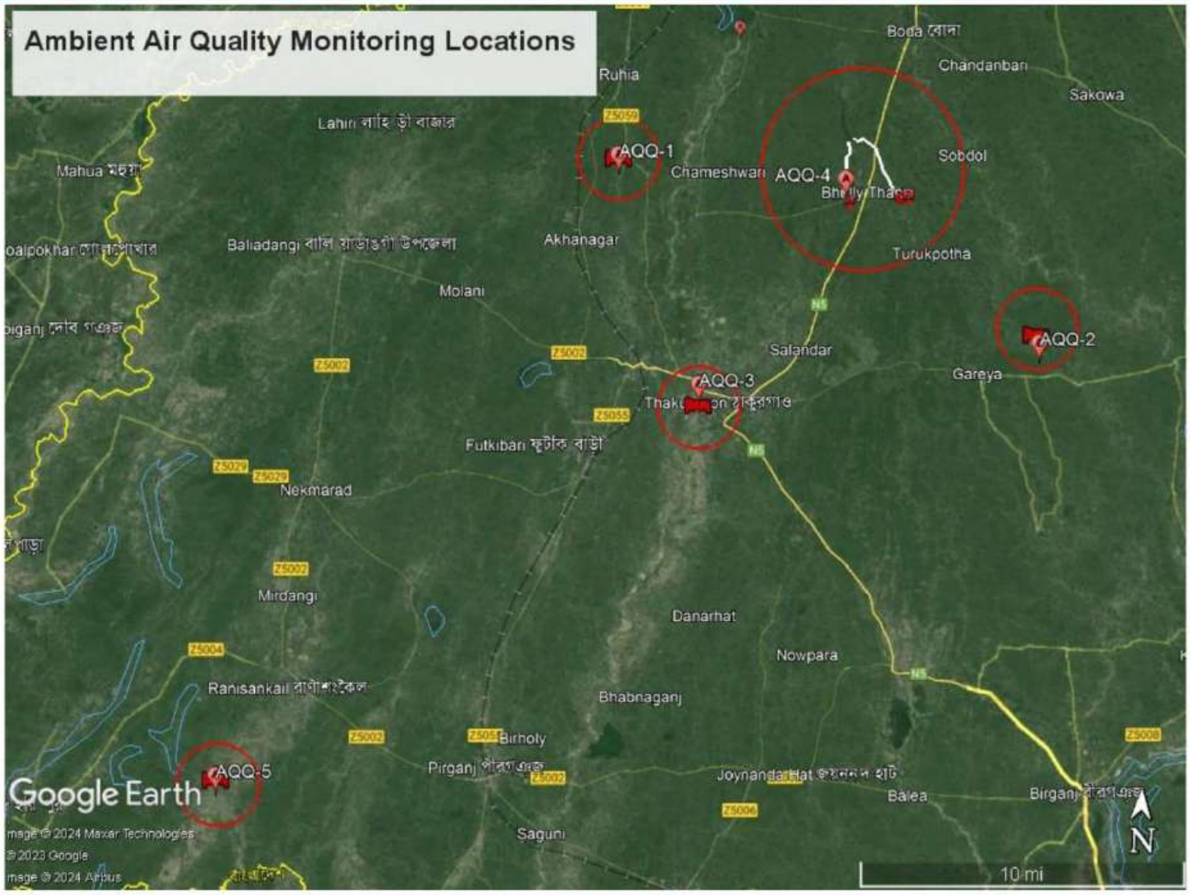
To assess the present air quality of the area, five (5) Ambient Air Quality Monitoring (AQQ-1, AQQ-2, AQQ-3, AQQ-4 and AQQ-5) Stations was set up in the project site. Details of the ambient air quality monitoring locations are presented in **Table 4-7** and **Figure 4-17**. The photographs of ambient air quality monitoring are presented in **Figure 4-18**.

Table 4-7: Ambient Air Quality Monitoring Locations

Code	Monitoring Location	GPS Coordinates	Monitoring Date
AAQ-1	Project Site	26° 7'37.00"N, 88°24'39.00"E	16-05-2024
AAQ-2	Project Site	26° 3'4.32"N, 88°37'23.00"E	16-05-2024
AAQ-3	Project Site	26° 1'35.00"N, 88°27'19.00"E	16-05-2024
AAQ-4	Project Site	26° 7'14.00"N, 88°31'26.00"E	17-05-2024
AAQ-5	Project Site	25°50'35.00"N, 88°13'30.00"E	17-05-2024

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-17: Ambient Air Quality Monitoring Location Map



Project Name: EIA of Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District

Prepared By: Eco Technology	Data Source: Admin Boundary: BBS; Coordinate System: GCS WGS 1984; Datum: WGS 1984; Monitoring Data: Field Survey

Legend

- Ambient Air Quality Monitoring Locations (AQQ-1, AQQ-2, AQQ-3, AQQ-4 and AQQ-5)
- Impact Zone

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-18: Photographs of Ambient Air Quality Monitoring

AQQ-1: Project site

AQQ-2: Project site

AQQ-3: Project site

AQQ-4: Project site

AAQ-5: Project site

Source: Field Survey by Eco Technology Team, May 2024

4.5.1.3 Monitoring Method

Sampling and analysis of ambient air quality were conducted by K600M Gas Detector by Bosean. The K600M Gas Detector was used to collect ambient air monitoring data. Sampling rate or air quality data were measured automatically every one minute and directly read and recorded onsite for measured parameters (SO_2, NO_2, CO, SPM, PM_{10}, $PM_{2.5}$) as shown in **Table 4-8**. The sampling pump was operated at 2 L/min. Different analysis methods are integrated in the instrument, such as Particulates 90° Infrared Light Scattering for particulate matters (SPM, PM_{10}, $PM_{2.5}$) and electrochemical sensors for toxic gases (NO_2, SO_2 and CO).

Table 4-8: Sampling and Analysis Method for Air Quality

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

4.5.1.4 Ambient Air Quality Monitoring Results

The summary of the ambient air quality results is presented in **Table 4-9**.

Table 4-9: Summary of Ambient Air Quality Monitoring Results

Sl#	Code	GPS Location	Ambient Air pollution concentration in µg/m^3					
			SPM	$PM_{2.5}$	PM_{10}	SO_2	NOx	CO
1	AAQ-1	26° 7'37.00"N 88°24'39.00"E	65.45	12.98	23.85	14.52	31.32	<1
2	AAQ-2	26° 3'4.32"N 88°37'23.00"E	59.75	9.12	29.43	11.34	27.23	<1
3	AAQ-3	26° 1'35.00"N 88°27'19.00"E	66.34	15.34	22.13	11.12	32.11	<1
4	AAQ-4	26° 7'14.00"N 88°31'26.00"E	55.36	14.56	25.21	9.89	27.23	<1
5	AAQ-5	25°50'35.00"N 88°13'30.00"E	54.38	12.13	26.26	15.34	26.34	<1
Duration (hours)			8	24	24	24	24	8

Sl#	Code	GPS Location	Ambient Air pollution concentration in µg/m³					
			SPM	$PM_{2.5}$	PM_{10}	SO_2	NOx	CO
Weather Condition			Sunny					
Air Pollution (Control) Rules, 2022			200	65	150	80	80	5

Source: Field Measurement and Laboratory Analysis by Eco Technology, May 2024

4.5.1.5 Result Analysis

Concentration of Suspended Particulate Matter (SPM)

The 8-hourly SPM concentration in ambient air in the project study area was recorded 65.45 µg/m³, 59.75 µg/m³, 66.34 µg/m³, 55.36 µg/m³ and 54.38 µg/m³. SPM level of the Project study area was reported below the National Ambient Air Quality Standards of Bangladesh.

Concentration of Particulate Matter ($PM_{2.5}$)

The 24-hourly $PM_{2.5}$ concentration in ambient air in the project study area was recorded 12.98 µg/m³, 9.12 µg/m³, 15.34 µg/m³, 14.56 µg/m³ and 12.13 µg/m³. $PM_{2.5}$ concentration in the project study area was low due to the lack of industries. $PM_{2.5}$ level at monitoring location was reported below the NAAQS.

Concentration of Particulate Matter (PM_{10})

The 24-hourly PM_{10} concentration in ambient air in the project study area was 23.85 µg/m³, 29.43 µg/m³, 22.13 µg/m³, 25.21 µg/m³ and 26.26 µg/m³. PM10 concentration in the project study area was low due to the lack of industries. PM_{10} level at monitoring location was reported below the NAAQS.

Concentration of Sulphur Dioxide (SO_2)

The 24-hourly SO_2 concentration in ambient air in the project study area was recorded as 14.52 µg/m³, 11.34 µg/m³, 11.12 µg/m³, 9.89 µg/m³ and 15.34 µg/m³. SO_2 concentration in the project study area was low due to the lack of industries. SO_2 level at monitoring location was reported below the NAAQS.

Concentration of Oxides of Nitrogen (NO_x)

The 24-hourly NO_x concentration in ambient air in the project study area was recorded as 31.32 µg/m³, 27.23 µg/m³, 32.11 µg/m³, 27.23 µg/m³ and 26.34 µg/m³. NO_x level at monitoring location was reported below the NAAQS.

Concentration of Carbon Monoxide (CO)

The 8-hourly CO concentration was recorded at the project study area <1 ppm. CO concentrations are reported low at the monitoring location while comparing with the Bangladesh Standards (10 ppm)

4.5.2 Ambient Noise Quality

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

4.5.2.1 Sampling Methodology

Noise level measurement data were collected during both day and night-time for 24- hours with 1-min interval. Digital sound level meter CEM DT8850 was used for the measurement of noise level. It was mounted on a tripod at 1.5 m above ground level and at least 3.5m away from any sound-reflecting surfaces. The sound level meter was calibrated before the noise monitoring survey. Noise levels were recorded as sound pressure levels with the help of a digital sound level meter. The purpose of ambient noise level measurement was to determine sound intensity at the monitoring locations. These locations were chosen to record representative data all over the project site. The sound level is recorded as A-weighted equivalent continuous sound pressure level values using A-weighting filters in the noise measuring instrument.

4.5.2.2 Ambient Noise Monitoring Locations

Noise levels were recorded at seven (7) locations in the study area during the monitoring period. The details of noise monitoring locations are presented in **Table 4-10** and depicted in **Source:** Field Survey by Eco Technology Team, May 2024

Figure 4-19. The photographs of ambient air quality monitoring are presented in **Source:** Field Survey by Eco Technology Team, May 2024

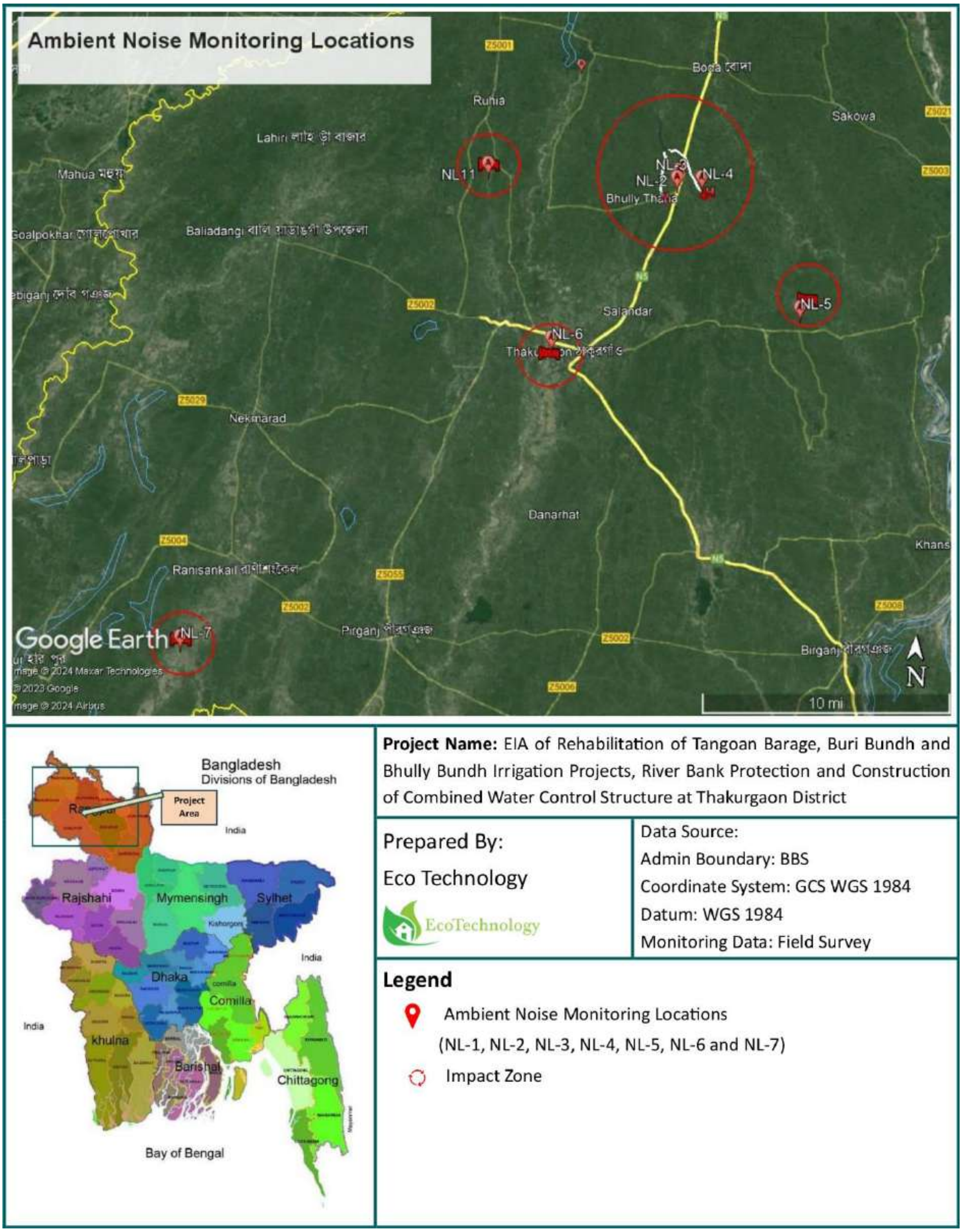
Figure 4-20.

Table 4-10: Ambient Noise Monitoring Locations

Code	Monitoring Locations	GPS Coordinate	Monitoring Date
NL-1	Project Site	26° 7'34.00"N 88°24'38.00"E	16-05-2024
NL-2	Project Site	26° 7'38.00"N 88°32'4.00"E	16-05-2024
NL-3	Project Site	26° 7'22.00"N 88°31'60.00"E	16-05-2024
NL-4	Project Site	26° 7'24.00"N 88°32'58.00"E	16-05-2024
NL-5	Project Site	26° 3'0.00"N 88°36'59.58"E	16-05-2024
NL-6	Project Site	26° 1'35.00"N 88°27'23.00"E	17-05-2024
NL-7	Project Site	25°50'35.00"N 88°13'29.00"E	17-05-2024

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-19: Ambient Noise Monitoring Location Map



Source: Field Survey by Eco Technology Team, May 2024

Figure 4-20: Photographs of Ambient Noise Monitoring

NL-1: Project Site

NL-2: Project Site

NL-3: Project Site

NL-4: Project Site

NL-5: Project Site

NL-6: Project Site

NL-7: Project Site

Source: Field Survey by Eco Technology Team, May 2024

4.5.2.3 Ambient Noise Monitoring Results

The recorded ambient noise levels in the study area are summarized in **Table 4-11**.

Table 4-11: Ambient Noise Level in the Study Area

Code	Noise Level in dB(A)				Location Setting	Bangladesh Standard[4]	
	Leq_{day}	Leq_{night}	L_{max}	L_{min}		Day	Night
NL-1	54.4	49.8	64.2	37.4	Residential	55	45
NL-2	48.8	38.1	59.5	35.2	Mixed	60	50
NL-3	61.2	47.3	71.7	55.4	Commercial	70	60
NL-4	54.2	39.7	70.6	30.8	Mixed	60	50
NL-5	60.2	46.4	72.8	56.3	Mixed	60	50
NL-6	46.1	35.2	56.3	30.8	Silent	50	40
NL-7	47.4	39.5	57.3	33.21	Mixed	60	50

Source: Field Survey by Eco Technology Team, May 2024

4.5.2.4 Result Analysis

Table 4-11 shows the summary findings of Leq Day and Leq Night calculation in all monitoring locations. The noise level was monitored for 24 hours continuously in a single monitoring point. According to noise pollution control rules 2006, daytime extends from 06 am to 09 pm, while nighttime extends from 09 pm to 06 am. The monitoring locations were classified into five different classes, namely silent zone, residential zone, mixed zone, commercial zone and industrial zone based on the noise pollution control rules 2006. NL-6 monitoring location falls under the silent zone where noise levels were not found within the acceptable standard level 50 dBA and 40 dBA during day and nighttime, respectively. NL-1 monitoring locations fall under the residential where noise levels were

[4] Noise Pollution (Control) Rules, 2006.

found within the acceptable standard level 55 dBA and 45 dBA during day and nighttime, respectively.

NL-2, NL-4, NL-5 and NL-7 monitoring location falls under mixed zone where noise levels were found within the acceptable standard level 60 dBA and 50 dBA during day and nighttime, respectively.

NL-3 monitoring location falls under the Commercial zone where noise levels were found within the acceptable standard level 70 dBA and 60 dBA during day and nighttime, respectively.

Overall, the findings imply that the noise level of five locations is within the acceptable standard of DOE.

4.5.3 Water Quality

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

4.5.3.1 Methodology

Surface water sample was collected as grab water sample in a standard sampling bottle and 1000 ml sterilized clean PET bottle for complete physicochemical and bacteriological tests respectively. The samples were analyzed as per standard procedure/methods given in Standard Method for Examination of Water and Wastewater Edition 20, published by APHA. Details of the analysis method and protocol for the surface water and groundwater are presented in **Table 4-12**.

Table 4-12: Methodology for the Parameters of the Surface Water and Groundwater

Parameter	Unit	Test Method (APHA)
Arsenic	mg/L	Modified Gutzeit method
Biological Oxygen Demand (BOD_5)	mg/L	5 days incubation
Calcium	mg/L	Colorimetric Method
Chloride	mg/L	mercury (II) thiocyanate Method
Chloroform	mg/L	Graphite Furnace AAS
Chromium (total)	mg/L	Photometric method
COD	mg/L	USEPA 410.4 Approved Method
Fecal Coliform (FC)	n/100	AFNOR approved method
Total Coliform (TC)	n/100	AFNOR approved method
Copper	mg/L	Bicinchoninate Method
DO	mg/L	Ion Electrode method
Hardness (as CaCo3)	mg/L	Titrimetric Method
Iron (Fe)	mg/L	Phhenantroline Method

Parameter	Unit	Test Method (APHA)
Oil & Grease	mg/L	Gravimetric Method
pH	--	Ion electrode method
Suspended Particulate Matters	ppm	Dry and filtration
Sulfate	mg/L	Turbidimetric Method
TDS	ppm	Ion electrode method
Temperature	ºC	Ion electrode method
Zinc (Zn)	mg/L	AAS
Turbidity	NTU	Turbidimetric Photoelectric Method

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

4.5.3.2 Surface Water Quality

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

4.5.3.3 Surface Water Sampling Locations

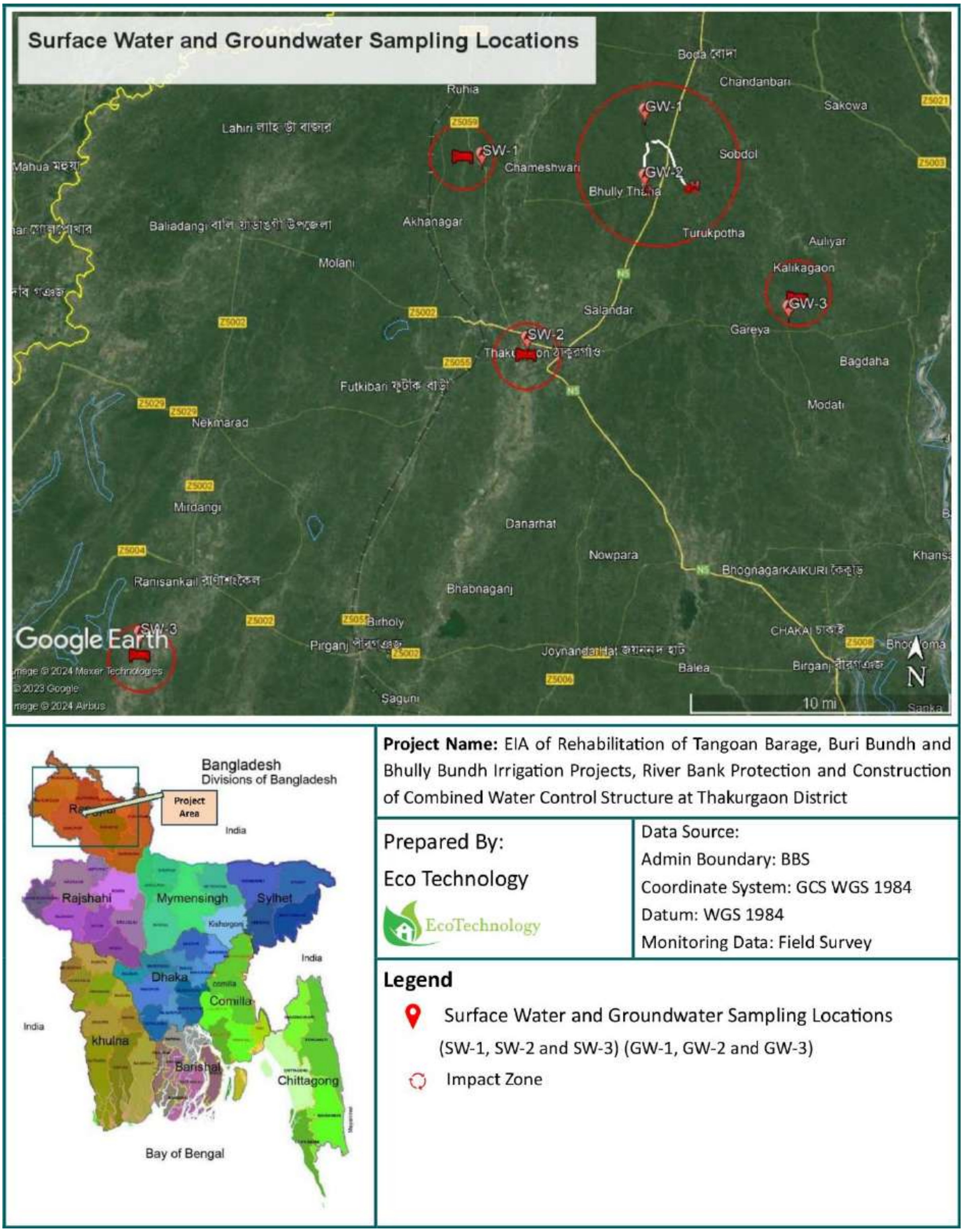
The surface water sample was collected from the nearby canal located at Three surface water sample was collected during monitoring period (May 2024) from the canal. Details of the surface water monitoring location is presented in Table 4-13 and Figure 4-21 The photographs of the sampling are presented in Figure 4-22**.**

Table 4-13: Details of Surface Water Sampling Location

Code	Location	GPS Coordinate	Sampling Date
SW-1	Project Site	26° 7'39.00"N 88°25'22.00"E	16.05.2024
SW-2	Project Site	26° 1'36.00"N 88°27'20.00"E	16.05.2024
SW-3	Project Site	25°51'14.00"N 88°13'30.00"E	17.05.2024

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-21: Surface Water Sampling Location



Source: Field Survey by Eco Technology Team, May 2024

Figure 4-22: Photographs of Surface Water Sampling

SW-1:

SW-2:

SW-3:

Source: Field Survey by Eco Technology Team, May 2024

4.5.3.4 Result Analysis

The analyzed results for surface water were compared to Bangladesh Standards (ECR, 2023). Results of inland surface water analysis are presented in Table 4-14.

Table 4-14: Surface Water Analysis Results

Parameter	Unit	Analysis Method	SW-1	SW-2	SW-3	Bangladesh Standards*
DO	mg/L	*Ion electrode method*	8.1	7.4	9.2	6 or more
TDS	mg/L	*Ion electrode method*	30	41	29	--
pH	--	*Ion electrode method*	6.29	6.56	6.67	6.5-8.5
Turbidity	NTU	*Turbidimetric*	0.2	0.27	0.25	--

		Photoelectric Method				
Temperature	°C	*Ion electrode method*	26.0	28.1	27.2	--
Electric Conductivity (EC)	µS/cm	*Ion electrode method*	60	71	56	2250
Salinity	ppt	*Ion electrode method*	0.02	0.05	0.04	--
Phosphate	mg/L	*Photometric method*	0.23	0.27	0.34	--
Nitrate	mg/L	*Photometric method*	0.5	0.4	0.4	--
Iron	mg/L	*Photometric method*	0.032	0.039	0.033	--
BOD5 (at 20°C)	mg/L	*Ion electrode method*	1.8	1.5	1.6	2 or less
COD	mg/L	*Photometric method*	23.2	21.1	23.5	--
Total Suspended Solid	mg/L	*Standard Methods (2005), 2540D and EPA (1983) Method 160.2*	26.2	21.1	29.3	--

Source: Laboratory Analysis by Eco Technology laboratory

* Bangladesh Environment Conservation Rules (ECR), 2023, Schedule-2 (Standards for Inland Surface Water)

Interpretation of Surface Water Quality

The analysis results show that the pH value is within the specified standard (6.5 to 9.0) for all categories of inland water quality.

The Dissolved Oxygen (DO) values of indicate favorable conditions for the growth and reproduction of fish and other aquatic organisms in the water.

The electric conductivity of water samples and The Total Dissolved Solids (TDS) of both samples were found within the standard. The Total Suspended Solid, BOD and COD are within the standard. Turbidity, Iron and Nitrate are also with in the standard.

The water quality of the canal water sample reveals that it is usable for all purposes as per ECR 2023-Schedule 2 (a).

4.5.3.5 Groundwater Quality

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

4.5.3.6 Groundwater Sampling Location

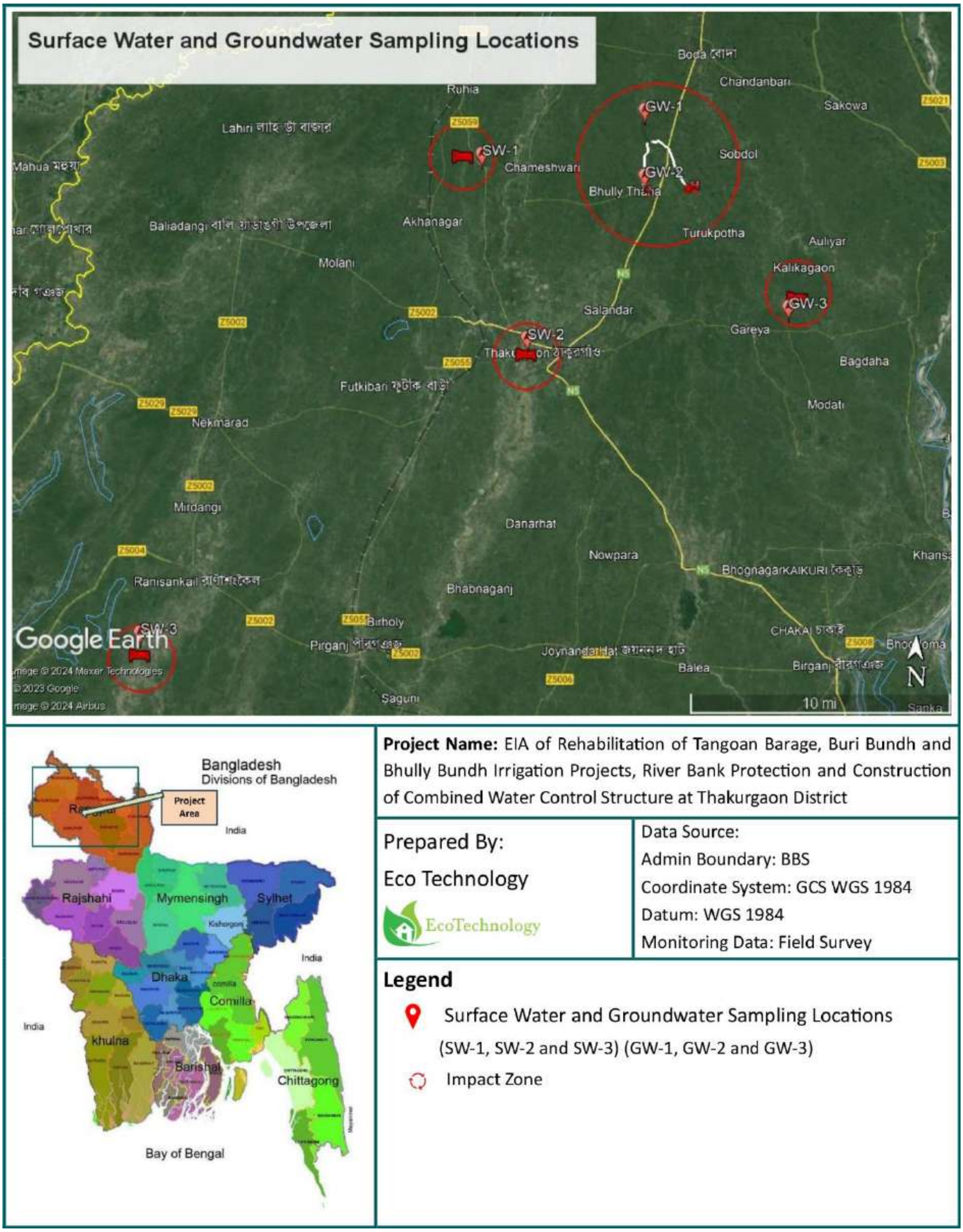
Ground water sample was collected from Three (3) representative selected groundwater source close to the project site during monitoring period (May 2024). Details of the ground water quality monitoring location is depicted in **Table 4-15** and Figure 4-23. The photographs of surface water quality monitoring are presented in Figure 4-24.

Table 4-15: Details of Groundwater Sampling Location

Code	Location	GPS Coordinate	Sampling Date
GW-1	Project Area	26° 9'21.00"N 88°31'20.00"E	16.05.2024
GW-2	Project Area	26° 7'10.00"N 88°31'26.00"E	16.05.2024
GW-3	Project Area	26° 3'0.00"N 88°36'58.00"E	16.05.2024

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-23: Groundwater Sampling Location Map



Source: Field Survey by Eco Technology Team, May 2024

Figure 4-24: Photographs of Groundwater Sampling

GW-1:

GW-2:

GW-3:

Source: Field Survey by Eco Technology Team, May 2024

4.5.3.7 Result Analysis

The analyzed results for ground water were compared to Bangladesh Standards (ECR, 2023). Results of ground water analysis are presented in Table 4-16.

Table 4-16: Ground Water Analysis Results

Parameter	Unit	Analysis Method	GW-1	GW-2	GW-3	Bangladesh Standards*
Arsenic	mg/L	Modified Gutzeit method	0.02	0.01	0.01	0.05
Alkalinity	mg/L	Photometric method	25	27	21	--
Color	PCU	Photometric method	1.7	1.5	1.6	15

Chromium	mg/L	Photometric method	0.0	0.0	0.0	0.05
Chloride	mg/L	Photometric method	1.2	1.2	1.1	150-600
EC	µS/cm	Ion electrode method	70	90	80	--
Iron	mg/L	Photometric method	0.5	0.5	0.7	0.3 – 1.0
pH	--	Ion electrode method	6.21	6.17	6.47	6.5 – 8.5
Potassium	mg/L	Photometric method	5.3	4.8	6.7	12
DO	mg/L	Ion electrode method	6.9	7.8	6.2	6.0
Sulfate	mg/L	Photometric method	2.3	2.0	2.7	400.0
TDS	mg/L	Ion electrode method	50	60	45	1000
Temperature	°C	Ion electrode method	23.7	22.9	21.7	20 - 30
Total Hardness	mg/L	Titrimetric method	40	32	45	200 - 500
Ammonia-Nitrogen (NH3-N)	mg/L	Photometric method	0.00	0.00	0.00	--

Source: laboratory

* [1]*According to the Schedule-2, Rule 31 (Kha) of Environmental Conservation Rules, Amendment 2023, Government of Bangladesh.*

Interpretation of Ground Water Quality

The analysis results show that the pH value is within the specified standard (6.5 to 9.0) for all categories of inland water quality.

The Dissolved Oxygen (DO) values indicate favorable conditions for the growth and reproduction of fish and other aquatic organisms in the water.

The electric conductivity and Total Dissolved Solids (TDS) of all samples were found within the standard. The concentration of alkalinity in surface water samples was found to be 25 mg/L and the hardness was found to be 30 mg/L. The nitrate concentration of both the samples was found to be 0.00 1 mg/L.

Arsenic concentrations were found below <0.03 mg/L and Iron concentration within the standard.

Water quality of the ground water samples reveals that it is usable for all purposes as per ECR 2023-Schedule 2.

4.5.4 Soil Quality

Soil quality is the ability of a soil to perform functions that are essential to people and the environment. Soils support plant growth, recycle dead material, regulate, and filter water flows, support buildings and roads, and provide habitat for many plants and animals. Depending on the land use, many of these functions occur simultaneously. Soil quality assessments go beyond measuring degradation (erosion, compaction, or contamination) to focus on these soil functions and the processes that create them.

The SRDI has identified about 500 soil series in Bangladesh and FAO-UNDP has identified 21 different general soil types based on the diagnostic horizons and diagnostic properties of the soil (FAO-UNDP, 1998). According to the classification three types of soil class; Mainly Noncalcareous Brown Floodplain soils, Noncalcareous Dark Grey Floodplain Soils and Black Terrain Soils are found within the 5 km buffer area of the project site.

4.5.4.1 Sampling Methodology

The soil sampling strategy was designed to assess the existing soil quality in the study area. Soil sample was collected from the project site. Soil sampling was conducted using tools from a depth of 45 cm from the topsoil surface. Soil sample was collected from three spots and homogenized. The homogenized samples were collected following quartering technique and then packed in polythene plastic jars and sealed. The sealed sample was sent to the laboratory for analysis. The soil sample was analyzed for physical and chemical characteristics.

4.5.4.2 Soil Sampling Location

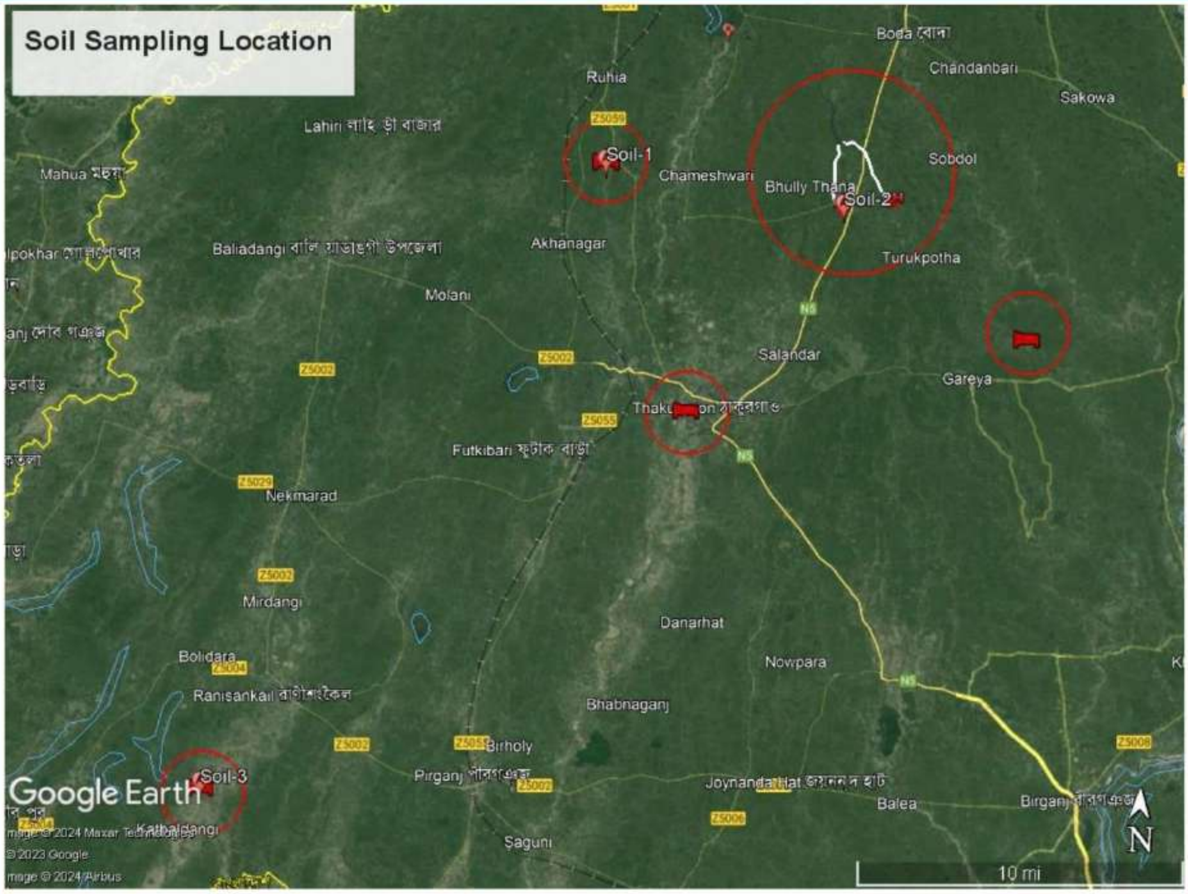
Three (3) representative sample was collected from near the project site area. The details of the soil monitoring are presented in the below **Table 4-17**.

Table 4-17: Soil Sampling Location

Code	Location	GPS Coordinates	Sampling Date
SQ-1	Near Project site	26° 7'37.00"N 88°24'39.00"E	16-05-2024
SQ-2	Near Project site	26° 6'42.00"N 88°31'43.00"E	16-05-2024
SQ-3	Near Project site	25°50'40.00"N 88°13'30.00"E	17-05-2024

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-25: Soil Sampling Location Map



Project Name: EIA of Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District

Prepared By: Eco Technology	Data Source: Admin Boundary: BBS Coordinate System: GCS WGS 1984 Datum: WGS 1984 Monitoring Data: Field Survey

Legend

- Soil Sampling Locations (Soil-1, Soil-2 and Soil-3)
- Impact Zone

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-26: Photographs of Soil Sampling

SQ-1: Near Project Site

SQ-2: Near Project Site

SQ-3: Near Project Site

Source: Field Survey by Eco Technology Team, May 2024

4.5.4.3 Result Analysis

The following Table 4-18 shows the analysis result of soil sample.

Table 4-18: Analysis Result of Soil Sample

Parameter	Unit	SQ-1		
Soil Type	-	Deep brown soil	Deep brown soil	Deep brown soil
pH	-	5.66	5.45	5.78
EC	dS/m	3.6	4.8	4.7
Potassium (K)	m.e/100g soil	0.14	0.17	0.13
Phosphorous (P)	µg/g (ppm)	6.9	6.3	7.2
Zinc (Zn)	µg/g (ppm)	0.97	0.82	0.77
Copper (Cu)	µg/g (ppm)	3.1	2.8	3.5
Iron (Fe)	µg/g (ppm)	91.4	81.7	77.5

Manganese (Mn)	µg/g (ppm)	2.7	2.5	2.3
Lead (Pb)	µg/g (ppm)	0.38	0.27	0.41
Organic Matter	%	1.72	1.61	1.91

Source: Laboratory Analysis by Eco Technology Laboratory, May 2024

4.6 Biological Environment

An ecosystem and biodiversity assessment study were undertaken in diverse habitat types within the project AOI includes five upazila. This study was carried out to gather the primary and secondary data necessary for establishing a concrete baseline for the biological environment. The following objectives were considered for this study:

- Establishing a comprehensive ecological and biodiversity profile of the AOI
- Identification of areas of conservation significance within the AOI
- Identifying different habitat types occurring in the AOI
- Determining vegetation type and diversity associated with respective habitat types
- Identifying Protected Species following Wildlife Conservation and Security Act, 2012, Threatened species (Critically Endangered, Endangered & Vulnerable species) and Endemic species occurring in the AOI
- Assessing fisheries resources of the project AOI by direct observation, fish market survey, formal and informal consultation, FGD with local fishermen, etc.
- Conducting the baseline aquatic sample collection and analyzing the sample of phytoplankton, zooplankton, and benthos organisms of the AOI
- Collection of secondary information, including literature review, FGD to know the floral and faunal components and habitats of the AOI.

4.6.1 Bio-ecological Zone

Flora and fauna in a particular bio-geographic region or zone tend to have shared characteristics in terms of broader climatic & geographical feature preferences/requirements. Therefore, IUCN has classified Bangladesh into 25 Bio-ecological Zones[5] in the context of physiographic and biological diversity. The project AOI has fallen under Himalayan Piedmont Plain Bio-Ecological Zone (IUCN, 2002[5]). Typical Characteristics of these bio-ecological zones within the AOI is provided in **Table 4-19** and the map of bio-ecological zones is provided in **Figure 4-27**.

Table 4-19: Typical Characteristics of Bio-ecological Zones of AOI

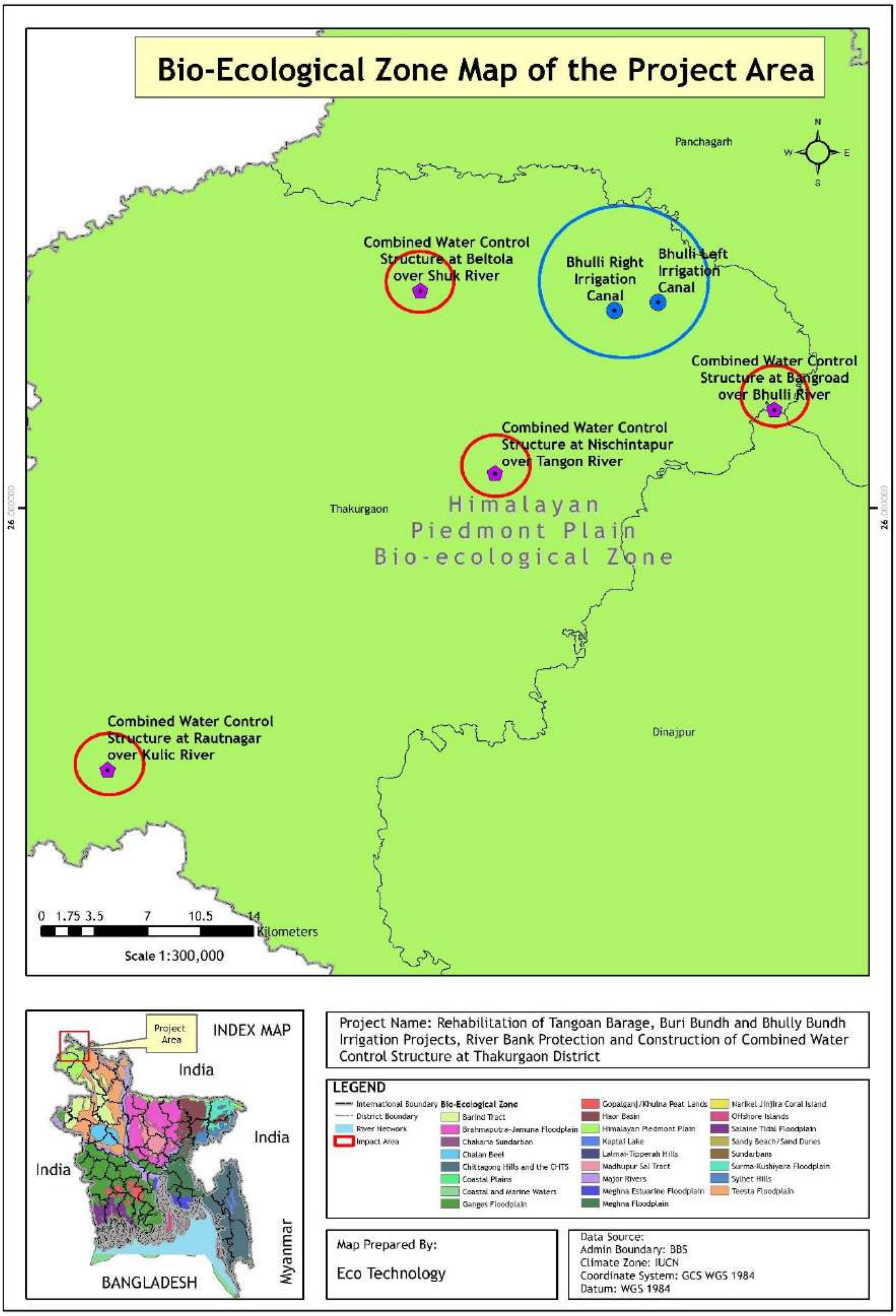
Himalayan Piedmont Plain Bio-Ecological Zone		
Floral Diversity	Trees	Kanthal *(Artocarpus heterophyllus),* Aam *(Mangifera indica),* Toon *(Toona ciliata),* Pitraj *(Apimnamixis polystachya)*.
	Shrubs and Herbs	Assar *(Grewia microcos),* Keya kanta *(Pandanus foetidus),* Kurchi *(Holarrhena antidysenterica),* Choto akanda *(Calotropis procera),*

[5] Nishat, A., S.M.I. Huq, S.P. Barua, A.H.M.A. Reza and A.S.M. Khan. 2002. Bio-ecological Zones of Bangladesh. The World Conservation Union (IUCN), Dhaka, Bangladesh. 141 pp

		Murta/Patipata *(Clinogyne dichotoma),* Jali bet *(Calamus guruba)*.
	Aquatic plants	Binna ghash *(Vetiveria zizanioides),* Shada shapla *(Nymphaea nouchali),* Jhanji *(Hydrilla verticillata),* Makhna *(Euryale ferox)*.
Faunal Diversity	Mammals	Asian Elephant (*Elephas maximus*), Hoolock Gibbon (*Hylobates hoolock*), Mainland Serow (*Capricornis Sumatraensis*), Clawless Otter (*Aonyx Cinerea*), Binturong (*Arctictis binturong*)
	Birds	Ashy Bulbul (*Hemiros flavala*), Gull-Billed Tern (*Gelochelidon nilotica*), Spot Throated Babbler (*Pellorneum albiventre*), Asian Glossy Starling (*Aplonis panayensis*
	Reptiles	Slender Coral Snake (*Callopllis melanurus*), Pit Viper (*Trimeresurus gramineus*), Banded Krait (*Bunsarustasciatus*), Ring Lizard (*Varanus salzutor*)
	Amphibians	Ornate Microhylid (*Microhyla ornata*), Bull Frog (*Hoplobatracltus tigerinus*)
5a. Haor Basin		
Floral Diversity	Trees	Hijal (*Barringtonia acutangular*), Barun (*Crataeva murvala*), Koroj (*Pongamia pinnata*), Pitali (*Trewia mudiflora*), Bhui dumur (Ficus *heterophyllus*)
	Herbs and Shrubs	Pani golpa/ban golap (*Rosa involucrate*), Khagra (Phragmites *karka*), Nol/Bara Nol (*Arundo donax*), Urusia (*Erianthus ravannae*) Kash (*Saccharum spontaneum*)
	Aquatic Plants	Chalia (*Hemarthria protensa*), Singara (*Trapa bispinosa*), Padda (Nelumbo *nucifera*), Chechra (*Schenoplectus articulates*)
Faunal Diversity	Mammal	Ganges river dolphin (*Platanista gangetica*), Thick-eared bat (*Eptesicus pachyotis*), Common otter (*Lutra lutra*), Fishing cat (*Prionailurus viverrinus*) Grey mask shrew (*Suncus murinus*)
	Birds	Pallasos fish eagle (*Haliaeetus leucoryphus*), Darter (Anhinga *melanogaster*), Malayan night heron (*Gorsachius melanophus*), Spot-billed duck (*Anas poecilorhyncha*), Black-breasted parrotbill (*Paradoxornis flavirostris*)
	Reptiles	Green rat snake (*Coluber nigromarginatus*), Indian roofed turtle (Kachuga *tecta*), Spotted Pond turtle (Geoclemys *hamiltonii*), Red-necked keelback (*Rhabdophis subminiatus*)
	Amphibians	Red microhylid (*Microhyla rubra*), Taipeh frog (*Rana taipehensis*), Maculated tree frog (*Polypedates maculatus*)

Source: Atlas of Bio-ecological Zones of Bangladesh, IUCN 2002

Figure 4-27: Bio-ecological Zones of the Study Area



Source: Bio-ecological Zones of Bangladesh, IUCN, 2002

4.6.2 Habitat Types within Area of Influence (AOI)

Habitat type within the AOI was primarily determined by reviewing Satellite imagery and followed by on ground verification during primary survey. Habitat types are generally classified based on predominant land use.

Terrestrial ecosystem within the AOI can be classified into three habitat types:

i. Agricultural Habitat;
ii. Homestead Plantation Habitat; and
iii. Small Hill/ Hillock Habitat.

Aquatic ecosystem within the AOI can be divided into three habitat types:

i. Riverine Habitat;
ii. Canals/ stream; and
iii. Stagnant Waterbodies.

4.6.3 Aquatic Life and Fisheries

4.6.3.1 Habitat

The aquatic habitat includes riverine habitat, canals/stream and stagnant waterbodies.

4.6.3.2 Riverine Habitat of Tangan, Kulik and Nagar River

The rivers of Tangan, Kulik and Nagar are generally flowing from north to south. Although not throughout the year, the rivers regain their youth during the rainy season. Extreme levels of flood danger were announced in at least two places. However, the region is especially flooded during the monsoon. Pirganj, Haripur and Sadar upazilas have low water bodies. However, in the dry season, they remain completely dry. The course of the river is slowly shrinking due to siltation. Apart from rivers, there are many canals in this area. There is enough water in the canal beel during the monsoon season. However, most of the canals dry up during the dry season. Only some of the larger bills contain water.

Tangan River: The Tangan River originates from the lower waters of Atwari upazila of Panchagarh district bordering India and Bangladesh and flows southwards through Bochaganj upazila of Dinajpur. The river then enters Balurghat in India and re-enters Bangladesh and joins the Punarbhara river at Chapai Nawabganj. Eventually this combined current merged into the Mahananda river near Rohanpur. Thakurgaon Sadar is located on the left bank of this river. From Tangan and other major rivers, tributaries and tributaries named Shuk, Senua, Mara Pathraj and Charalban have originated

Tangan is flood-prone in the monsoon. The flood season is generally from the last week of May to the middle of October. Periodically almost every year during the monsoon Tangan river floods its banks and new silt is deposited in the adjacent terrestrial habitats increasing fertility and productivity. Moreover, flooding is of immense importance for aquatic habitats like floodplains and large shallow waterbodies, locally called “beels”. The only habitat type that can be considered as “Natural Habitat” within the AOI is “Riverine Habitat of Tangan, Kulik and Nagar”.

4.6.3.3 Canals/Stream

Natural drainage canals in the AOI ultimately drain into Tangan, Kulik and Nagar. During monsoon often when water level of Tangan, Kulik and Nagar River rises, backflow from the river through the canals occasionally results in massive flooding. To reduce such risk, canals have largely been modified by installing “lock gated” to control connectivity with the river. During the site visit in May 2024, most of these canals were found to be in a dry state.

4.6.3.4 Stagnant Waterbodies

Stagnant waterbodies within the AOI can be further classified as follows:

Beels

Beel a large surface waterbody that accumulates surface runoff water through internal drainage channels; these depressions are mostly topographic lows produced by erosions and are seen all over Bangladesh. The term beel is synonymous to baor, and they are small saucer-like depressions of a marshy character. Many of the beels dry up in the winter but during the rains expand into broad and shallow sheets of water, which may be described as fresh water lagoons. Beels is mainly fed by surface runoff water. A few larger ones are fed by floodwater during the wet season from the parent river channel. The beels are considered the most productive wetland resources of Bangladesh due to the presence of large variety of small fishes, swamp forests and migratory birds.

Ponds

Ponds are largely located within in villages and associated with individual houses or mosques. Traditionally ponds were dug to use the soil to elevate the household land or to use soil as raw material for building “clay huts”. But today clay is hardly used as construction material, but ponds remain and are maintained in villages often to fulfill requirement of water for household use.

4.6.3.5 Vegetation Profile of the AOI

4.6.3.5.1 Vegetation Profile of Stagnant Waterbodies and Canals

Degraded and denuded freshwater swamp forests are distributed throughout the beels and canals. This type of forest consists of flood-tolerant evergreen trees. Swamp forest is adapted to monsoon flooding for three to four months, to depths of 0.5 to 2.5 m. Principal wetland vegetations of beels include open water vegetation and seasonally inundated aquatic vegetation including homestead, reed land and stand of trees. *Barringtona acutangula (hijal), Pongamia pinnata (koroch)* are dominant tree species of freshwater swamp forest.

Reed swamp forest (nal-khagra bon) is adapted to lands intermediate in height between the water basin homestead lands. This area is fairly deeply flooded during the flood season and dries out during the dry season. The grasses *Phragmites karka (nol)* and *Saccharum spontaneum (kans, aisha)* predominate. Some sedge/ medow grasses are also found here, in lesser amount, such as *Vetiveria zizanioides* (binna), *Sclerostachya fusca* (khuri) and *Arundo donax* (baranol, gobanol).

Large bloom of Water Hyacinth (*Eichhornia sp*.) was found to be common in most of the beels and canals within the AOI. Water Hyacinth (native to South America) are invasive species in South Asia, and some waterbodies are found to be completely infested with it, covering the entire surface area. Apart from that other floating aquatic plants (Roots not attached to substratum, freely floats on survace) viz. Water Lettuce (*Pistia stratiotes*), Duck Week (*Spirodela polyrhiza*), Floating Fern (*Salvinia natans*) and *Azolla sp*. were recorded from the stagnant waterbodies and stagnant canals of the study area.

Rooted plant species like Water Lilies (*Nymphaea pubescens*), are commonly observed in stagnant waterbodies of the AOI. Water lilies prefer stagnant shallow water, where the rhizome remains firmly rooted in the muddy substratum and leaves and flowers floats on the surface. Some completely submerged aquatic plants like *Potamogeton* crispus and *Vallisneria sp*. were observed particularly in stagnant waterbodies. Growth of algal like *Cladophora sp*., was observed among the nearshore submerged plants.

Some dominant aquatic plant species are shown in Figure 4-28.

Figure 4-28: Aquatic Plants Observed in the AOI

		
Water Hyacinth *(Eichhornia sp.)*	Kochu (*Colocasia esculenta*)	Bet (*Schumannianthus dichotomus*)
		
Helencha (*Enhydra fluctuans*)	Nol (*Phragmites karka*)	Jalibet (*Calamus tenius*)

Source: Field Survey by Eco Technology Team, May 2024

4.6.3.5.2 Vegetation Profile of Tangan, Kulik and Nagar River

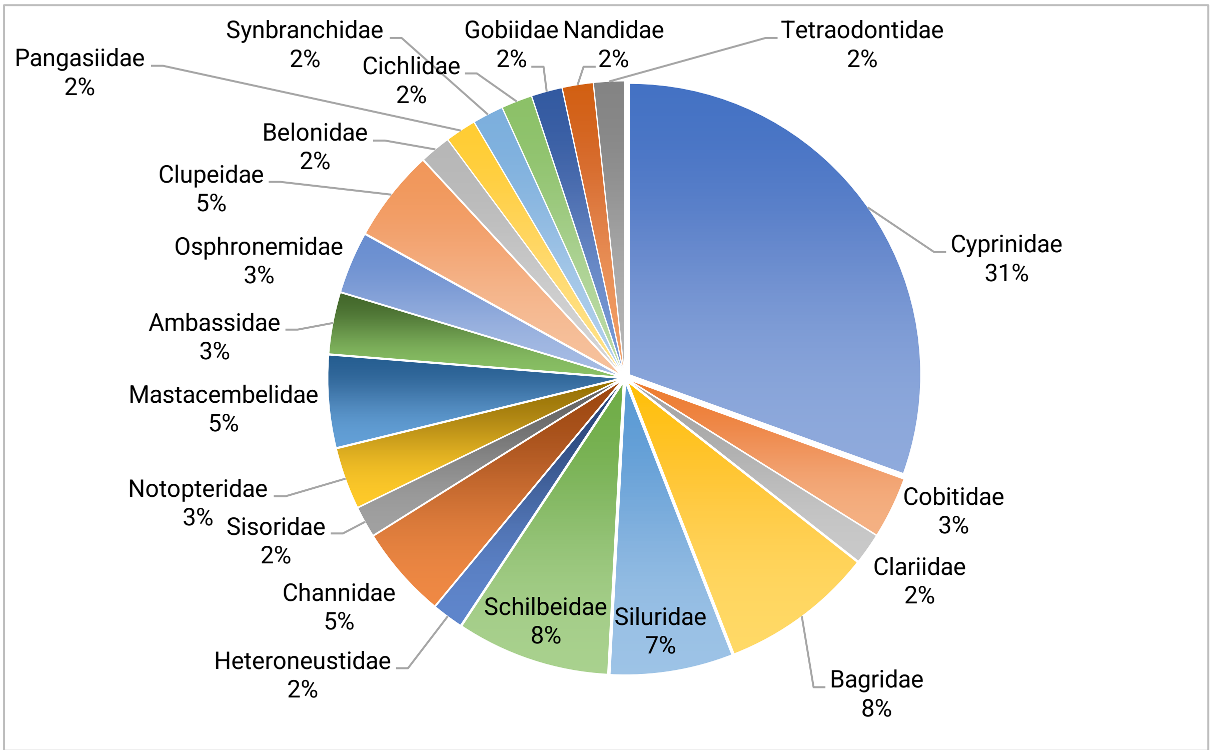
Riparian vegetation is present along the river side, the main plant species observed are *Syzygium cumini* and *Samanea saman*. Apart from these plant species found along the edge of water, in the amphibious zone are *Eichhornia sp., Enhydra fluctuans, Ipomoea aquatic* etc.

4.6.3.6 Fisheries Profile of the AOI

4.6.3.6.1 Ichthyofauna Profile of the AOI

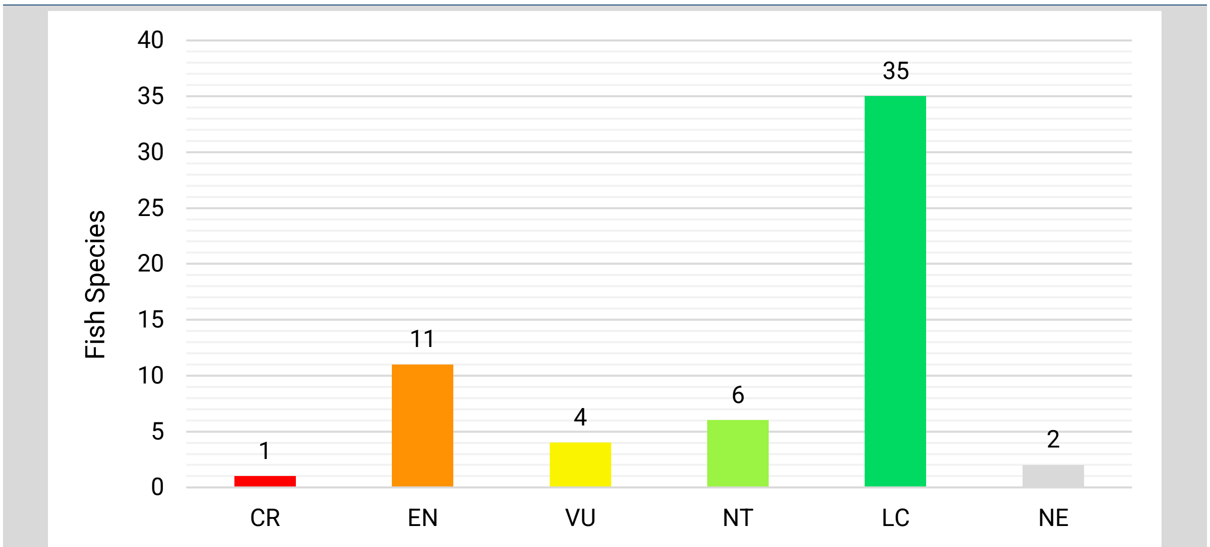
A total of 59 fish species under 21 families have been enlisted based on primary observation, consultation with fishermen and secondary sources. Among them, Cyprinidae (31%) family has been found highest times. During this study, one critically endangered species (*Bagarius bagarius*), eleven endangered species (*Megarasbora elanga, Botia dario, Chitala chitala, Channa marulius, Pangasius pangasius, Rita rita, Ompok pabda, Clupisoma garua, Ompok bimaculatus, Ompok pabda,* *Mastacembelus armatus*), and four vulnerable species (*Sperata aor, Monopterus cuchia, Puntius ticto, and Gudusia chapra*) were enlisted according to IUCN red list, Bangladesh, 2015. Fishermen of the survey areas stated that fish catch reaches its peak during mid-September to mid-November when water starts receding and lowest catch during monsoon (June and July). Moreover, in terms of species, fish catch is much more diverse during post monsoon season. Important fish species with respect to significant composition of catch in different seasons has been represented in Table 4-20.

Figure 4-29: Family-Based Fish Species Diversity in the AOI



Source: Eco Technology, May 2024

Figure 4-30: Variation of Fish Species Respect to IUCN Red List, Bangladesh



Source: Eco Technology, May 2024

Table 4-20: Variation of Fish Catch with Respect to Season

Season	Bengali Month	English Month	Significant Fish Species	Hydrological Event
Summer	Chaitra, Baisakh, Jaisthya	March, April, May and June	*Corica soborna*, *Labeo rohita*, *Labeo gonius*, *Sperata aor*, *Chanda nama*, *Labeo calbasu*, *Macrobrachium lamarrei*, *Pangasius bocourti*, *Salmostoma acinaces*, *Batasio tengana*, *Eutropiichthys vacha*, *Corica soborna*	Water level gradually decreases in river, canals dry up or becomes highly eutrophic, shallow waterbodies completely dries up. By, end of summer Water sacristy reaches extreme limits. Fish populations struggles to survive, decreases, and becomes fragmented and isolated.
Monsoon	Ashar, Shravan, Vadra	June end, July August, middle of September	*Tenualosa ilisha*, *Ilisha megaloptera*, *Puntius chola*, *Labeo rohita*, *Gibelion catla*, *Labeo calbasu*, *Salmostoma acinaces*,	Onset of Monsoon rainfall in plains of Bangladesh and Hills of Northeast India leads to rise in water level of river and even leads to flood. Rivers, canals, and waterbodies gets connected. Spanning season for most fish species. Fish population gets widely dispersed over newly inundated area and fish stock in isolated waterbodies gets naturally replenished. As fish resource gets dispersed over wide area, fishing becomes difficult.
Post Monsoon	End of Vadra, Ashwin, mid of Kartik	Middle of September, October, early November	*Wallago attu*, *Pangasius bocourti*, *Tenualosa ilisha*, *Sperata aor*, *Amblypharyngodon mola*, *Chitala chitala*, *Labeo gonius*, *Labeo calbasu*, *Labeo rohita*, *Rita rita*, *Ilisha megaloptera*, *Botia Dario*, *Sperata aor*, *Heteropneustes fossilis*, *Corica soborna*, *Ailiichthys*	After monsoon is over, water level in river starts dropping to normal level, canals and waterbodies again becomes isolated but filled with water, and fish stock along with spans. Monsoon provides opportunity for natural replenishment of fish stock due to abundant resources.

Season	Bengali Month	English Month	Significant Fish Species	Hydrological Event
			punctata, Amblypharyngodon mola, Puntius chola, Chanda nama, Channa striata, Batasio tengana *Eutropiichthys vacha, Salmostoma acinaces, Anguilla bengalensis.*	Receding water level and isolated waterbodies concentrates fish stock and makes it relatively easy to fish.
Winter	Agrohyan Poush, Magh, Falgoon	Middle of November, December, January, February	*Batasio tengana*, *Puntius chola*, *Botia dario*, *Wallago attu*, *Pisodonophis cancrivorus, Batasio tengana*, *Corica soborna*, *Sperata aor, Eutropiichthys vacha*	Waterbodies gets further isolated and fish catch comes back to normal level.

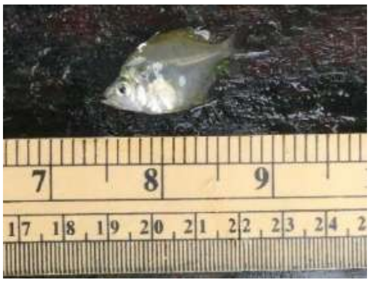
Source: Islam M.M., Faruque H. (2019); Consultation with Fishermen

During this study, the team observed in the fish market and fishermen has also reported presence of Goonch catfish (*Bagarius bagarius*) (locally known as "Bagha ayre") in Tangan, Kulik and Nagar River, and occasional catch of specimen weighing over 50kg is not uncommon. It is the only Critically Endangered (IUCN Bangladesh, 2015), reported to be present in Surma River within the AOI.

Based on Global IUCN Red-list status (v1-2021) no Critically Endangered or Endangered fish species were reordered or reported from the AOI. Six Vulnerable species can be found within the AOI, Mrigal Carp (*Cirrhinus cirrhosis*), Kuchia (*Monopterus cuchia*), Tit punti (*Puntius ticto*), Chela (*Chela cachius*), Common carp (*Cyprinus carpio*) and Boal (*Wallago attu*). All these species except kuchia are highly prised as food-fish.

Figure 4-31: Photographs of Ichthyofauna Recorded from the AOI

		
Gonia (*Labeo gonius*)	Rani (*Botia dario*)	Bagha ayre (*Bagarius bagarius*)

		
		
Kankila (*Xenentodon cancila*)	Tengra (*Mystus vittatus*)	Kalibaush (*Labeo calbasu*)
		
Koi (*Anabas testudineus*)	Guchi Baim (*Macrognathus pancalus*)	Chapila (*Gudusia chapra*)
		
Ilish (*Tenualosa ilisha*)	Sar Punti (*Systomus sarana*)	Ayre (*Sperata aor*)
		
Mrigel (*Cirrhinus cirrhosus*)	Nama Chanda (*Chanda nama*)	Potka (*Tetraodon cutcutia*)

Source: Field Survey by Eco Technology Team, May 2024

4.6.3.7 Planktonic Profile of the AOI

In Primary Productivity Analysis of Inland Water ecosystem, the biological part of the limnology study of Phytoplankton and Zooplankton are of paramount importance. Like plants in terrestrial ecosystem, planktons (particularly phytoplankton) are the primary producers, converting photo energy into chemical energy, thus planktons provides data/ information in the productivity of a given aquatic ecosystem as well as to determine the type of Aquatic Habitat which is related to the seasonal abundance, relative occurrence of planktonic flora and fauna and their relationship with some important physio-chemical quality conditions of water bodies adjacent to the AOI.

4.6.3.7.1 Phytoplankton

A total of seventeen (12) species of phytoplankton were identified by sample analysis from predefined three sample collection location. Volvox sp. was the highest abundant plankton species whereas Microspora sp. was the least abundant species. The location of species composition and amount of phytoplankton per liter has been presented in Table 4-21. The diversity indices by sampling location have been presented in Source: Field Survey by Eco Technology Team, May 2024

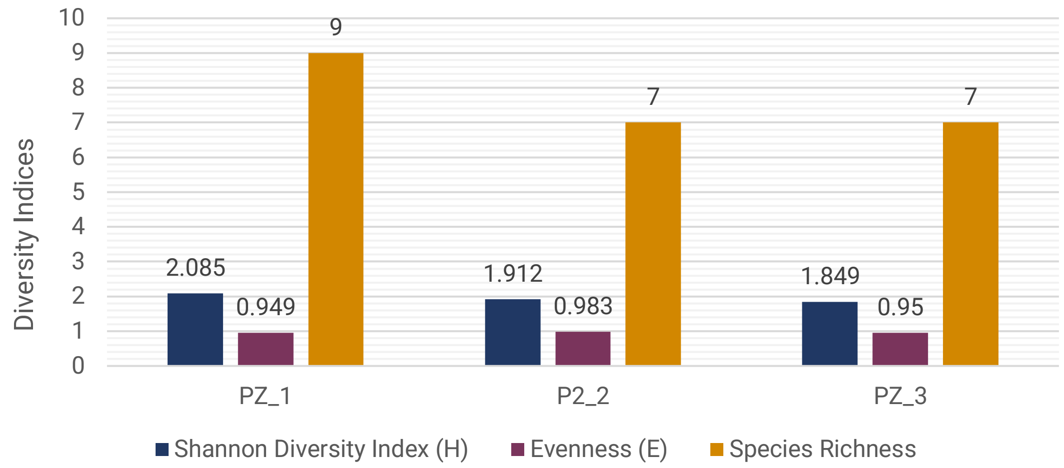
Figure 4-32.

Table 4-21: List of Phytoplankton Found in the Study Area

S/N	Group/Order	Genus	Number (Individuals/ L)		
			PS1	PS2	PS3
1	Bacillariophyta	Cymbella sp.	0	0	6
2		Melosira sp.	12	0	0
3		Synedra sp.	0	12	5
4		Navicula sp.	10	9	7
5	Chlorophyta	Spirogyra sp.	7	6	0
6		Volvox sp.	24	8	6
7		Microspora sp.	9	0	0
8		Clostrium sp.	6	12	4
9		Ulothrix sp.	8	0	0
10	Euglenophyta	Euglena sp.	22	0	15
11		Lamanea sp.	12	6	0
12	Pyrrophyta	Ceratium sp.	0	10	6

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-32: Diversity Indices of Phytoplankton



Source: Field Survey by Eco Technology Team, May 2024

4.6.3.7.2 Zooplankton

A total of eleven (11) species of zooplankton were identified by sample analysis from predefined three sample collection location. *Diaptomus sp*. was the highest abundant zooplankton species whereas *Daphnia sp*. was the least abundant species. The location of species composition and number of zooplankton per litre has been presented in Table 4-22. The diversity indices by sampling location have been presented in Source: Field Survey by Eco Technology Team, May 2024

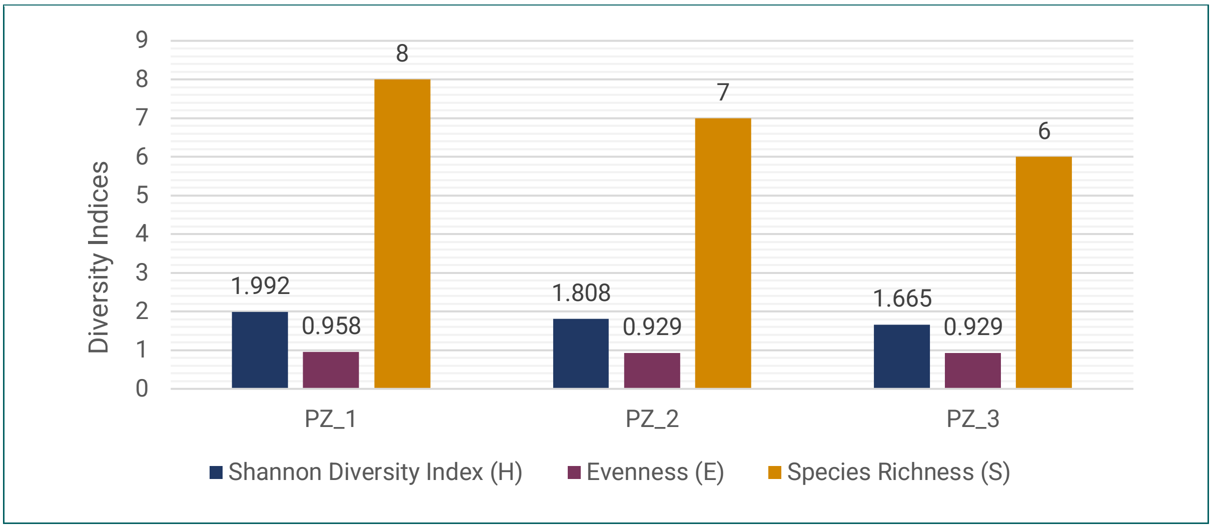
Figure 4-33.

Table 4-22: List of Zooplankton Found in the Study Area

S/N	Group/Order	Genus	Number (Individuals/ L)		
			PS1	PS2	PS3
1	Copepods	Diaptomus sp.	14	8	5
2		Cyclops sp.	7	0	3
3	Rotifers	Brachionus sp.	5	7	0
4		Asplanchna sp.	0	4	3
5		Keratella sp.	12	7	0
6	Cladocera	Moina sp.	8	0	7
7		Bosmina sp.	9	2	1
8		Daphnia sp.	3	2	0
9	Odonata	Sida sp.	12	10	5

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-33: Diversity Indices of Zooplankton



Source: Eco Technology Team, May 2024

4.6.4 Terrestrial Habitats

4.6.4.1 Habitat

Terrestrial habitat includes habitats in agricultural lands, homestead plantations and small hill/ hillock habitats. All the habitats are modified habitats. There is no natural habitat like forest in the AOI.

4.6.4.1.1 Agricultural Habitat

Agricultural habitats are the most dominant habitat type within the AOI, covering over 50% of AOI. Agricultural habitat within the AOI is mostly defined by huge expanses of contiguous paddy fields extending over a few kilometers. Hardly any large tree species are present within agricultural habitats, larger tree species are mostly concentrated along roadside plantation and homestead plantation. During monsoon season, Aman paddy has been cultivated in the agriculture land of the AOI. During dry season, Boro paddy has been cultivated, where the irrigation water has been available. Within the study area most of the agricultural habitats are mono-cropped and mono-cropped paddy fields are in postharvest stage and were primarily devoid of vegetation. Some fields were used for paddy cultivation by using ground water, water from canals, rivers or larger waterbodies.

Agricultural habitats are extensively modified by humans to increase crop productivity, so “Agricultural Habitats” can be classified as “Modified habitat”.

4.6.4.1.2 Homestead Plantation Habitat

Apart from human settlement, the villages are always associated with homestead plantation. “Homestead Plantation Habitat” covers about 20 percent of the AOI, but maximum diversity of plant species, particularly of tree species are expected from homestead plantations. Homestead plantation are species- which include rich agroforestry systems maintained based on choice, needs and importance of plants for household consumption or the market (Vogl and Vogl-Lukasser, 2003) or aesthetic value or religious and cultural values; which results in assemblage of large number of flowering and fruit bearing trees. Such assemblage of tall woody tree, flowing and fruiting trees provides suitable shade, shelter, nesting habitat (particularly for birds) and source of food which supports large number of faunal species.

Though, compared to agricultural habitat, homestead plantation habitats are more diverse and even homestead plantation can host large number of native species, still species assemblage of homestead plantation habitat, particularly assemblage floras species is largely controlled by human intervention and often floral species are regularly modified or tended to increase production of fruit or flowers. So “Homestead Plantation Habitat” is also classified as “Modified Habitat”.

4.6.4.2 Vegetation Profile of the AOI

Agricultural land dominates the project area. Different types of agricultural practices were observed within the AOI. Agricultural habitat is mostly large expense of open fields where paddy is cultivated and hardly any large tree species is present within agricultural habitat. Trees are present along the edge of Agricultural habitat, in homestead plantation habitat or along the roads. Predominant agricultural method is the mono-cropping of paddies. Other crops that are cultivated are seasonal vegetables, chilli, watermelon, and nut were to be found in the study area. The major roadside vegetation passing through agricultural landscape consists of *Mangifera indica, Acacia auriculiformis, Ficus benghalensis, Eucalyptus spp., Samanea saman,* etc.

4.6.4.2.1 Species Composition

In the project AOI, a total of 27 species under 18 families of trees and 23 flora species comprising of herbs and shrubs under 17 family was identified by field survey. The photographs of some tree species have been presented in **Figure 4-34**.

Table 4-23: Flora Species (Trees) Recorded from the Study Area

S/N	Local Name	Common Name	Scientific Name	Family	Uses
1	Aam	Mango	*Mangifera indica*	Anacardiaceae	Fruit, Timber, Fuel Wood
2	Aamra	Ambda	*Spondias pinnata*	Anacardiaceae	Fruit, Medicinal
3	Arjun	Arjun	*Terminalia arjuna*	Combretaceae	Medicinal
4	Ataphal	Custard apple	*Annona reticulata*	Annonaceae	Fruit, Fuel, Wood
5	Barun	Three leaved capers	*Crataeva magna*	Capparaceae	Fuel, Timber, Medicinal
6	Bethua Bans	Bamboo	*Bambusa chachrensis*	Gramineae	Basketry works, Construction material
7	Boroi	Indian Jujube	*Ziziphus mauritiana*	Rhamnaceae	Fruit
8	Borua bans	Female Bamboo	*Bambusa balcooa*	Poaceae	Basketry works, Construction material
9	Chikoin Bans	Common Bamboo	*Bambusa Chachrensis*	Poaceae	Basketry works, Construction Material
10	Eucalyptus	Eucalyptus	*Eucalyptus camaldulensis*	Myrtaceae	Timber
11	Gaab	Gaub Tree	*Diospyros malabarica*	Ebenaceae	Fruit
12	Jalpai	Olive	*Elaeocarpus floribundus*	Elaeocarpaceae	Fruit, Medicinal, Timber
13	Jam	Black plum	*Syzygium cumini*	Myrtaceae	Fruit, Medicinal, Timber
14	Jarul	Giant crepe-myrtle	*Lagerstroemia speciosa*	Lythraceae	Timber, Ornamental
15	Jigor	Indian Ash Tree	*Lannea coromandelica*	Anacardiaceae	Fodder, Hedge, Timber
16	Kanthal	Jackfruit	*Artocarpus heterophyllus*	Moraceae	Fruit
17	Kodom	Burflower-tree	*Neolamarckia cadamba*	Rubiaceae	Fuel wood, Fodder, Timber
18	Koroi	White Siris	*Albizia procera*	Fabaceae	Fodder, Fuel Wood, Timber
19	Lichu	Lychee	*Litchi chinensis*	Sapindaceae	Fruit, Timber
20	Mahogany	Mahogany	*Swietenia*	Meliaceae	Timber, Medicinal

S/N	Local Name	Common Name	Scientific Name	Family	Uses
			mahagoni		
21	Mangium	Mangium	*Acacia mangium*	Fabaceae	Timber
22	Narikel	Coconut	*Cocos nucifera*	Arecaceae	Fruit
23	Narikel	Coconut	*Cocos nucifera*	Arecaceae	Coir, Fruit, Oil Yielding
24	Peyara	Guava	*Psidiun guajava*	Myrtaceae	Fruit, Fodder, Timber, Medicinal
25	Rain Tree	Rain Tree	*Samanea saman*	Fabaceae	Timber, Fodder, Fuel Wood
26	Shegun	Teak	*Tectona grandis*	Lamiaceae	Timber
27	Supari	Betel palm	*Areca catechu*	Arecaceae	Fruit

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-34: Floral Species Observed in Project AOI

Mahogany (Swietenia mahagoni)

Rain tree (Samanea saman)

Bamboo (Bambusa Sp.)

Eucalyptus (Eucalyptus camaldulensis)

	
Guava (Psidium guajava)	Betel palm (Areca catechu)
	
Coconut (Cocos nucifera)	Mango (Mangifera indica)

Source: Field Survey by Eco Technology Team, May 2024

Table 4-24: Flora Species (Herbs and Shrubs) Found in Project Area

S. No.	Local Name	Scientific Name	Family	Type
1.	Adalya Phul	*Aidia densiflora*	Rubiaceae	Shrub
2.	Akhond	*Calotropis gigantea*	Asclepiadaceae	Shrub
3.	Assam lata	*Mikania cordata*	Asteraceae	Climber
4.	Datmardan	*Senna alata*	Caesalpiniaceae	Shrub
5.	Dekia	*Ampelopteris prolifera*	Thelypteridaceae	Herb
6.	Dhai Ful	*Woodfordia fruticosa*	Lythraceae	Shrub
7.	Dheki shak	*Christella dentata*	Thelypteridaceae	Herb
8.	Dholpata	*Commelina benghalensis*	Commelinaceae	Herb
9.	Dudhia	*Euphorbia hirta*	Euphorbiaceae	Herb
10.	Dumur	*Ficus hispida*	Moraceae	Shrub
11.	Durba	*Cynodon dactylon*	Poaceae	Herb
12.	Kalomoricha	*Clausena suffruticosa*	Rutaceae	Shrub
13.	Kanchira	*Commelina benghalensis*	Commelinaceae	Herb
14.	Kechla	*Eleusine indica*	Poaceae	Herb

S. No.	Local Name	Scientific Name	Family	Type
15.	Kochu	*Colocasia esculenta*	Araceae	Herb
16.	Kolkashunda	*Senna occidentalis*	Caesalpiniaceae	Shrub
17.	Lazzabati	*Mimosa pudica*	Mimosaceae	Herb
18.	Motha	*Cyperus rotundus*	Cyperaceae	Herb
19.	Nimbhut	*Glycosmis pentaphylla*	Rutaceae	Shrub
20.	Sharnalata	*Cuscuta reflexa*	Cuscutaceae	Climber
21.	Stholpadda	*Hibiscus sabdariffa*	Malvaceae	Shrub
22.	Thankuni	*Centella asiatica*	Apiaceae	Creeper
23.	Vat	*Clerodendrum viscosum*	Verbenaceae	Shrub

Source: Field Survey by Eco Technology Team, May 2024

4.6.4.3 Faunal Profile of the AOI

4.6.4.3.1 Avian Faunal Profile of the AOI

A total of 57 species under 37 families have been recorded from the study area. The highest number of birds dominated in the study area belonging to the family Sturnidae, Alcedinidae, Rallidae and Corvidae are also dominated family. Some significant avifaunal species are given in Table 4-25. Some significant avifaunal species are shown in Source: Field Survey by Eco Technology Team, May 2024

Figure 4-35.

Table 4-25: Observed Avian Fauna in the AOI

S/N	Family	Common Name	Local Name	Scientific Name	IUCN Banglades h (2015)	IUCN Global (V. 2021-2)
1	Accipitridae	Black kite	Bhubon Chil	*Milvus migrans*	LC	LC
2	Accipitridae	Brahminy Kite	Shonkho Chil	*Haliastur indus*	LC	LC
3	Aegithinidae	Common Iora	Fotikjol	*Aegithina tiphia*	LC	LC
4	Alcedinidae	Pied Kingfisher	Pakra Machranga	*Ceryle rudis*	LC	LC
5	Alcedinidae	White-breasted Kingfisher	Dhola gola Machranga	*Halcyon smyrnensis*	LC	LC
6	Alcedinidae	Common Kingfisher	Chhoto Maachranga	*Alcedo atthis*	LC	LC
7	Apodidae	Asian Palm Swift	Ashio Talbatashi	*Cypsiurus balasiensis*	LC	LC
8	Apodidae	House Swift	Ghor Batashi	*Apus affinis*	LC	LC
9	Ardeidae	Little Egret	Choto boga	*Egretta garzetta*	LC	LC
10	Ardeidae	Indian pond heron	Kani Bok	*Ardeola grayii*	LC	LC
11	Ardeidae	Intermediate	Majhari Bok	*Ardea intermedia*	LC	LC

S/N	Family	Common Name	Local Name	Scientific Name	IUCN Bangladesh (2015)	IUCN Global (V. 2021-2)
		Egret				
12	Ardeidae	Cattle Egret	Go Boga	*Bubulcus ibis*	LC	LC
16	Ciconiidae	Asian Openbill Stork	Shamukkhol	*Anastomus oscitans*	LC	LC
17	Cisticolidae	Common Tailor Bird	Tuntuni	*Orthotomus sutorius*	LC	LC
18	Cisticolidae	Zitting cisticola	Bhomra Choton	*Cisticola juncidis*	LC	LC
19	Columbidae	Spotted Dove	Tila Ghughu	*Streptopelia chinensis*	LC	LC
20	Columbidae	Rock Pigeon	Gola Paira	*Columba livia*	LC	LC
21	Coracidae	Indochinese Roller	Neel-Kantha	*Coracias affinis*	DD	LC
13	Corvidae	Large-billed Crow	Dar kak	*Corvus macrorhynchos*	LC	LC
14	Corvidae	House Crow	Pati Kak	*Corvus splendens*	LC	LC
15	Corvidae	Rufous Treepie	Harichacha	*Dendrocitta vagabunda*	LC	LC
22	Cuculidae	Asian Koel	Kokil, koel	*Eudynamys scolopaces*	LC	LC
23	Dicruridae	Bronzed Drongo	Fingey	*Dicrurus aeneus*	LC	LC
24	Dicruridae	Black Drongo	Kala Fingey	*Dicrurus macrocercus*	LC	LC
25	Estrildidae	Black Headed Munia	Pora Munia	*Lonchura atricapilla*	LC	LC
26	Jacanidae	Bronze winged Jacana	Jolpipi	*Metopidius indicus*	LC	LC
27	Laniidae	Brown Shrike	Badami Koshai	*Lanius cristatus*	LC	LC
29	Megalaimidae	Coppersmith Barbet	Chhoto Basanta Bauri	*Psilopogon haemacephalus*	LC	LC
30	Megalaimidae	Blue-throated Barbet	Nil-gola Basonti Baori	*Psilopogon asiaticus*	LC	LC
28	Meropidae	Green bee-eater	Suichora	*Merops orientalis*	LC	LC
31	Monarchidae	Black-naped Monarch	Kalagarh Rajon	*Hypothymis azurea*	LC	LC
32	Motacillidae	Paddyfield Pipit	Dhani Tulika	*Anthus rufulus*	LC	LC
33	Muscicapidae	Oriental Magpie	Doel	*Copsychus saularis*	LC	LC

S/N	Family	Common Name	Local Name	Scientific Name	IUCN Bangladesh (2015)	IUCN Global (V. 2021-2)
		Robin				
34	Nectarinidae	Purple Sunbird	Niltuni	*Cinnyris asiaticus*	LC	LC
35	Oriolidae	Black hooded Oriole	Halde Pakhi	*Oriolus xanthornus*	LC	LC
36	Paridae	Great Tit	Titpokh	*Parus major*	LC	LC
37	Passeridae	House sparrow	Pati choroi	*Passer domesticus*	LC	LC
38	Pellorneidae	Abbott's Babbler	Battasia	*Malacococinla abbotti*	LC	LC
39	Phalacrocoracidae	Little Cormorant	Choto Pankowri	*Microcarbo niger*	LC	LC
40	Phylloscopidae	Greenish Warbler	Nitidus	*Phylloscopus trochiloides*	LC	LC
41	Picidae	Fulvous-breasted Woodpecker	Batabi Kathkurali	*Dendrocopos macei*	LC	LC
42	Picidae	Black-rumped Flameback	Sonali kaththokra	*Dinopium benghalense*	LC	LC
43	Ploceidae	Baya Weaver	Babui	*Ploceus philippinus*	LC	LC
44	Psittaculidae	Rose-ringed Parakeet	Sobuj Tia	*Psittacula krameria*	LC	LC
45	Pycnonotidae	Red-vented Bulbul	Bangla bulbul	*Pycnonotus cafer*	LC	LC
46	Rallidae	White-breasted Waterhen	Dahuk	*Amaurornis phoenicurus*	LC	LC
47	Rallidae	Purple Swamphen	Kalim	*Porphyrio porphyrio*	LC	LC
48	Rallidae	Common Moorhen	Pati Jolmurgi	*Gallinula chloropus*	LC	LC
49	Rhipiduridae	White-throated Fantail	Dholagola Chatagurani	*Rhipidura albicollis*	LC	LC
50	Scolopacidae	Common Sandpiper	Pati Batan	*Actitis hypoleucos*	LC	LC
51	Scolopacidae	Wood Sandpiper	Bon Batan	*Tringa glareola*	LC	LC
52	Sturnidae	Common Myna	Salik/Bhat Salik	*Acridotheres tristis*	LC	LC
53	Sturnidae	Asian Pied Starling	Go Shalik	*Sturnus contra*	LC	LC
54	Sturnidae	Jungle Myna	Juti Shalik	*Acridotheres fuscus*	LC	LC

S/N	Family	Common Name	Local Name	Scientific Name	IUCN Bangladesh (2015)	IUCN Global (V. 2021-2)
55	Sturnidae	Chestnut-tailed Starling	Kath Shalik	*Sturnia malabarica*	LC	LC
56	Timalidae	Jungle Babbler	Chhatare Pakhi	*Turdoides striata*	LC	LC
57	Upupidae	Common Hoopoe	Hudhud	*Upupa epops*	LC	LC

Note: LC=Least Concern

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-35: Photographs of Terrestrial Birds Recorded from AOI

		
Black Drongo (*Dicrurus macrocercus*)	Black-hooded Oriole (*Oriolus xanthornus*)	Tricoloured Munia (*Lonchura malacca*)
		
Red-vented Bulbul (*Pycnonotus cafer*)	Green Bee-eater (*Merops orientalis*)	Fulvous-breasted woodpecker (*Dendrocopos macei*)
		
Black Kite (*Milvus migrans*)	Brahminy kite (*Haliastur indus*)	Spotted Dove (*Spilopelia chinensis*)

Source: Field Survey by Eco Technology Team, May 2024

4.6.4.3.2 Terrestrial Mammal

Eight terrestrial mammal species belonging to six families were recorded or reported to be present within the AOI and listed in Table 4-26. Out of them, common palm Civet (*Paradoxurus hermaphroditus*) is a threatened species which is enlisted as Near Threatened according to IUCN Bangladesh Red list, 2015. The photographs of some mammal species have been presented in Source: Field Survey by Eco Technology Team, May 2024

Figure 4-36.

Table 4-26: List of Mammal Species Found in Study Area

S/N	Family	Local Name	Common Name	Scientific Name	IUCN Bangladesh Status	IUCN Global Status
1	Canidae	Pati Shiyal	Golden Jackal	*Canis aureus*	LC	LC
2	Herpestidae	Choto Beji	Small Indian Mongoose	*Herpestes auropunctatus*	LC	LC
3	Muridae	Metho Indur	Common Indian Field Mouse	*Mus boodug*	LC	LC
4	Muridae	Nengti Indur	House Mouse	*Mus musculus*	LC	LC
5	Muridae	Indur	Common House Rat	*Rattus rattus*	LC	LC
6	Pteropidae	Badur	Indian Flying Fox	*Pteropus giganteus*	LC	LC
7	Sciuridae	Kath Birali	Irrawaddy Squirrel	*Callosciurus pygerythrus*	LC	LC
8	Viverridae	Gandha Gokul	Common Palm Civet	*Paradoxurus hermaphroditus*	NT	LC

Note: LC = Least concern, NT = Near threatened

Source: Field Survey by Eco Technology Team, May 2024

Figure 4-36: Photographs Terrestrial Mammals Recorded from the AOI

Golden jackal (*Canis aureus*)

Irrawaddy Squirrel (Callosciurus pygerythrus)

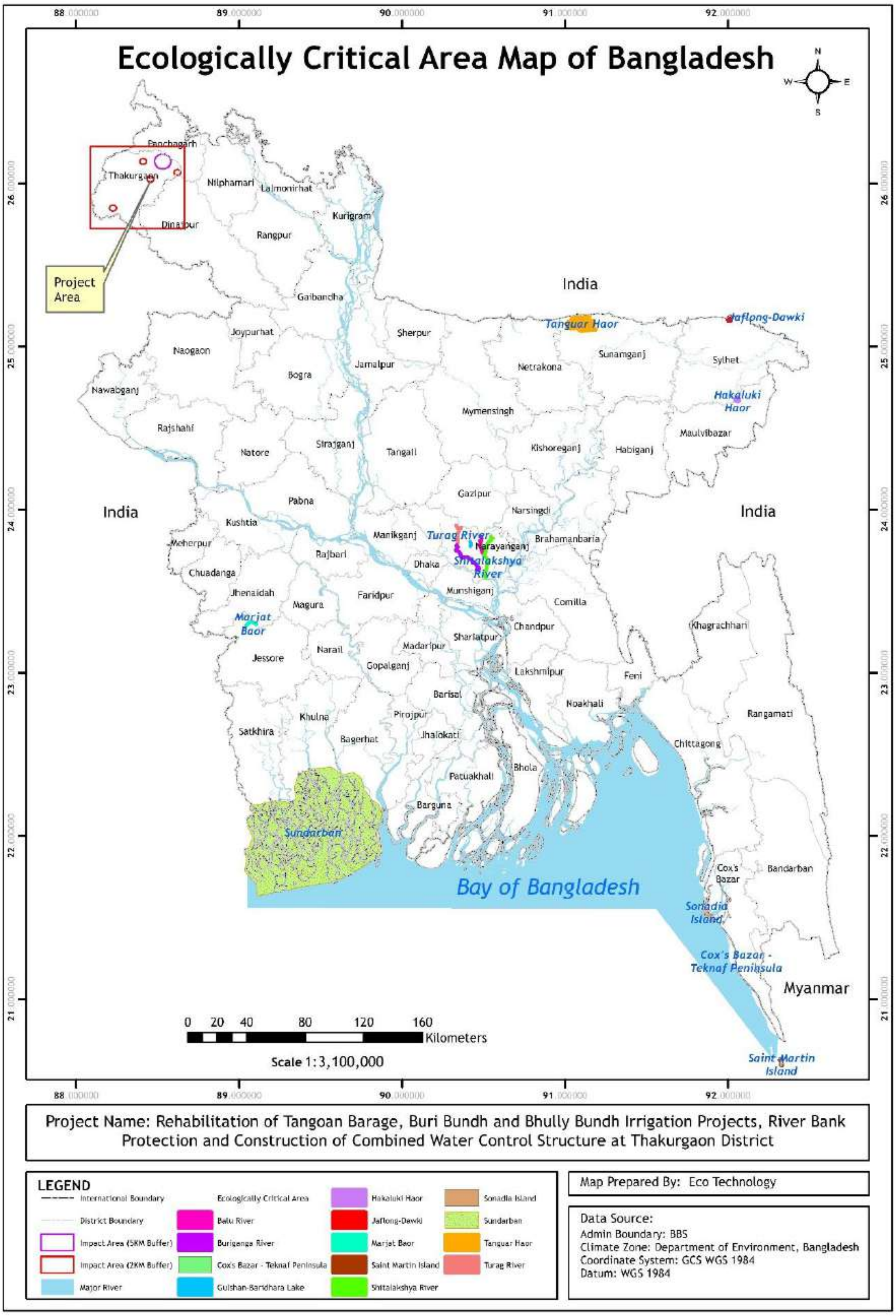
Source: Field Survey by Eco Technology Team, May 2024

4.7 Ecological Sensitive Areas

4.7.1 Ecologically Critical Area

An Ecologically Critical Area (ECA) is an environmental protection zone in Bangladesh. In 1995, specific areas in Bangladesh could be deemed ECAs as a result of the ECA. The Government after considering the human habitat, ancient monuments, archeological sites, forest sanctuary, national parks, game reserve, wild animals' habitat, wetland, mangrove, forest area, biodiversity, and other relevant factors of the area can declare it as ECA. As per the legal mandate, the MoEFCC till now declared 13 areas as ECA. The DoE as a statutory body is entrusted to manage the ECAs. There is no ECA area inside the proposed project site and its surroundings. The nearest ECA area from the project site is presented in **Figure 4-37**.

Figure 4-37: Ecologically Critical Area of the study area

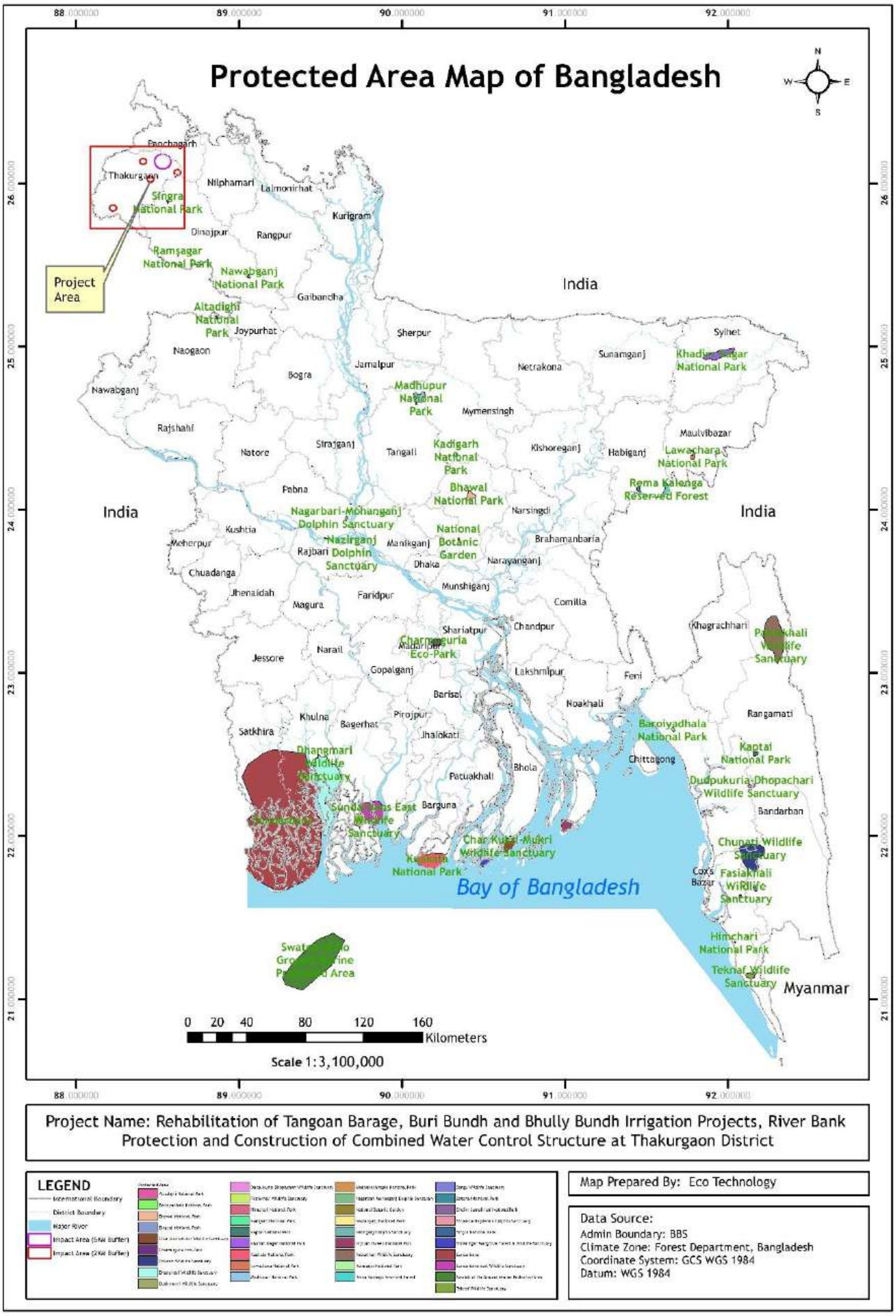


Source: Department of Environment 2016

4.7.2 Protected Area (PA)

A protected area is referred to an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity and natural and associated cultural resources and managed through legal or other effective means i.e., a protected area is predominantly a natural area established and managed in perpetuity, through legal or customary regimes, primarily to conserve their natural resources. According to the Wildlife (Conservation and Security) Act, 2012 types of protected areas are national parks, sanctuaries, eco-park, botanical gardens, community conservation areas, safari parks, Kunjaban, etc. No protected areas are inside the proposed project site and its Area of Influence (AOI). The nearest protected area from the project site is Singra National Park. The distance between the project site and the nearby protected areas is depicted in **Figure 4-38**.

Figure 4-38: Protected Area (PA) of the Study Area



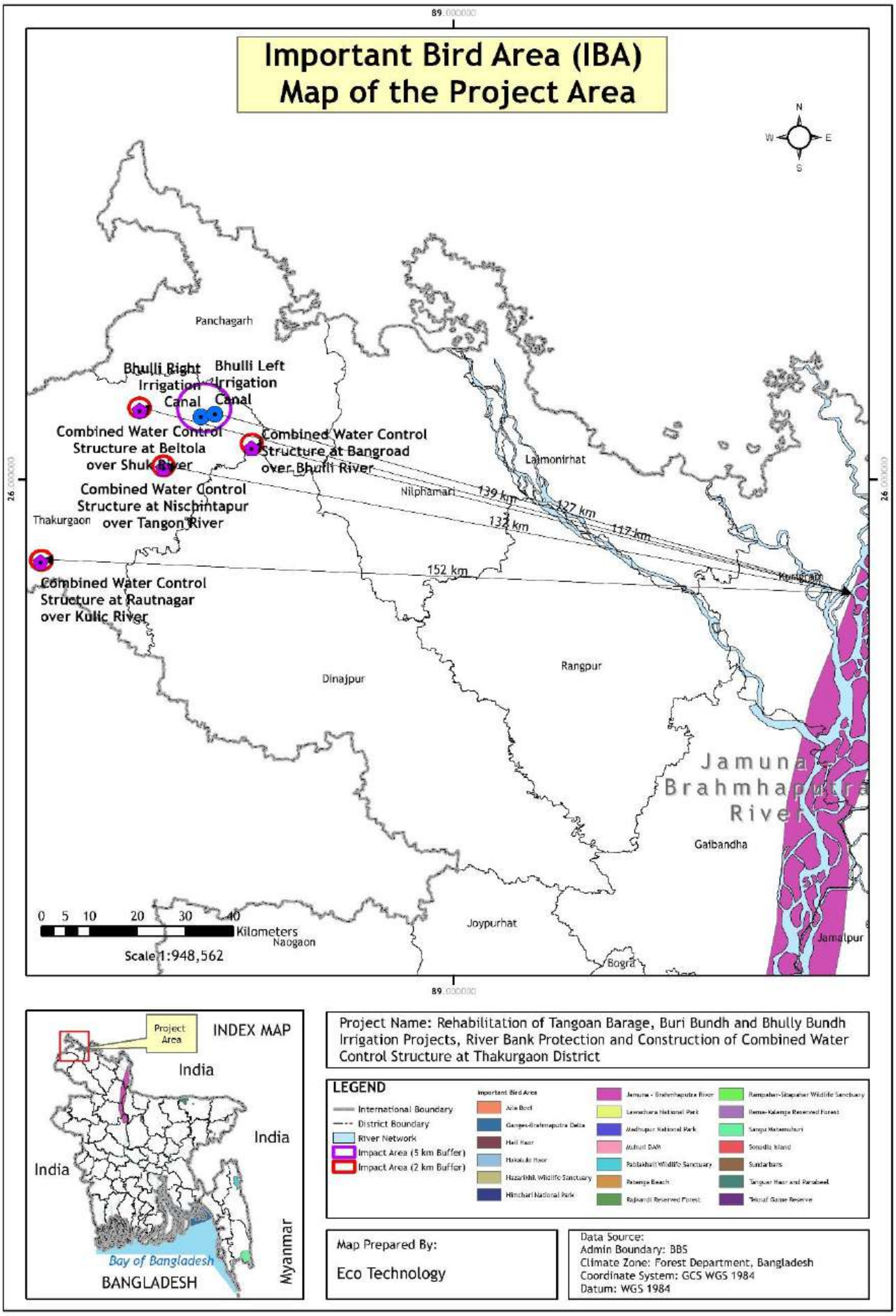
Source: Bangladesh Forest Department (BFD), 2022

4.7.3 Important Bird Area (IBA)

An Important Bird Area (IBA) is an area recognized as being a globally important habitat, especially for the conservation of birds. Currently, there are about 10,000 IBAs all over the world. The IBA program was developed by BirdLife International, and, in Bangladesh, 19 areas are designated as IBAs by the organization. Of Bangladesh's 19 IBAs, 11 (58%) are inside protected areas, two (11%) are partially inside protected areas, and six (32%) are not.

No Important Bird Areas are inside the proposed project site and its Area of Influence (AOI). The nearest protected area from the project site is Jamuna Brahmaputra River. The distance of from the project site is about 117 km. **Figure 4-39** depicts the location of Important Bird Area near the proposed project site.

Figure 4-39: Important Bird Area of the Study Area



Source: Bird Life International,2020

Chapter 5

Socio-economic Environment

5 Socio-Economic Environment

The socioeconomic status of the project area's residents in 2011 will serve as a solid reference point for assessing the likely socioeconomic impact of the planned measures. This will allow us to compare the current changes and impacts of project interventions. The socioeconomic baseline scenario describes the socioeconomic characteristics of the project region based on secondary data acquired during the 2011 Population and Housing Census. The socio-economic characteristics include administrative area, demographic, household size, education, occupation, housing, employment opportunity, access to water and sanitation status etc.

5.1 Population

5.1.1 Administrative area and location

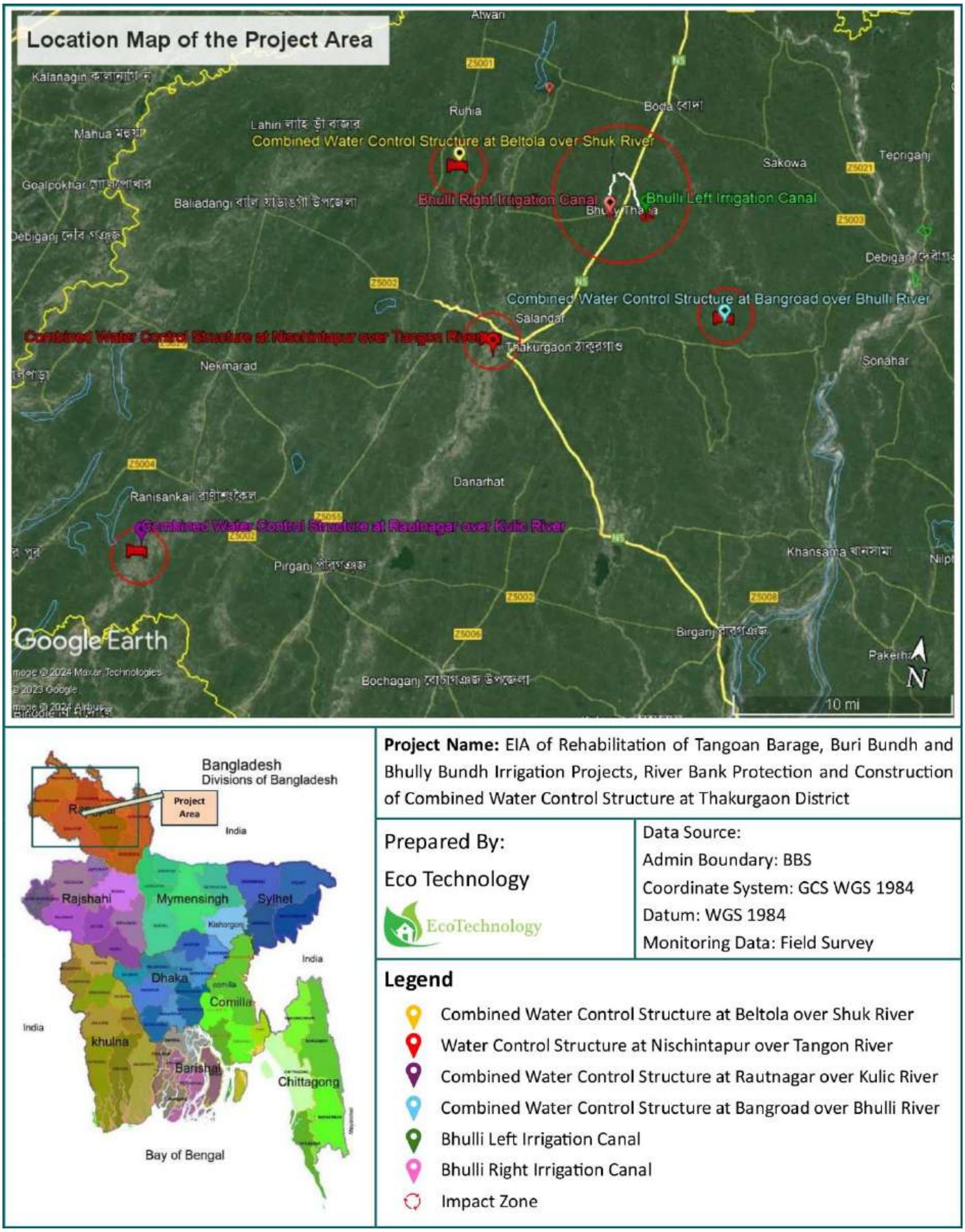
The proposed project is located in the Thakurgaon district. Based on the assessment of the project, its surrounding and its environmental & social influence, a 2KM radius of AOI for Combined Water Control structure at Nischintapur on the Tangon River, Combined Water Control structure at Bangroad on the Bhulli River, Combined Water Control structure at Beltola on the Shuk River, Combined Water Control structure at Rautnagar on the Kulic River and 5KM radius of AOI for Extension of Left and Right Bhulli Irrigation canal is considered from the project boundary as the study area for the social study. **Table 5-1** shows the study area of the project across Upazilas and Districts. The socio-economic features of the study area are discussed in this section.

Table 5-1: Administrative Boundary of the Study Area

Districts	Upazilas
Thakurgaon	Baliadangi
	Haripur
	Pirganj
	Ranishankail
	Thakurgaon Sadar

The project study area lies within the administrative area of Upazila of District. The districts are under division. The socio-economic study area is shown in **Figure 5-1**

Figure 5-1: 2km Radius for Four Water Structure and 5 km Radius for Irrigation Canal Buffer Map for Socio-economic Study



Source: Bangladesh Water Development Board (BWDB), 2024

5.1.2 Demography

There are 1,381,583 people (Ref: Population and Housing Census 2011) and 318,860 households in the entire study area. Of the total population 697,021 (50.45%) are male and 684,562 (49.55%) are female, meaning that the male population is higher than the female population. The average sex ratio of males and females in these Upazilas is 101.8:100, which is higher than the national figure of 100.3:100 (BBS 2011), meaning that there are 101.8 males against 100 females. The average density of the population is 754 persons per sq. km, which is much lower than the national density of 1,015 persons per sq. km.

Table 5-2: Demographic Data of the Study Area

Upazila	HHs	Population			Sex Ratio	Population density [sq. km]	Growth Rate
		Both	Male	Female			
Baliadangi	44,941	192,613	97,536	95,078	103	686	1.38
Haripur	31,781	144,198	72,332	71,865	101	736	1.41
Pirganj	58,052	242,503	122,034	120,469	101	688	1.2
Ranisankail	50,822	221,288	111,692	109,596	102	773	1.24
Thakurgaon Sadar	133,264	580,981	293,427	287,554	102	887	1.41
Total/average	**318,860**	**1,381,583**	**697,021**	**684,562**	**101.8**	**754**	**1.33**

Source: Population and Housing Census 2011, (BBS- 2012)

The population of 2011 has been projected[6] (based on Population and Housing Census, 2011) to 2023 using individual Upazila-specific growth rates. Based on this projection, it is found that 1631225 number of people residing in the study area.

Table 5-3: Project Population of the Study Area

Upazila	Population			Sex Ratio
	Both	Male	Female	
Baliadangi	229917	116425	113492	103
Haripur	175015	87791	87224	101
Pirganj	281014	141413	139600	101
Ranisankail	257712	130077	127635	102
Thakurgaon Sadar	687567	347259	340309	102
Total/Average	**1631225**	**822965**	**808260**	**101.8**

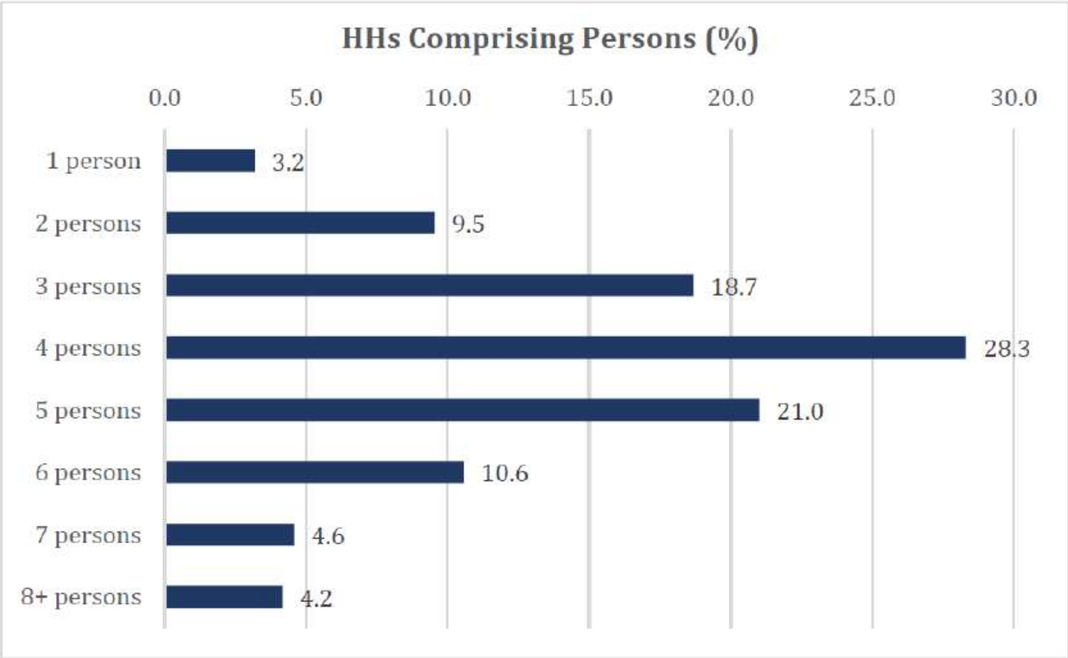
Source: Population and Housing Census 2011, (BBS- 2012) (Estimated for 2023)

[6] Projected Population= Present Population* ((1+ growth rate/100) ^^{n}), where n= number of years

5.1.3 Household Size

It is found that most of the households (28.3%) in the study area are comprised of 4 people, while 21% households are comprised of 5 members. Similarly, about 19.3% of households comprise 6 or more family members. While the lowest 3.2% having one person in their household is also seen in the study area. The average household size is 4.3, which is little bit lower than the national average of 4.4 (BBS 2011). Distribution of person per household in the study area is shown in Figure 5-2 .

Figure 5-2: Distribution of Household by Size



Source: Population and Housing Census 2011 (BBS, 2012)

5.1.4 Age Structure

In the study area, 34.6% of total population is children, who belongs to age category up to 14 years, while about 58.5% are youth belong to age category ranges from 15 to 59 years and they are considered as the potential workforce. On the other hand, about 6.9% belong to age category above 59 years and are considered as elderly people (Table 5-4).

According to the population and housing census, 2011, dependency ratio refers to ratio of dependent population (population aged up to 14 years and above 59 years) to the working age population (population aged between 15 to 59 years). Considering dependency ratio in the study area, it is found that 41.5% people are depending on 58.5% population. It is also found that the dependency ratio[7] is 71 in the study area meaning that almost 71 persons are dependent on 100 working people.

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

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

Table 5-4: Dependency Ratio According to Age

<table>
<tr><td rowspan="2">Dependent</td><td>Age group</td><td>0-4 Years</td><td>5-9 Years</td><td>10-14Years</td><td>60-64Years</td><td>65+ Years</td><td rowspan="2">Dependency ratio*</td></tr>
<tr><td>Population %</td><td>10.7</td><td>12.6</td><td>11.3</td><td>2.5</td><td>4.4</td></tr>
<tr><td rowspan="2">Work force</td><td>Age group</td><td>15-19 Years</td><td>20-24 Years</td><td>25-29 Years</td><td>30-49 Years</td><td>50-59 Years</td><td rowspan="2">71</td></tr>
<tr><td>Population %</td><td>8.7</td><td>8.6</td><td>9.4</td><td>25.3</td><td>6.5</td></tr>
</table>

Source: Population and Housing Census 2011 (BBS, 2012)

5.1.5 Education & Literacy Rate

Literacy rate is defined as the ability to read and write. Currently, Bangladesh has a literacy rate of 74.66% (BBS, 2022). However, when compared to the Census 2011, the literacy rate in the study area was much lower than the national average literacy rate, which was 46.64%, with 50.82% for males and 42.38% for females. The literacy rate of the study area by Upazila is presented in Table 5-5 below:

Table 5-5: Upazila Wise Literacy Rate in the Study Area

Upazilas	Both	Male	Female
Baliadangi	43.4	48.9	37.7
Haripur	42.1	45.0	39.2
Pirganj	47.8	52.4	43.2
Ranisankail	46.6	50.2	42.9
Thakurgaon Sadar	53.3	57.6	48.9
Average	**46.64**	**50.82**	**42.38**

Source: Population and Housing Census 2011 (BBS, 2012)

School attendance rate is measured by BBS from 3 years to 29 years by six clusters of age groups. 3 to 5 years is defined as preschool attendance, 6 to 10 as primary, 11 to 19 years as secondary and higher secondary and finally 20 to 29 years as higher as well as advanced level attendance at educational institutions. Comparative picture of attending and not attending rate shows that net attendance rate is the highest (12.7%) for both sexes at primary level, after which the rate starts declining. The secondary level shows the threshold point from which not attending rate moves upward and attending rate starts declining. This trend is true for higher as well as advanced level studies (Error! Reference source not found.).

Table 5-6: Distribution of School Attending and Not Attending Rate Among Different Age Groups

Age category	Attending school		Not attending school	
	Male %	Female %	Male %	Female %

3-5 years	0.5	0.5	6.6	6.3
6-10 years	9.4	8.9	3.0	2.6
11-14 years	6.3	6.4	1.6	1.0
15-19 years	3.8	3.3	3.8	3.7
20-24 years	1.2	0.7	5.1	8.4
25-29 years	0.3	0.1	7.2	9.2
Total	**41.4**		**58.6**	

Source: Population and Housing Census 2011 (BBS, 2012)

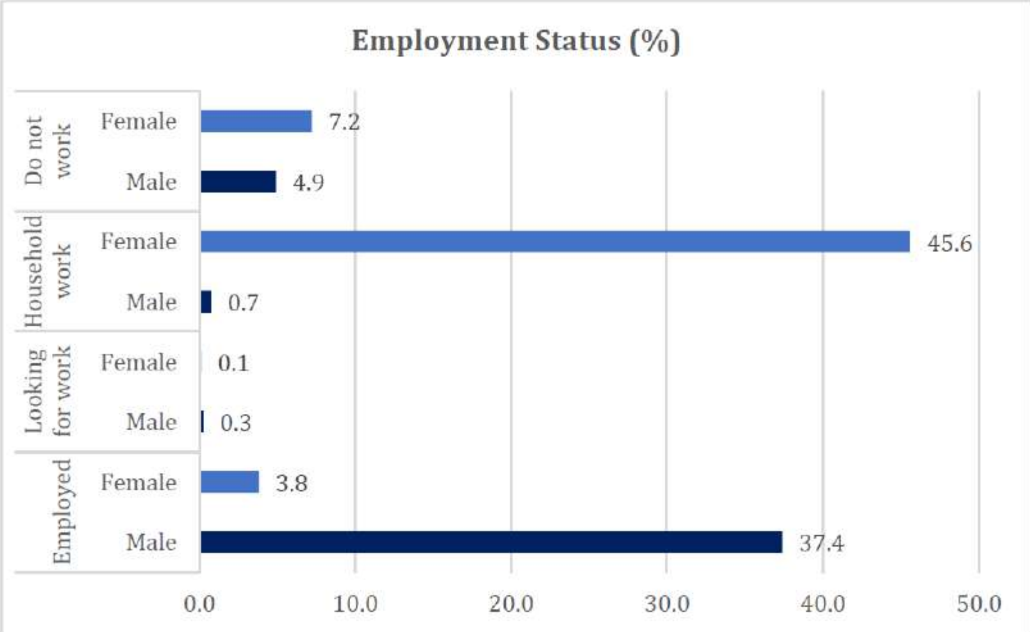
Male-female attendance ratio is almost equal with a little difference at primary level in which female attendance is comparatively higher than that of males. Field findings confirm that female attendance at this stage is higher because of existing scholarship program, and the parents also consider this basic schooling as an investment for securing a good marriage of their girls. It has also been observed and our data confirms that after completion of primary education, most of the girls get married and therefore, the attendance rate gradually starts decreasing. However, male attendance rate also starts decreasing due to their involvement in income generating activities. Data confirms that preschool attendance rate is 1%, whereas not attending rate is 6.5% (3 to 5 years), which suggest a class bias.

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

5.1.6 Employment Status

Data shows that about 41.2% of the population (age 7+ not attending school) is employed in different sectors of which 37.4% are male and 3.8% are females. Similarly, about 46.3% of population are doing household work and majority (45.6%) of them are female. Women involvement in different income generating sector is still negligible. Due to cultural barrier and dependency on men, women are less likely to expose themselves. They are mostly involved in household activities. A large number of people still remained unemployed (12.1%) and dependent on the earning members of their household. The following figure (Figure 5-3) represents the employment status in the study area.

Figure 5-3: Employment Status of the Studied Population

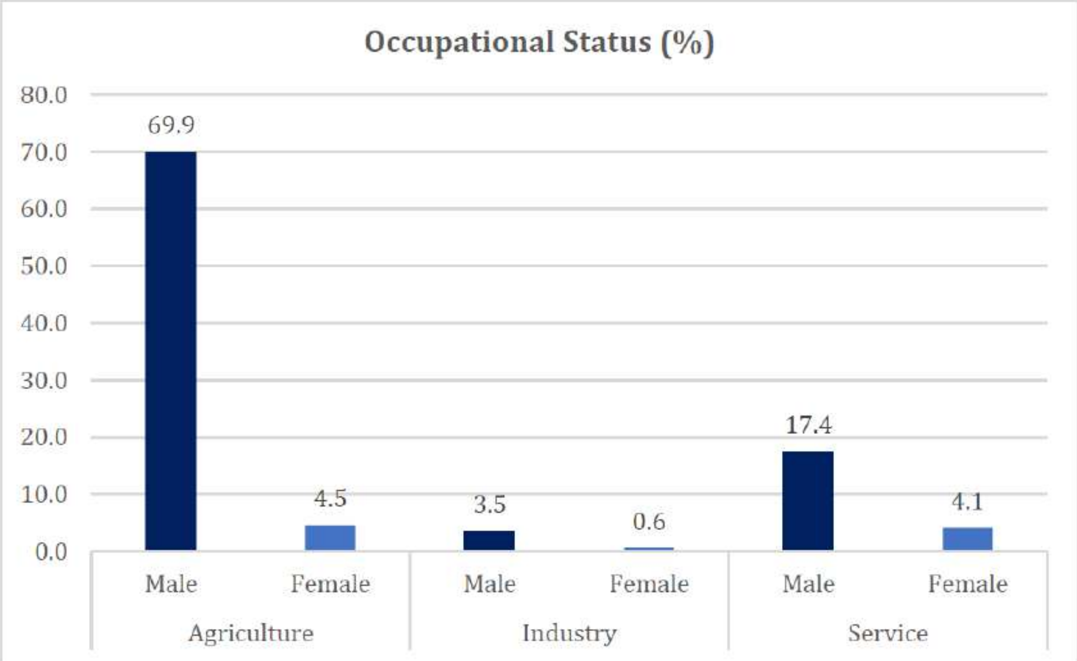


Source: Population and Housing Census 2011 (BBS, 2012)

5.1.7 Livelihood Situation

Distribution of employed population at reference period of the 2011 census shows that 74.4% are engaged in agricultural activities, 4.1% in industry and 21.5% in service. Agricultural activities include broadly crop farming, fishery and livestock, duck rearing and poultry farming. Scope of employment in agricultural sectors is still very high than the other area of Bangladesh but it is gradually decreasing as urbanization and industrial establishments are changing land use patterns e.g., the farmlands are being converted into human settlements and industrial enterprises (Figure 5-4).

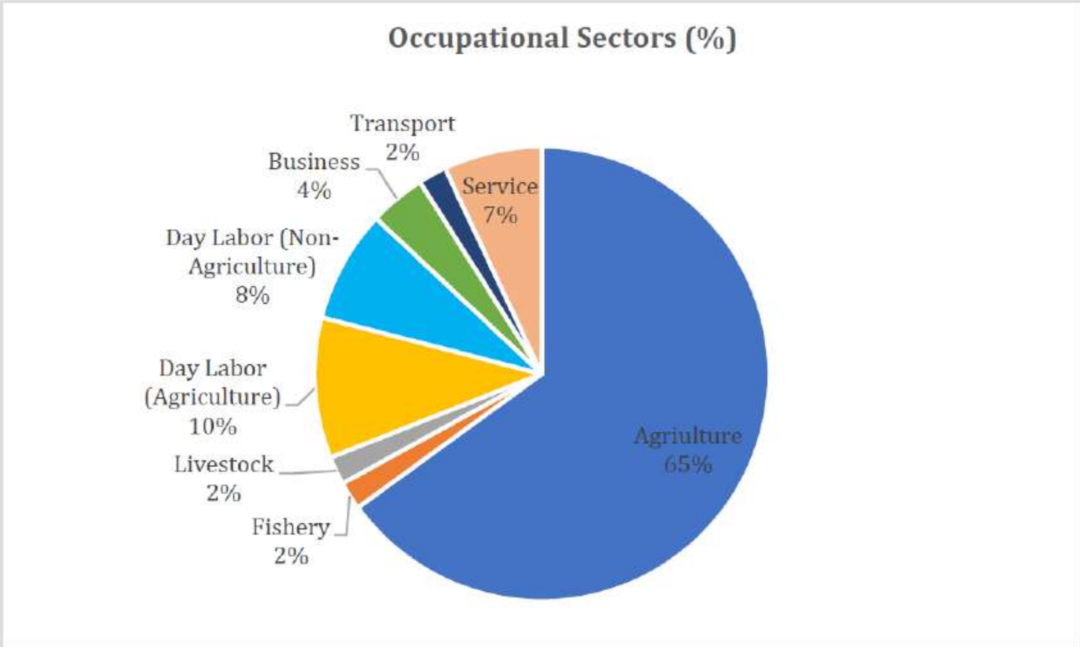
Figure 5-4: Proportionate Distribution of Population by Field of Activity



Source: Population and Housing Census 2011 (BBS, 2012)

The local people rely mainly on agriculture for their income, with many farmers involved in various agricultural pursuits. According to field observations, around 65% of people depend on agriculture. Besides paddy, jute, wheat, nuts, and vegetables are also the principal crops cultivated in the area. Livestock rearing is also an essential part of the additional source of income: farmers rear cattle, goats, sheep, and poultry for milk, meat, and egg production. A huge number of women can be seen working outside their home study area. At present, people's involvement in the service sector is also notable. Around 7% of people are involved in the service sector at present. Female participation in this sector is also seen. But, most women in the study can be seen engaged in agriculture. A large number of the workforce are involved in both agriculture (10%) and non-agriculture (8%) activities as day labors. In many parts of certain Upazilas, a decent number of people are involved in stone and sand mining. which is the major occupational activity of the local people. Involvement in fishers are also be seen in the study area. Other than these, people are also seen to be involved in businesses such as tea stalls, fertilizer shops, small vegetable shops, grocery shops, farms, etc. A small number of people are working as transport (CNG, vans, and auto rickshaws) drivers as well. Due to the availability of rechargeable batteries, more people are getting involved in this sector. The proportionate distribution of livelihood situations based on field observation in the study area is presented in Figure 5-5 below:

Figure 5-5: Occupational Status in Study Areas based on Field Observations



Source: BWDB Field Visit, 2024

5.1.8 Wage Rate

The wage structure varies from one Upazila to another. The labors receive wage for agriculture activities are higher compared to non-agriculture activities. In both agriculture and non-agriculture activities, women receive less wages compared to their counterparts. The highest amount of wage is found to be BDT. 650 for agriculture activities and BDT. 600 for non-agriculture activities. The lowest for agricultural activities was found to be BDT. 400 and for non-agriculture activities BDT. 300.

Table 5-7: Distribution of Wage Rate in Agricultural and Non-agricultural Activities

Upazila	Agriculture		Non-Agriculture	
	Men	Women	Men	Women
Baliadangi	600	450	500	400
Haripur	500	400	400	350
Pirganj	500	350	400	300
Ranisankail	500	400	400	350
Thakurgaon Sadar	600	450	500	400

Source: BWDB Field Visit, 2024

Figure 5-6: Labor Engagement in Agricultural and Non-Agricultural Sector

Engagement in agriculture & non-agriculture labor activities

Source: BWDB Field Visit, 2024

5.1.9 Quality of Life Indicators

Housing Condition:

According to the administrative boundary, five Upazilas of Thakurgaon. The housing conditions of the study area are given below in the figure. There are four categories of household structures namely, pucka, semi-pucka, kutcha, and jhupri. According to the Population and Housing Census (2011), total household of the project study area are 318,860. The predominant structures are Kutcha (72.7%) followed by Semi-pucka 20.5%), Pucka and Jhupri (4.1% and 2.8%). Housing tenancy areas are owned by (89.5%), rented (0.8%) and rent free (9.7%).

Figure 5-7: Housing Structures in Study Area

View of a Semi-pucca House

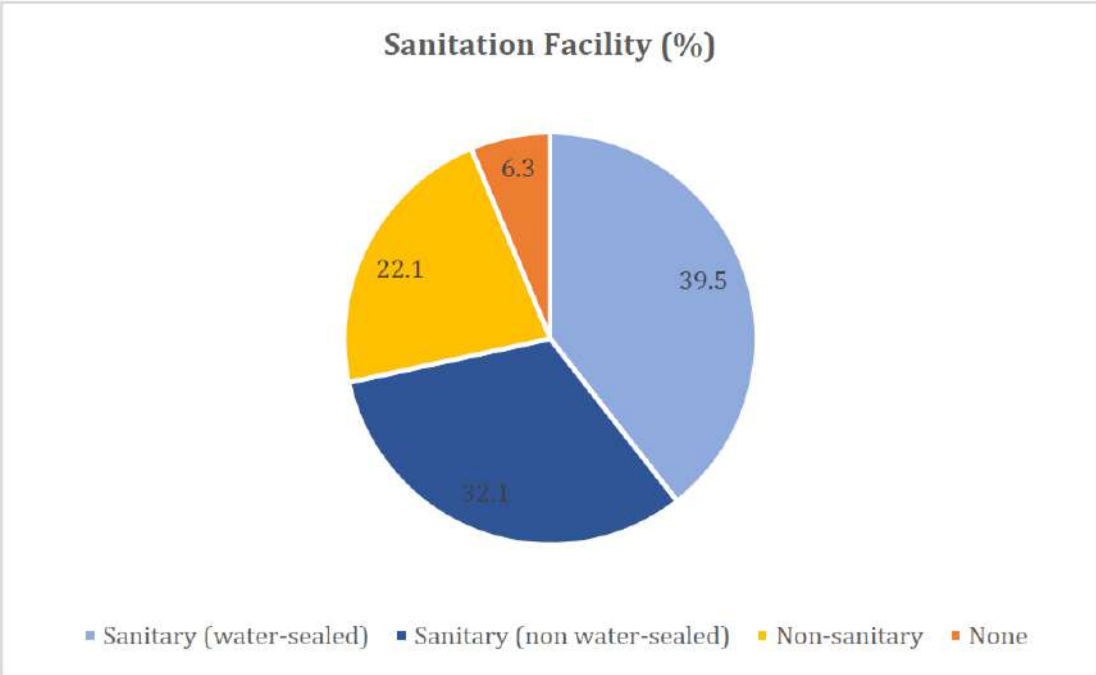
View of a Kutcha House

Source: BWDB Field Visit, 2024

Sanitation:

The overall sanitation facility in the study area is given in the figure below. Based on the field observations and secondary sources, different scenario was seen in different Upazilas. Some Upazilas have higher non-water-sealed sanitary and some has water sealed ones. The average condition of sanitation across the study area is presented below. It can be seen that 6.3% people do not have sanitary facilities, who uses neighbor's toilets; and sometimes defecates in open places but the number is negligible. Around 39.5% households have water-sealed sanitary latrines and 32.1% have non-water-sealed sanitary latrines.

Figure 5-8: Percentage of Sanitation Facilities in the Study Area based on Field Observation



Source: BWDB Field Visit, 2024

Figure 5-9: Sanitary Facility in the Study Area

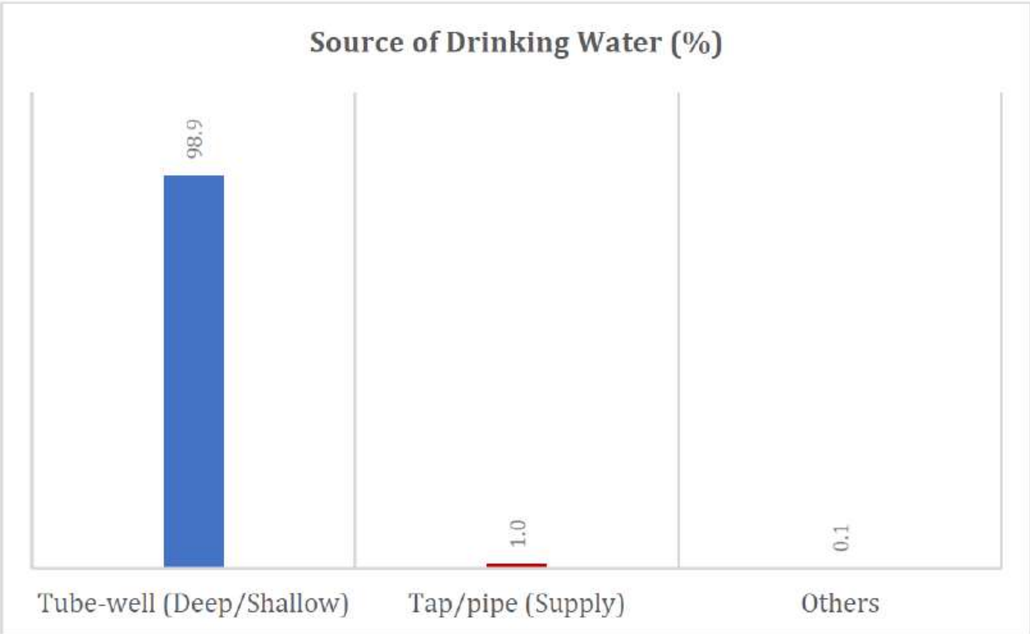
	
Sanitary Latrine (Water-Sealed)	Latrine (Non-Sanitary)

Source: BWDB Field Visit, 2024

Drinking Water:

Most of the households (98.9%) in the study area depend on tube-well for their drinking water, whereas only 1% use tap water. These are mostly in Sadar Upazila and Pourashabha areas. Only 0.1% of households were found to use other sources such as, well, bottled/jar water for drinking purposes.

Figure 5-10: Percentage of Drinking Water Condition in the Study Area based on Field Observations and Secondary Sources

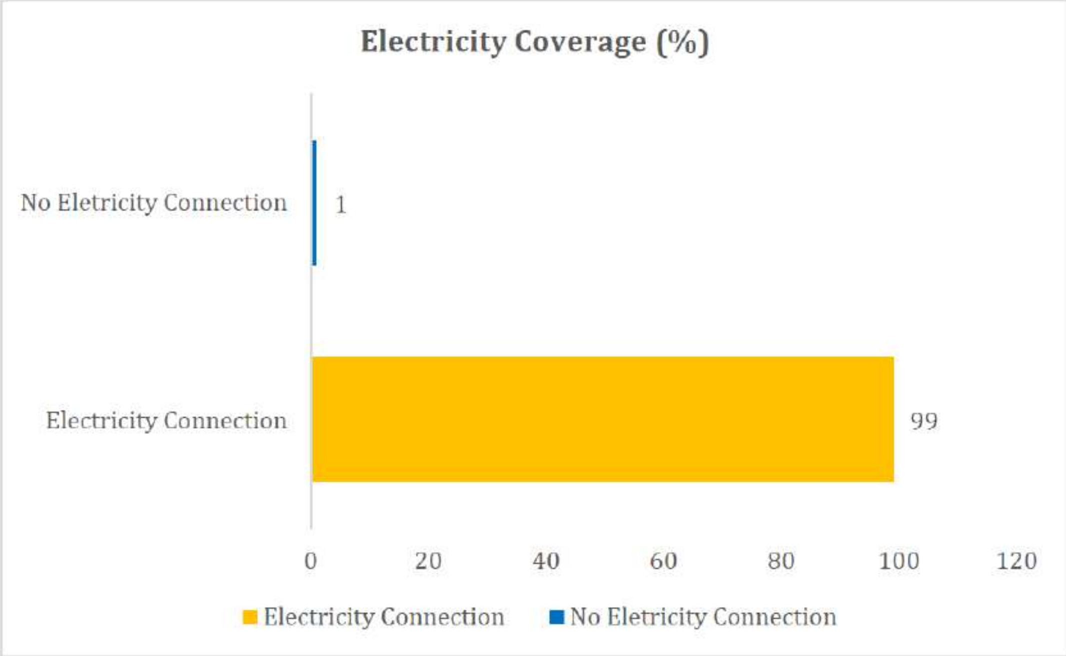


Source: Population and Housing Census, 2022 (Volume 1)

Electricity Coverage

The field observations and recent publication by Population and Housing Census, 2022 (Volume 1) indicates that almost all the households in study area are under electricity coverage. These areas are mostly covered by National Grid, Palli Biddut, and a few Solar Power. A very few numbers of households especially in remote area were found not to have electricity connection at all.

Figure 5-11: Electricity Coverage in Study Area based on Field Observations and Secondary Sources

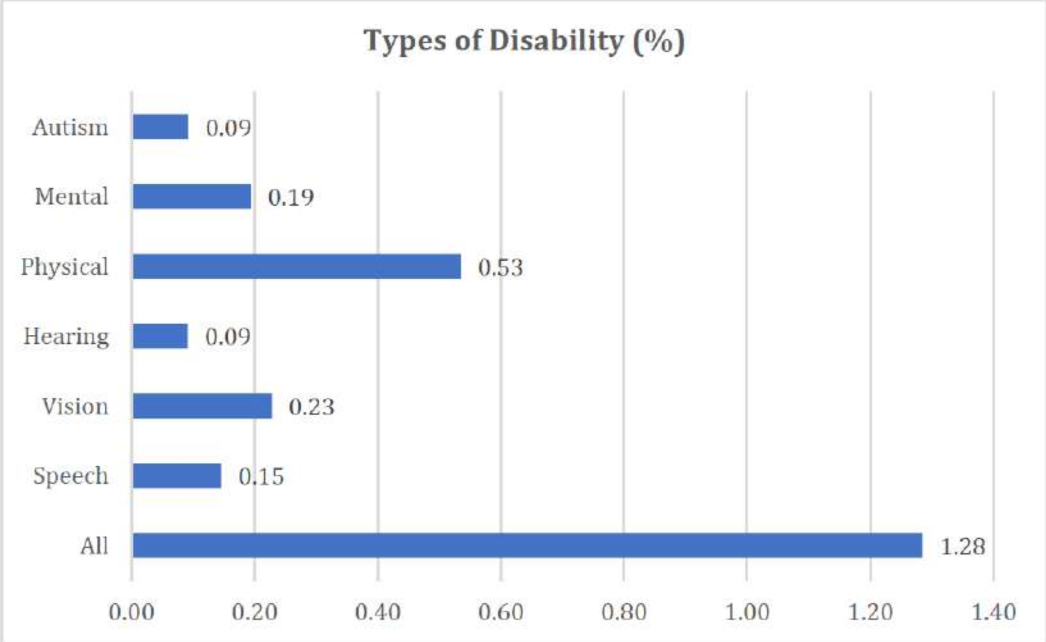


Source: Population and Housing Census, 2022 (Volume 1)

Public Health and Facilities

Access to health services and facilities refers to the availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability of health services. Field data shows that all most every Upazila has Community Clinics and Union Health and Mother Welfare Centers. Local people stated that the existing services are accessible to rural poor people. People also go to the Private Clinics; Upazila Health Complexes and District Headquarters for getting better treatment. However, the tendency to receive services from local chemist and village trained physicians is also noticeable. The Population Census, 2011 identified almost six types of disabilities in the study area, Figure 5-12 depicts their proportionate distribution. The distribution shows that about 1.28% people are suffering from all types of disabilities, of which about 0.53% people are physically challenged, 0.23% of are suffering from vision and 0.19% of are suffering from mental problem.

Figure 5-12: Proportionate of Population by Types of Disability



Source: Population and Housing Census 2011 (BBS, 2012)

5.1.10 Ethnic Community

Thakurgaon has a large number of Ethnic and Dalit households. According to ECO-Social Development Organization (ESDO), there are 4796 households in which 2348 are Ethnic and 2448 are Dalits. The highest number of Ethnic households are seen in Thakurgaon Sadar Upazila and least in Baliadangi Upazila. Thakurgaon Sadar Upazila also has the highest number of Dalit households (887).

Table 5-8: Ethnic and Dalit Families in Thakurgaon District

Upazila	Ethnic (Households-NOS)	Dalits (Households-NOS)
Baliadangi	25	291
Haripur	270	275
Pirganj	717	491
Ranisankail	460	504
Thakurgaon Sadar	876	887
Total	**2348**	**2448**
		4796

Source: ESDO, 2024

5.1.11 Cultural Heritage and Tourist Site

There are some fascinating heritage and tourist sites available in Thakurgaon. The Harinmari Suryapuri Mango Tree is one of the attractions for the tourists in Baliadangi Upazila. The tree is more than 200 years old and it still produces fruit. The highest number of tourists gather here during Eid holidays. People also informed that the number reaches to around 8-10 thousand daily during that period. On normal day around 100 people visits the tree and the number reaches to 200-300 on Fridays and Saturdays. The Jamidarbari Mosque, in Jamalpur village under Thakurgaon Sadar is another popular tourist attraction. The mosque has three large domes and the top of the dome was made with glass stone. Every year thousands of people across the country visits the mosque.

Table 5-9: Distribution of Cultural, Heritage and Tourist sites in Thakurgaon District

Upazila	Name of Heritage Site/ Tourist Site				
Baliadangi	Adhardighir Mela	Harinmari Shiv Mondir	Harinmari Suryapuri Mango Tree	Fatehpur Mosque	Rupganj Zamidar Bari
Haripur	Haripur Jamidar Bari	-	-	-	-
Pirganj	Rajbhita	Fun city	-	-	-
Ranisankail	Jagadal Rajbari	Bashnahar Adarsha Gram Pukur	Rajbari of King Tonkonath	-	-
Thakurgaon Sadar	Jamalpur Zamidar Bari Jame Masjid	Balia Jiner Masjid	Lokayan biodiversity museum	Balaka Uddan	-

Source: Upazila Parishad Office, 2024

Figure 5-13: Distribution of Cultural, Heritage and Tourist sites in Thakurgaon District

Haripur Zamindar Bari, Haripur, Thakurgaon

Harinmari Suryapuri Mango Tree, Baliadangi,

Harinmari Shiv Mondir, Baliadangi, Thakurgaon

Jamalpur Zamidar Bari Jame Masjid, Thakurgaon

Source: BWDB Field Visit, 2024

5.1.12 Communication Facilities

The communication facility across the study area is quite decent. The primary modes of local transportation are bicycle, auto, motorized van and motorcycle. Regular bus services are available from Panchagarh, Thakurgaon, and Dinajpur Districts to travel to the neighbouring Districts and Subdivisions. Bus and train services are also available from Dhaka to Panchagarh, Thakurgaon, and Dinajpur.

Figure 5-14: Pictures of Communication Facilities

Local riding bicycle form school to home

Bridge over River

Source: BWDB Field Visit, 2024

5.1.13 NGOs and GOs

Several NGOs are found in the study area, who have been providing different kinds of services to the local communities. These NGOs are- BRAC, RDRS BURO Bangladesh, Suchona, GUK, RIC, ESDO and ASA. These NGOs have different development activities but the most common and widely provided service is loan facilities for the locals. Among the Government organizations BWDB, RHD, LGED, BADC, and BMDA have implemented many projects and infrastructures such as irrigation projects, sluice gates/rubber dams/water control structures/riverbank protection works, bridges and roads, and conducted dredging/re-excavation works in many rivers in the study area, which provide immense benefits to the locals.

5.2 Agricultural Activities

Agriculture is still the major livelihood of Bangladesh. The sector has a significant impact on the national economy. The baseline condition of agricultural resources has been established through the collection of secondary data followed by primary data collection from the study area. During the field visit, several questionnaires were filled in form in different locations of Thakurgaon Districts. Besides this, consultation with the Deputy Director of Agriculture Extension (DD, DAE), Additional Upazila Agricultural Officer (AUAO), Upazila Agricultural Officer (UAO) and Sub-Assistant Agriculture Officer (SAAO), Plant Protection Officer (PPO) of the abovementioned Districts were conducted. The study areas have been considered for evaluation of baseline on various agriculture parameters for EIA study.

5.2.1 Farming Practices

Farming practices largely depend on the land types, length of growing seasons, and other environmental as well as socio-economic factors. There are two distinct cropping seasons in a year. They are Kharif and Rabi seasons. Based on crop adaptability and crop culture, the Kharif season has been further sub-divided into the Kharif-I and Kharif-II seasons.

The Kharif-I season, starts in March and ends in June. This season is characterized by high temperature, low humidity with uncertainty of alternating dry and wet spells.

The Kharif-II season comprises a wet and cloudy environment with heavy rainfall but uneven distribution, low solar radiation, high temperature, and humidity. The Kharif-II season starts in July and ends in October.

The Rabi season starts in November and ends in February. During this season, crops are favored with high solar radiation, low humidity, and temperature but a lack of adequate soil moisture depresses the crop yield.

In the project area, Jute and vegetables are grown in Kharif-I season while Aman is grown in Kharif-II. Rabi offers a variety of crops, including Boro, mustard, wheat, maize, vegetables, pulses, chili etc.

5.2.2 Cropping Pattern

Traditionally farmers develop their cropping pattern by their own experiences, which is largely governed by various factors mainly land topography and rainfall. Other factors that are responsible for the development of cropping patterns are: climatic factor, soil factor, biological factors and socio-economic condition. The most prominent cropping patterns in the study area are (a) Fallow-HYV T. Aman-HYV Boro and (b) Fallow-HYV Aman -Maize. Besides paddy, jute, wheat, nuts, and vegetables are also the principal crops cultivated in the area.

5.2.3 Cropped Area

The total cropped area in the study area is 151593 hectares.

5.2.4 Crop Damage

According to the local farmers and officials of DAE, no crop damage was recorded in the last 2-3 years in the project area.

5.2.5 Crop Production

The main agricultural production comes from rice crops. In the study area total production is 963835 metric tons of crops.

5.2.6 Agriculture Input Use

Seed

The role of seeds is very important for growing crops. The seed rate (kg/ha) varies from crop to crop and catchment to catchment. Usually seed rate of this study area is higher than recommended rate. The seed rate used (Kg/ha) in the study area is presented in Table 5-10.

Labor

Most of the cultural practices for crop production are being done manually. So, agricultural labour is considered as one of the essential inputs for crop production. The number of labour requirement varies from crop to crop and from area to area. Labour requirement of different crops is presented in Table 5-10.

Fertilizer and Pesticide

The use of fertilizer rate per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability of the farmers. The major fertilizers used in this area are Urea, TSP, MP and Gypsum. The quantities of fertilizer used are generally lower than the recommended doses. The use of nitrogenous fertilizer (Urea) is higher than other chemical fertilizers. Generally, farmers do not use manure or compost in their fields. Unbalanced use of chemical fertilizers is practiced, which affect the soil health and ultimately is reflected on crop production.

The use of pesticides depends on the degree of pest infestation. The number of pesticide application depend on pest infestation and varies from crop to crop. The major insects as reported by the farmers are: Rice Green Leaf Hopper, Yellow Stem borer, Ear cutting caterpillar, Blast of rice, Jute hairy caterpillar, stem rot, black band, soft rot of jute, red spot of leaf sheath, Rind disease (sour rot), Brinjal fruit and shoot borer, Aphids, Fruit weevils etc. Local farmer reported that they are using different types (Granular, powder and liquid) of pesticides such as Bamper, Newvit, Acenone, Banglameg, Prithavit, Virthako, Casper 5 SG, Sumikron, Setara, Abamectin, Acephate, Acetamipirid, Bifenthrin, Cartap, Carbofuran, Carbosulfan, Cumulus, Thiovit, Karate, Basudin(10G), Diazinon(10G), Bistracin, Furfuran, Vita furan, Bison, Dimecron, Marshal, Ricord, Mela (Table 5-10**)**.

Table 5-10: Agriculture Input Use

Crop Name	Seed (kg/ ha)	Labor (No/ha)	Fertilizer (kg/ha)					Pesticides		
			Cow -dung/	Urea	TSP	MP	Gypsum	No. of application	Liquid ml/ha	Granular kg/ha
HYV Aus	40-45	130-150	-	70	40	30	-	1-2	300	0
HYV Aman	35-40	130-140	-	120	110	90	-	1-2	600	0
HYV Boro	40-45	140-150	-	260	62	65	50-60	1	500	0
Vegetable	3-8	160-180	1500	150-180	80	80	10-15	2-3	500	0
Chilli	1.5-10	120	-	90	50	45	10	1-2	400	0
Wheat	120	130	-	120	110	90	-	2	600	0
Pulses	20-25	80-100	-	30	35	10	-	1	0	2
Oilseed	5-6	110-120	-	80	70	40	10	1	700	0
Maize	30-35	200-220	-	130	120	90	-	-	-	-
Ground nut	-	50	100	150	100	4	1-2	-	3	1
Potato	1.5 ton	150-170	500	255	150	150	0	3	1000	400
Sugarcane	3,500 cutting	150	120	80	50	1000	1-2	250	700	2
Fruits	200 plant	180	4.7kg/ plant	4.1kg/ plant	3.4kg / plant	3.5kg / plant	7kg/plant	1	400	-

Source: DAE of project area, and field observation, 2024

5.2.7 Irrigation

Irrigation is a major concern in the study area. At present, a number of irrigation schemes are in operation in this area, where the major share is covered by Deep tube wells (DTWs) and Shallow tube wells (STWs). In addition to these, BWDB has four barrages, one of which (Pathraj) is out of commission due to lack of maintenance. Only twelve (12) active irrigation schemes in Panchagarh and Thakurgaon are currently being operated by BWDB. Supplementary irrigation is provided to Aman crop field by Tangon Barrage irrigation scheme, Buribandh irrigation scheme and Vulli bandh irrigation scheme. Out of the total irrigated area of 1,03,443 ha, GW and SW based irrigated area are 87,927 ha (84.9%) and 15,516 ha (15.1%) respectively. Status of irrigation in the study area is presented in Table 5-11.

Table 5-11: Status of Irrigation in the Study Area

Name of crops	Partial /Supplementary Irrigated (ha)	Full irrigated (ha)	Cost of irrigation		
			DTWs	STWs	LLPs
HYV Aus	353	-	3,000-4,000	5,000-6,000	1,800-2,000
HYV Aman	34,365	-	3,000-4,000	5,000-6,000	1800-2,000
HYV Boro	-	19,738	10,000-12,000	14,000-14,500	9,500-10,000
Oilseeds	1,508	-	2,000-2,200	2,000-2,500	1,800-2,000
Maize	-	11,015	2,000-2,500	2,000-2,500	1,200-1,500
Wheat	-	789	2,000-2,200	2,000-2,500	1,800-2,000
Pulses	510	-	2,000-2,200	2,000-2,500	1,800-2,000
Chilli	-	2,045	2,000-2,500	2,000-2,500	1,200-1,500
Potato	-	6,433	2,000-2,200	2,000-2,500	1,800-2,000
Winter vegetables	-	14,633	2,000-2,200	2,000-2,500	1,800-2,000
Groundnut	-	5,007	2,000-2,200	2,000-2,500	1,800-2,000
Sugarcane	-	882	2,000-2,200	2,000-2,500	1,800-2,000
Fruits	-	30	2,000-2,200	2,000-2,500	1,800-2,000
Jute	-	6,135	2,000-2,200	2,000-2,500	1,800-2,000
Grand Total	**36,736**	**66,707**	**-**	**-**	**-**
Total Irrigated Area	**1,03,443**				

Sources: DAE, BMDA, BADC of project area and field investigation 2024

5.2.8 Irrigation Potentiality

In addition to the current situation, the project area has a considerable amount of potential to provide surface water if appropriate maintenance work is done. BWDB's LLPs, can be brought into operation with minimal maintenance. BWDB mostly provides irrigation water by vertical flow, which will not only reduce pressure on groundwater but also cut fuel use. If, BWDB's irrigation projects are fully operational, farmers' irrigation costs will drop to one-fifth of what they currently pay. According to the local farmers and other stakeholders of the study area following potential rivers for surface water irrigation are presented in Table 5-12 that should be explored by the technical study team to be ensured whether the enlisted rivers have the irrigation potentiality or not.

Table 5-12: Potential Rivers for Surface Water Irrigation

River name	District	Irrigation potentiality	Remarks
Kulic	Thakurgaon	Yes	Already proposed another project
Pathraj	Thakurgaon	Yes	-
Nagar	Thakurgaon	Yes	-
Tangon	Thakurgaon	Yes	-
Shuk	Thakurgaon	Yes	-
Tirnai	Thakurgaon	Yes	-

Sources: BWDB of project area and field investigation 2024

5.2.9 Crop Production Constraints

According to field visit (Questionnaire survey, FGD with farmers and KII with UAO, AUAO, SAAO of DAE), it is observed that there are some considerable crop production constraints in the project area. Usually, the land of the project area is dominated by high land. In the Rabi season (November–March), a large number of crops are damaged by drought, especially HYV Boro and winter vegetables, though their productivity was rather low due to irrigation crisis and inputs cost, and non-ensured fare price of produces. The details are presented in Table 5-13.

Table 5-13: The Major Constraints and Causal Problems for Crop Production in the Project Area

Major constraints		Causal problems
Marketing facilities	•	Poor marketing system/facilities of agricultural products.
Slow technology transfer	• •	Farmers were not updated on high yielding crops, varieties and technologies suitable for the project area. Farmers were not well trained on modern cultivation practices and post-harvest management technologies.
	•	Farmers were not updated on fruits and spices crops cultivation.
Quality seeds are not readily available	• • •	Lack of heat tolerant and short duration crop varieties. Lack of diseases/pest tolerant quality seed or crops variety. Farmers do not have adequate knowledge on production and preservation of quality seeds in their own vicinity.
	•	Farmers purchase low quality/ adulterated seed from local market.

Lack of adequate irrigation facility	•	Interruption of electricity supply and high diesel cost for running irrigation pump.
Lack of storage facility	• •	Lack of proper knowledge and skills on effective storage of agricultural products. Inadequate knowledge of farmers about processing of different crops.
	•	Due to lack of storage facility, farmers were bound to sell their products during harvesting period at a lower price.
Lack of credit facility	•	Farmers seldom had enough money to purchase inputs timely.
	•	Lack of institutional credit support in the remote area.

Sources: BWDB of project area and field investigation 2024

Chapter 6

Analysis of Alternatives

6 Analysis of Potential Alternatives

The project has been considered and investigated for several alternatives to reduce the environmental and social impacts. The alternatives assessed were not limited to environmental and social aspects, but the assessment also included the technical aspects of different options.

The Project has considered alternatives in terms of site location, design, and technology options. An analysis of these alternatives has been undertaken for the proposed Project including consideration of a no-Project scenario. The no-go option, or not building the proposed project, is based on the supposition that the project won't proceed. No environmental or social repercussions would be caused by this choice of location or neighborhood. It serves as the standard against which other options are measured and will be considered throughout the report.

6.1 No Project Scenario

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

It is concluded that the “No build” alternative is unacceptable and the potential socio-economic benefits of implementation of such project far outweigh the adverse impacts which are minor and temporary can be controlled and minimized to an acceptable level.

6.2 Consideration of Alternatives

The locations of the Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District are determined by the availability of land without affecting settlement, access to transportation facilities for transportation of project equipment, construction equipment, construction workers, etc. No other alternative sites were found that can fulfill the required criterion.

To avoid or minimize the impacts resulting from the activities of the project, Bangladesh Water Development Board authority is expected to adopt appropriate technological design, improvements or adjustments, policy including good site operational practices and applicable EMP, etc. The overall strategy shall follow the following sequence:

- Impact avoidance or minimization;
- Adequate Compensation where impacts are unavoidable.
- Enhancement Measures-Employment benefits enhancement measures proposed by the consultants

Furthermore, the feasibility study of the Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District didn’t consider any alternative analysis for the proposed project.

6.3 Environmental Sensitivity Investigation

The proposed project is located on the Tangon River, Bhulli River, Shuk River and Kulic River. Floods, rivers, and natural hazards are the main concern of this location. These environmentally sensitive issues were investigated by a selected consultant group by carrying out primary and secondary data analysis. The main hindrance to the proposed project's sustainability is natural calamities like flooding intensity. Design consultants could consider this sensitive issue in the design structure to make the project environmentally sound and sustainable. The structure should be maintained at an adequate height to protect it from stormwater. Adequate tree plantation will be required along the right of way.

6.4 Environmental Assets

Environmental assets are the naturally occurring living and non-living components of the Earth, together constituting the bio-physical environment, which may provide benefits to humanity. The environmental assets are two types one is the individual type and the other is the ecosystem approach. In the project area individual environmental assets/resources include Timber, Water, Soil, and Fish. Ecosystem assets include Forests, Lakes, and green areas. In the project area, the river Tangon River, Bhulli River, Shuk River and Kulic River are considered a rich ecosystem, a source of fisheries and freshwater resources. It is also a common property resource.

6.5 Environmental Hot Spots

No significant environmental hot spots exist in the project area. The project area is on the Tangon River, Bhulli River, Shuk River and Kulic River. on the Tangon River, Bhulli River, Shuk River and Kulic River are itself an environmental hotspot for multiple resource diversity like fresh water, fisheries, and other aquatic resources. The project authority will take appropriate protective measures to save these natural resources.

6.6 Likely Beneficial Impact

Many people are doing business in Thakurgaon. Due to the proposed project development, economic connectivity between local and national areas will be improved. People will get benefits through setting up new development projects and increasing employment and business opportunities. By improving network connectivity, people easily contact other areas, exchange their views and customs, and share experiences. Various utility services facilities like electricity, road facilities, etc. enhance the local people's livelihood and living standard.

Benefits of the construction of the Combined Water Control structure:

- If the combined water control structure is constructed, it will be possible to irrigate total 6000 hectares of land.
- The drinking water crisis of thousands of families adjacent to the project will be solved by raising the level of ground water.
- If the combined water control infrastructure is constructed, there will always be 2.5 meters to 3.0 meters of water throughout the year, which will create a fish sanctuary and enhance the beauty of the city.

- As a result of the construction of the combined water control structure, the project area will be developed as a tourist area.
- The construction of the structure will improve the communication system.
- As a result of the construction of the structure, it will be possible to provide irrigation using surface water, which will lead to the savings of fuel.

Benefits of the construction of the irrigation canal structure:

- If the irrigation canal is constructed then it will be possible to increase irrigation coverage.
- The construction of the Irrigation canal will improve the communication system.
- As a result of the construction of the irrigation canal, it will be possible to provide irrigation using surface water, which will lead to the savings of fuel as well as reduce the use of underground water.

6.7 Community Recommendations

People's Opinion Regarding the Impact of Proposed Project

The analytical result reveals that Local people actively participate in the consultation. Among the community people, the Local Primary school Headmistress, community leader, and general people participate. Local people express their views regarding development adjacent to their settlement. The results are as follows.

Recommendation:

- Local people should be employed in the project area based on their qualifications and providing skill training.
- The construction of a local road network will help the local people
- Adequate Environmental Measures should be taken for the proposed project, Compensation plan should be prepared for any kind of Environmental damage.
- For new kinds of land acquisition people should be consulted

Chapter 7

Identification and Evaluation of Potential Impacts

7 Identification and Evaluation of Potential Impacts

This section assesses the manner in which the Project will interact with elements of the physical, ecological, social, cultural or human environment to produce impacts to resources or receptors. This has been organized as per the various stages of the project life cycle to understand the risks and impacts associated with each of these individual stages. The environmental and social impacts due to the Project activities are considered in the three distinct stages of the Project life cycle: (a) pre-construction (b) construction (c) operation and maintenance of the project.

Impacts are identified and predicted based on the analysis of the information collected from the following:

- Project information (as outlined in Section 3); and
- Baseline information (as outlined in Section 4 & 5).

The identification of likely impacts during the pre-construction, construction and operation phases has been based on the potential impact of activities that are likely to be undertaken during these phases on environmental and socio-economic parameters, which are presented in Table 7-1.

Table 7-1: Impact Identification Matrix for the Proposed Project

Project Activities	Potential Impacts																														
	Physical Resources												Biological Resources				Socio-economic Resources								Health and Safety						
	Air Quality	Noise	Vibration	Surface water resource	Surface water quality	Groundwater resource	Groundwater quality	Soil resources	Sediment quality	Land use	Drainage pattern	Aesthetics	Vegetation/forest cover	Wildlife	Aquatic fauna	Protected areas	Demographic (incl. Physical displacement)	Economy and livelihood	Social and cultural structure	Economic displacement	Infrastructure and service	Cultural resources	Education and skills	Agriculture/cash crops	Occupational Health and Safety	Public transportation	Communicable/non-communicable disease	Vector-borne disease	Sexually transmitted disease	Community Health	Vulnerable groups
Construction Phase																															
Site clearing and leveling	✓	✓			✓				✓																						
Transportation and storage of construction materials and equipment	✓	✓			✓			✓							✓											✓					
Civil construction activities	✓	✓	✓		✓		✓	✓	✓					✓	✓										✓						
Construction of bore wells	✓	✓				✓		✓																							
An influx of labor and the construction of temporary houses					✓	✓																					✓	✓	✓	✓	
Storage, handling, and disposal of construction debris					✓		✓	✓							✓													✓			
Generation of domestic waste and discharge					✓		✓	✓							✓															✓	
Sourcing of construction water and				✓											✓																

Project Activities	**Potential Impacts**																														
	Physical Resources												**Biological Resources**				**Socio-economic Resources**								**Health and Safety**						
	Air Quality	Noise	Vibration	Surface water resource	Surface water quality	Groundwater resource	Groundwater quality	Soil resources	Sediment quality	Land use	Drainage pattern	Aesthetics	Vegetation/forest cover	Wildlife	Aquatic fauna	Protected areas	Demographic (incl. Physical displacement)	Economy and livelihood	Social and cultural structure	Economic displacement	Infrastructure and service	Cultural resources	Education and skills	Agriculture/cash crops	Occupational Health and Safety	Public transportation	Communicable/non-communicable disease	Vector-borne disease	Sexually transmitted disease	Community Health	Vulnerable groups
domestic water																															
Operation Phase																															
Transportation	✓	✓			✓																					✓				✓	
Maintenance (cleaning, oil change, lubrication, etc.)					✓		✓	✓							✓																
Extraction of water						✓																									
Waste generation					✓		✓	✓							✓															✓	
Domestic waste or domestic use of water					✓		✓	✓							✓															✓	

7.1 Impact Assessment Methodology

The impact assessment has involved the prediction, evaluation, and mitigation of impacts and report on impacts including residual impacts and cumulative impacts. The main EIA steps are summarized below and comprise of:

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

7.1.1 Prediction of Impacts

Prediction of impacts is essentially an objective exercise to determine what could potentially happen to the environment as a consequence of the Project and its associated activities. This is essentially a repeat of the process undertaken in scoping, whereby the potential interactions between the Project and the baseline environment are identified. From these potential interactions, the potential impacts to the various resources or receptors are identified and are elaborated to the extent possible. The diverse range of potential impacts considered in the IA process typically results in the application of a wide range of prediction methods, including quantitative, semi-quantitative and qualitative techniques. The nature and types of impacts that have been addressed in this EIA is defined in the Figure 7-1.

Figure 7-1: Nature and Types of Impacts Considered for Impact Assessment

- **Negative,** when impact is considered to represent adverse change from the baseline conditions or to have introduced a new undesirable factor; and
- **Positive or beneficial,** when impact is considered to represent improvement to baseline conditions or to have introduced a new desirable factor.
- **Direct,** when impacts result from a direct interaction between the Project and a resource or receptor;
- **Indirect,** when impacts are derived from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment; and
- **Induced,** when impacts result from other activities (which are not part of the Project) that happen as a consequence of the Project

7.1.2 Impact Characteristics Terminology

Characteristics	Definition	Designations
Nature	A description indicating the relationship of the potential impact to the project (in terms of cause and effect).	Direct Indirect

Characteristics	Definition	Designations
		Induced
Geographical Extent	The "reach" of the potential impact (e.g., confined to a small area around the project footprint, projected for several kilometers, etc.).	Project Site Local Regional National International
Duration	The time period over which a resource/receptor is potentially affected.	Short Term Medium Term Long Term Permanent - Mitigated Permanent - No Mitigation
Intensity/severity	The degree to which the project affects or changes the environment.	Insignificant Low Medium High Very High
Probability	The likelihood or the chances that the impacts will occur.	Unlikely Low Medium High Definite

7.1.3 Evaluation of Impacts

In assessing the significance of impact, the following impact characteristics are taken into consideration:

7.1.3.1 Magnitude of an Impact

Magnitude, or the severity of an impact or degree of change caused by a project activity, is a function of one or more of the following characteristics:

- **Scale:** The degree of damage that may be caused to the environmental components concerned.
- **Extent:** The spatial or geographical extent of the impact due to Project and its related activities.
- **Duration:** The temporal scale of the impact in terms of how long it is expected to last.

Criteria have been defined for each of these key elements and classified based on the level of impacts (low, medium and high) on the environmental component, presented in Table 7-2 below:

Table 7-2: Criteria of an Impact

Impact Elements	Criteria	Ranking
Scale	• Natural, cultural, and social functions and processes permanently cease, and valued, important, sensitive, or vulnerable systems or communities are substantially affected. • Negative impacts cannot be reversed.	Very High
	• Irreversible damage to natural environment and/or difficult to • mitigate or may not to revert back to an earlier stage with • mitigation • Major changes in comparison to baseline conditions and/or • likely to regularly or continually exceed the standard	High
	• Reversible damage to the natural environment and likely to revert back easily to an earlier state with mitigation • Perceptible change from baseline conditions but well within acceptable norms	Medium
	• Effect is within the normal range of natural variation • No perceptible or readily measurable change from baseline conditions	Low
	• Changes due to potential/possible impact are minor, not visible/noticeable, natural functioning of the environment is not affected.	Insignificant
Geographical Extent	• Potential impacts' area only at or within the project boundary.	Project Site
	• Site and its immediate vicinity (0.5 km from Site)	Local
	• Site & AOI (5.0 km from Site)	Regional
	• AOI and beyond AOI	National
	• The impact is considered at a global level. The impact is considered not only at the national level but also within the neighboring country.	Trans-Boundary
Duration	• Continues beyond the life cycle of the Project	Long term
	• Continues across several phases of the Project life	Medium term

	cycle	
	• Only during particular activities or phase of the Project life cycle	Short term
	• Potential impact will remain after the operational life of a project, but appropriate mitigation measures reduce the impact.	Permanent – Mitigated
	• Potential/possible impact will remain after the operational life of the project.	Permanent – No Mitigation

Definitions of magnitude for physical, biological and human environmental resources or receptors are defined subsequently:

Table 7-3: Magnitude definitions for physical, biological and human resources/ receptors

Magnitude Definitions	**Biophysical and Environmental Receptors**	**Socio-economic, Cultural and Community Health Receptors**
Negligible	An immeasurable, undetectable or within the range of normal natural variation.	Change remains within the range commonly experienced within the household or community.
Small	Slight changes in background levels well within accepted norms. Emissions/ discharges are well within benchmark discharge limits. The affected environmental conditions are expected to recover within a few months.	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of households and is of a short duration.
Medium	Temporary or localized change in physical or biological environment. Such changes may return the baseline conditions and/or there may be occasional exceedance of benchmark limits for Emissions and discharge.	Clearly evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may be regional in scale.
Large	Change over a large area or ecological conditions that last over the course of several months and are likely to cause secondary impacts; and/or routine exceedance of benchmark limits for emissions and effluent discharge.	Change dominates over baseline conditions. Affects the majority of the area or population in the AOI and/or persists over many years. The impact may be experienced over a regional or national area.
Positive	In the case of positive impacts, no magnitude is assigned, unless there is ample data to support a more robust characterization. It is usually sufficient	

	to indicate that the Project will result in a positive impact, without characterizing the exact degree of positive change likely to occur.

Note: In the case of impacts resulting from unplanned events, the same resource/ receptor-specific approach was followed to designate a magnitude designation, but the 'likelihood' factor was considered, together with the other impact characteristics, when assigning a magnitude.

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource or receptor as a result of the impact. The magnitude combines the impact characteristics of Extent, Duration and Scale and is a multiplicative factor of these three criteria.

7.1.3.2 Determining Sensitivity/ Importance/ Vulnerability of Receptor

In addition to characterizing the magnitude of impact, the other principal step necessary to assign significance for an impact is to define the sensitivity, vulnerability and importance of the affected resource or receptor. There are a range of factors to be taken into account when defining the sensitivity, vulnerability and importance of the resource or receptor, which may be physical, biological, cultural or human as per the following understanding:

- Where the resource is physical (for example, a fresh water body), its quality, sensitivity to change and importance (on a local, regional, national importance) are considered.
- Where the resource or receptor is biological or cultural (for example, a wildlife habitat), its importance (for example local, regional or national importance) and its sensitivity to the specific type of impact are considered.
- Where the receptor is human, the vulnerability of the individual, community or wider social group is considered.

The definitions in Table 7-4 have been used to determine the sensitivity, importance and vulnerability of environmental resources or receptors.

Table 7-4: Sensitivity/Importance/ Vulnerability Criteria

Sensitivity Criteria	Contributing Criteria
High	• Existing physical environment is already under stress. • Ecologically sensitive/protected areas that provide habitats for globally protected species. • Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought on by the Project. • Human receptors/vulnerable communities are located within the Project footprint and directly affected by the Project.
Medium	• Existing physical environment shows some sign of stress, which is sensitive to change in quality or physical disturbance. • Natural habitat provides habitats for wildlife, which are protected under national regulations. • Multiple levels of vulnerability but retains an ability to at least in part adapt to change brought by the Project. • Human receptors/vulnerable communities are located adjacent the Site

	and likely to be affected by the Project
Low	• The quality of the existing physical environment is good. • Modified habitat provides habitats for common species. • Human receptors are located at a distance and are not likely to be affected by the Project.

7.1.3.3 Probability

Probability is the likelihood or the chances that the impacts will occur are given in Table 7-5.

Table 7-5: Probability of Impacts

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

7.1.3.4 Evaluating Significance of Impacts

Once the magnitude of an impact and the sensitivity, vulnerability and importance of the resource or receptor have been characterized, the significance was assigned for each impact. Impact significance is designated using the matrix shown in Table 7-6.

Table 7-6: Impact Significance Criteria Due to the Project

		Sensitive/Vulnerable/ Important Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources and receptors and all impacts to these resources and receptors. Considerations specific to each resource and receptor are factored into the assignment of magnitude and sensitivity, vulnerability and importance that are entered into the matrix. Table 6.6 provides context for what the various impact significance ratings signify.

7.1.3.5 Impact Significance

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

7.1.3.6 Categories of Impact Significance

Table 7-7: Categories of Impact Significance

Impact Category	Description of Impact Significance		
	Biophysical and Environmental Receptors	Social and Cultural Receptors	Community Health
Positive	Positive impacts provide resources or receptors, most often people, with positive benefits. The concepts of equity have been considered in assessing the overall positive nature of some impacts such as economic benefits, or opportunities for employment, improvement in infrastructure and overall development of region		
Negligible	An impact of negligible significance is one where a resource or receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be imperceptible or indistinguishable from natural variation in baseline conditions.	An impact of negligible significance is one where inconvenience caused, but with no consequences to livelihoods, culture or quality of life.	An impact of negligible significance is one where receptors may experience annoyance, minor irritation, or stress associated with change; minimal impact to perceived quality of life. Does not require treatment. No long-term consequences for the health of individuals and the community.
Minor	An impact of minor significance is one where a resource or receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource or receptor is of low sensitivity, vulnerability and importance. In either case, the magnitude should be well within applicable standards and guidelines.	An impact of minor significance is one where impacts are short-term and temporary and do not result in long term reductions in livelihood or quality of life.	An impact of minor significance is one where the temporary reduction of the health of certain individuals can be easily treated and does not result in long term consequences for community health. Impacts may lead to greater health inequalities in the Project area.
Moderate	An impact of moderate significance has an impact magnitude that is within applicable standards and guidelines, but falls somewhere in the range	An impact of moderate significance is one where adverse impact notably affect livelihood or quality of life at a household and	An impact of moderate significance is one where there is high risk of diseases or injuries as well as exposure to Project operational risks

	from a threshold below that of a minor impact, up to a level that might be just short of breaching a legal limit. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP).	community level. Impacts can mainly be reversed but some households may suffer long-term effects.	to the local community. This may result in long-term but reversible community health impacts.
Major	An impact of major significance is one where an accepted limit or standard may be exceeded, or impacts of a large magnitude occur to highly valued or sensitive resources or receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e., ALARP has been applied).	An impact of major significance is one where diverse primary and secondary impacts will be impossible to reverse or compensate for, possibly leading to long-term impoverishment or societal breakdown.	An impact of major significance is one where there is loss of life, severe injuries or chronic illness requiring hospitalization. There is exposure to and incidence of diseases not commonly seen previously in the area. There are likely to be long-term consequences for community health.

7.1.4 Mitigation and Enhancement Measures

Once the significance of an impact has been characterized, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this IA, ERM has adopted the following Mitigation Hierarchy:

- **Avoid at Source (Reduce at Source):** Avoiding or reducing at source through the design of the project.
- **Abate on Site:** Modifying design to abate the impact.

- **Abate at Receptor:** Implementing control measures off-site if an impact cannot be abated onsite.
- **Repair or Remedy:** Addressing impact through repair, restoration or reinstatement measures when there are impacts that involve unavoidable damage to a resource or receptor.
- **Compensate in Kind, or compensate through other means:** Compensation for loss, damage and disturbance when other mitigation approaches are not possible or fully effective.

The priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resulting effect to the resource or receptor via abatement, compensatory measures or offsets. In other words, the hierarchy entails reducing the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude.

7.1.5 Residual Impact Evaluation

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

7.1.6 Management and Monitoring

The final stage in the IAP is to define the management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components conform to applicable standards; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted.

An ESMP, which is a summary of all actions which the PP has committed to executing with respect to environmental, social and health performance of the Project, is also included as part of the EIA report. The ESMP includes mitigation measures, compensatory measures and offsets and management and monitoring activities.

7.1.7 Impacts During Pre-Construction and Construction Phase

7.1.7.1 Air Quality

7.1.7.1.1 Impacts from Dust Emissions

Dust is usually categorized into three size classifications or fractions:

- Total Suspended Particulates (TSP) – Particulates of less than 50 µm in aerodynamic diameter.
- PM_{10} – Particulates of less than 10 µm in aerodynamic diameter.
- $PM_{2.5}$ – Particulates of less than 2.5 µm in aerodynamic diameter.

Of these size fractions, only PM_{10} and $PM_{2.5}$ have the potential to enter the human respiratory system. Of respiratory size fractions, dust generated from construction activities typically comprises

PM_{10}. Studies show that 85-90% of such particles will have a particle size range between 2.5 to 10 µm[8].

7.1.7.1.1.1 Sources

Dust-generating activities during the project pre-construction and construction phase are likely to include the following:

- Earthworks such as land clearance and topsoil removal of the preparation of construction work areas and excavation for underground structures.
- Movement of construction vehicles on unpaved surfaces within the construction area prior to reinstatement of road surfaces, building, or landscaping works.
- Soil and/or construction material being tracked out by vehicles leaving the project construction area.

7.1.7.1.1.2 Receptors

Dust level generally decreases exponentially over the distance due to re-deposition, notwithstanding other influencing factors such as air stability (wind), topography, and the presence of trees or structures. There is currently limited evidence on the distance over which dust impact might occur.**Error! Bookmark not defined.**

The human receptors that would likely be exposed to increased dust levels from the construction activities associated with the project are therefore defined as any human receptor within 350 m of the project boundary or 50 m from any unpaved access route within 500 m of the project boundary. From the review of the land use within and surrounding the project site, the above-mentioned receptors would include staff and workers within the existing project and the local community. Flora and fauna within the buffer zone are also considered sensitive to elevated dust levels from construction activities.

7.1.7.1.1.3 Impacts

Increased dust levels may lead to acute health effects on human receptors, such as irritation of the respiratory system. Dust deposition may also lead to the soiling of existing structures leading to nuisance effects on human receptors such as the staff and workers. Dust deposition may also affect flora by coating leaves and impairing photosynthesis.

A very few amounts of clearance of vegetation will be undertaken to accommodate the proposed project. Soil samples indicate that the project area is predominantly underlain by sandy clay, which has a small grain size and is therefore prone to mobilization when dry and exposed to windy conditions, or when there are vehicular movement over unpaved roads within the construction work areas.

Higher wind speeds typically occur during the monsoonal periods. Dust emissions due to re-entrainment from wind are therefore likely to be attenuated by rainfall associated with thunderstorms characteristic of the monsoon season. However, the wind velocity in other seasons in the area is moderate. Windblown dust is not expected to have tangible effects.

[8] Institute of Air Quality Management. (2014). *Guidance on the Assessment of Dust from Demolition and Construction*. Institution of Environmental Sciences, London.

In consideration of the aforementioned influencing factor, the magnitude of impacts of dust generated from construction and earthworks during the project construction phase is evaluated to be Minor (details in section 7.2).

7.1.7.1.1.4 Mitigation Measures

Measures to avoid, minimize, and limit the magnitude of dust impacts caused by the project's construction phase are outlined in the following. Mitigation includes construction management best practices, monitoring, and general housekeeping activities.

- Follow the approved Environmental Management and Monitoring Plan throughout the pre-construction and construction activities.
- Phase dust-generating activities such as land clearance, earthworks, and building construction to minimize the area of ground exposed and the volume of soil and construction material handled at any one time.
- Land grading, improvement, or moving of materials should be undertaken during periods of low winds.
- Ensure availability of water for dust suppression at suitable locations, in particular the excavation sites. Use water suppression during excavation and earth handling at exposed areas.
- Soil and other materials that shall be stored in specifically designated areas will be properly stored at the site and shall be water-sprayed or covered.
- Cover stockpiles with well-maintained tarpaulin when not in use or as soon as practicable, in particular during dry periods. Stockpiles are to be maintained below a maximum height of 2 m.
- Maintain the maximum possible distance between stockpiles and receptors.
- To minimize the volume of spoil stockpiled, scheduled removal of spoil or waste material shall be prepared.
- Wherever reasonable and practicable, re-vegetate exposed ground as soon as possible to stabilize surfaces and minimize re-entrainment of dust.
- During construction, the access road shall be regularly maintained to keep it clean, and free from mud and slurry.
- Material transport shall be enclosed with impervious sheeting and wheel washing shall be carried out at the site.
- Enforcing speed limits. Speed restrictions on vehicles entering and leaving the site.
- Workers undertake proper housekeeping of the site and roadways linked to the construction area, at the end of each day. This is to ensure that roadways, vehicle wheels, and equipment tracks are clear of dust or mud and that appropriate barriers, tarpaulin covers/erosion blankets have been repaired and/or reinstated.

7.1.7.1.2 Impacts due to Increased Vehicular Emissions

Diesel-powered construction vehicles and equipment used on site and vehicles accessing the construction work area will give rise to the emission of CO, $PM_{2.5}$, $PM_{10,}$ and NO_2. In Bangladesh, there is no guideline for the sulfur content of fuels used in road and off-road applications. However, the emission of SO_2 is not expected to be significant from these sources.

7.1.7.1.2.1 Sources

Increased vehicular emissions during the project construction phase are anticipated due to the following:

- Transportation of raw materials, construction waste, excavated spoil, etc. to and from the construction worksites via dump trucks.
- Use of diesel-operated construction equipment, such as piling rigs, geotechnical equipment, generator sets, etc.
- Vehicular movement.

7.1.7.1.2.2 Receptors

The concentrations of species from vehicular emissions are directly associated with distance from the roads, the concentrations reduce as the distance increases. The distance for which the concentrations of species reduce to background levels depends on several factors including background concentrations, pollutant characteristics, wind speeds, and wind directions. For most gaseous and particulate species, concentrations reduce significantly within 200 m on the upwind side and between 300 m and 500 m on the downwind side of highways and major roads.[9]

Based on the review of land use within 500 m of the construction work area, receptors to vehicular emission mainly comprise staff and workers within the existing project and local community.

7.1.7.1.2.3 Impacts

Construction vehicles and equipment engine exhaust emissions include CO, $PM_{2.5}$, $PM_{10,}$ and NO_2. These substances have been identified as criteria air pollutants by the United States Environmental Protection Agency (USEPA) on account of their effect on human receptors in particular those who are more susceptible to air quality changes such as asthmatics, children, and the elderly; and the prevalence of these substances in the urban ambient environment.[10]

Such emissions will arise in construction work areas and where diesel-fueled construction equipment and generator sets will be used. Emissions will also be generated due to an increase in light-duty vehicles and heavy-duty vehicles moving along the existing road network. Apart from the movement of vehicles and equipment, traffic congestion due to road diversions could also lead to increased vehicular emissions.

It would be ensured that all vehicles plying during construction are properly turned and maintained to keep emissions within the permissible limits,

Therefore, the magnitude of impacts of vehicular emission during the project construction phase is evaluated to be negligible mentioned in Table 7-9.

7.1.7.1.2.4 Mitigation Measures

Measures to avoid, minimize, and limit the vehicular emission impacts caused by the project's construction phase are outlined in the following.

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[9] Health Effect Institute. (2010). *Traffic-Related Air Pollution: A critical review of the literature on emissions, exposure, and health effects.* Boston, Massachusetts, USA.

[10] USEPA. (2021, August 16). *Criteria Air Pollutants*. https://www.epa.gov/criteria-air-pollutants.

- Follow the approved Environmental Management and Monitoring Plan throughout the pre-construction and construction activities.
- All equipment and machinery used at the construction worksites should be maintained and operated in a manner such that they will not give rise to smoke emissions and will comply with the regulations.
- Implement regular checks of vehicles to ensure that emissions are within the prescribed limits.
- Avoid the use of diesel- or petrol-powered equipment by using electricity or battery-powered equipment where possible and if safety concerns can be overcome. Regularly maintain all diesel-powered equipment.
- Vehicles and equipment should not be left idle when not in use to minimize exhaust emissions of NO2, PM10, and SO2.
- No waste shall be burnt on or around the project site.

7.1.7.2 Water Quality

7.1.7.2.1 Impact on Surface Water from Pre-Construction and Construction Activities

7.1.7.2.1.1 Sources

Based on the project description and typical construction methods, impacts on surface water quantity and quality during the construction phase could arise from the following activities and conditions:

- Potential impacts on surface water quality and quantity arising from site runoff and site discharges:
  - Land clearance and grading for preparation of construction work area.
  - Storage fuel, chemicals, construction waste, stockpiling of spoil.
  - Construction of above-ground and underground structures.
  - Modification of surface and perimeter drains in the project area.
- Unplanned events:
  - Overflow of surface runoff from surface water drainage within the project area caused by a major rainfall event that exceeds the design capacity of the drains.
  - Firefighting — firewater runoff.
  - Leakage or spillage of fuels, chemicals, waste materials, etc. stored on the project site during construction that could enter the river.

7.1.7.2.1.2 Receptors

The baseline study for the project identified the Tangon River, Bhulli River, Shuk River, Kulic River and nearby water bodies as surface water-sensitive receptors due to their proximity to the project area. Upon further review of the site setting in conjunction with the project concept plan and key construction areas, surface water receptors to potential water quality impacts associated with the construction works were identified as:

- Tangon River, Bhulli River, Shuk River and Kulic River

The sensitivity of the receptors to surface water impacts from the project is High as the Tangon River, Bhulli River, Shuk River, Kulic River, are within water catchment areas and serve critical water supply functions. High sensitivity is also attributed to considering the ecological sensitivity of these receptors. These receptors contain a diversity of important habitats, including riparian vegetation, fast-flowing water, and pools. This attracts a variety of species reliant on water environments for their lifecycle.

7.1.7.2.1.3 Impacts

The construction site is in close proximity to the Tangon River, Bhulli River, Shuk River, Kulic River. Construction activities will involve land clearance, grading, and then ongoing construction activities for the proposed project over the course of the construction period. However, due to the construction being carried out on generally plain terrain, the soil losses will be negligible.

During the construction phase of the proposed project, water will be used for the construction of civil structures, dust suppression, and drinking purposes. The water requirement shall be met by the existing water supply of the BWDB. This may induce an impact on local hydrology in specific cases if not taken care of specific debris, mud, etc. will be generated during construction. Given the volume of rain during the monsoon season in Bangladesh, flushing of construction material, surface soil erosion, wastes, and potentially hazardous material (e.g., oils and fuels from equipment and machinery such as piling rigs, geotechnical equipment, etc. or waste from construction activities) could occur and flow into the nearby water bodies. This could result in sediment loading and discharge of construction waste and hazardous parameters (e.g., hydrocarbons) into the nearby surface water bodies.

Changes to surface water quality within the study area may also arise from chemical and waste storage and handling during the pre-construction and construction stages. Unplanned events such as hazardous material leakage from machinery, e.g., fuel from piling rigs and geotechnical equipment; and overflow of the existing surface runoff infrastructure from the existing project-operated areas caused by a major rainfall event could also impact surface water quality.

The overall impact on the water environment during the construction phase due to the proposed project is likely to be short-term and insignificant.

Therefore, the magnitude of impacts on surface water from construction activities during the project construction phase is evaluated to be Minor mentioned in Table 7-9.

7.1.7.2.1.4 Mitigation Measures

Mitigation measures for surface water quality include the following.

- Follow the approved Environmental Management and Monitoring Plan throughout the pre-construction and construction activities.
- Dust-generating activities such as land clearance, earthworks, and building construction minimize the area of ground exposed and the volume of soil and construction material handled at any one time.
- Waste management measures should include provisions to contain and dispose of construction wastes, prohibit waste discharge on the ground or any surface watercourse, and practice recycling as far as practicable.

- Combustible material can probably be used in the kiln.
- Implement a regular maintenance program for all equipment and machinery to prevent fuel spillage or leakage during construction activities.
- Properly store and manage hazardous materials during construction activities. Strategically locate areas for the temporary storage of hazardous materials away from surface water resources (at least 100 m away) and preferably down the topographic gradient of watercourses. Chemicals and fuels must be properly labeled and stored in a bunded area. Storage of hazardous materials on-site should be limited to minimize the impacts of any spillage or mitigation failure.
- Spill kits should be provided and all personnel managing hazardous materials should be adequately trained in hazardous materials handling and disposal. Such spill kits should be available where equipment and machinery are temporarily stored and used.
- Oil and grease separators shall be used for wastewater generated from cleaning activities.
- Locate temporary stockpiles of spoils as far as possible from drainage swales (at least 100 m away) and preferably down the topographic gradient of watercourses.
- Cover temporary stockpiles with tarpaulin when not in use.
- Wherever reasonable and practicable, re-vegetate exposed ground as soon as possible to stabilize surfaces.
- Control water suppression during excavation and earth handling to minimize excess water and sediment disposal into surface water.
- Discharge of wastewater from excavation to the surface water bodies shall be strictly prohibited due to ecological sensitivities. The discharge shall either be temporary storage tanks for removal or a temporary treatment system prior to discharge to a discharge point.
- Disposal of construction wastes into the river, khal, or ponds shall be strictly prohibited.
- Minimize soil exposure time during construction activities.
- Inspect and schedule preventive maintenance to all vehicles used to transport excavated and construction material.
- Vehicles used to transport spoil have tarpaulin securely covering the load.
- Vehicles should pass through a bunded wheel wash station upon exiting the construction work areas in order to control and manage wastewater and sediment.
- Vehicle maintenance and mechanical repairs are to occur in dedicated, designed locations, bounded to capture, and control oil, grease, and other spills to prevent flow into surface water resources.
- Adequate sanitary facilities, i.e., toilets provided for the construction workforce.
- Workers trained in the use of designated areas/bins for waste disposal and encouraged to use toilets.
- Sanitary wastewater shall be treated in STP; and all sewage and liquid effluent treated to meet the standards specified in the ECR, 2023.

7.1.7.2.2 Impact on Groundwater from Pre-Construction and Construction Activities

Based on the baseline study, the types of project-related impacts on groundwater resources that will be considered in this assessment include:

- Potential impacts on groundwater quality arising from site runoff and site discharges; and
- Unplanned events such as accidental spills and overflow of the stormwater drainage system and ancillary facilities due to major rainfall events.

7.1.7.2.2.1 Sources

Construction activities causing impacts on groundwater resources are likely to include the following:

- Land clearance and grading for preparation of construction work areas.
- Diversion of underground utilities (excluding existing drainage and sewer lines).
- Construction of above ground and underground structures.
- Leakage or spillage of fuels, chemicals, waste materials, etc. stored on the project site during construction that could enter the groundwater aquifer.

7.1.7.2.2.2 Impacts

Changes to the groundwater quality within the study area may arise from chemical and waste storage and handling during the pre-construction and construction stages. This may cause secondary effects on groundwater-dependent vegetation and any surface waterbodies hydraulically connected to the intercepted groundwater.

It is estimated that the total workforce will mainly come from the nearby areas and no construction camp is proposed at the project site. Hence, the domestic water requirement during the construction phase will be limited to drinking water and sanitation. All the domestic wastewater generated from the site shall be sent to septic tanks followed by soak pits so that it shall not contaminate the groundwater in the nearby areas.

Overall, the significance of impacts on groundwater from construction activities during the project construction phase is evaluated to be Minor mentioned in Table 7-9.

7.1.7.2.2.3 Mitigation Measures

The following mitigation measures shall be adopted to minimize the impact on groundwater quality.

- Implement a regular maintenance program for all equipment and machinery to prevent fuel spillage or leakage during construction activities.
- Protect groundwater sources during construction by ensuring sanitary facilities for workers are available. Waste from such facilities should be properly managed.
- Properly store and manage hazardous materials during construction activities. Locate areas for the temporary storage of hazardous materials away from groundwater resources. Chemicals and fuels must be properly labeled and stored in a bunded area. Spill kits should be provided and all personnel managing hazardous materials should be adequately trained in hazardous materials handling and disposal.
- Oil and grease separators shall be used for wastewater generated from cleaning activities.
- Locate temporary stockpiles of spoils as far as possible from excavations.
- Vehicle maintenance and mechanical repairs are to occur in dedicated, designed locations, bounded to capture, and control oil, grease, and other spills to prevent infiltration into groundwater resources.

7.1.7.3 Noise

7.1.7.3.1 Impacts from Noise

7.1.7.3.1.1 Source

Noise will be generated from the following sources during the pre-construction and construction activities:

- Operation and movement of heavy vehicles such as lorries, crane lorries for transportation of equipment and materials, and dump trucks and/or excavators for transportation of soil and waste material from the work site.
- Operation of construction equipment and vehicles including those which will emit noise from engines or safety alarms such as those triggered by the reverse movement of vehicles.
- Piling works, which may generate metal-on-metal noise.

7.1.7.3.1.2 Receptors

In general, noise is attenuated over distance from the source due to the dissipation of sound energy through the atmosphere. From a review of the land uses within and around the project area, noise-sensitive receptors include:

- Staff and workers in the project area.
- Residential areas located around the project area.
- The school and mosque are located between 100 m to 380 m from the construction work site.
- Fauna within and around the project site.

7.1.7.3.1.3 Impacts

Noise and vibration are generated from various construction activities such as the piling of foundations, crushing of stones and bricks, and installation of machines and equipment, etc. In addition, the working conversation of the labor force also enhances noise pollution. The noise pollution and vibration create disturbance to the workers of the adjacent establishments and surrounding people involved in various activities. Operation of different machinery and equipment for construction activities, running of heavy load traffic for construction materials transportation, and regular traffic movement may generate noise during the construction period. The heavy equipment, machinery, transportation, and earthworks used for construction activities are the major sources of noise. It is envisaged that there will be an increase in traffic and thereby in traffic noise impacts on the receptors near the approach road from the transportation of equipment, and construction materials. As detailed in the earlier sections, the residents in the vicinity of the site would be impacted due to noise emissions. The impact of noise generation on the settlements could be significant as the nearby settlement is within 2 km of the site area. Noise from generators, water, and booster pumps could be the sources of noise generation. All the generators shall be equipped with acoustics covers which shall mitigate the noise. Operational and booster pumps shall be maintained periodically and shall be kept in an isolated room to minimize noise generation from them. Table 7-8 shows the typical noise levels generated by some of the construction equipment expected to be used during the construction phase. As seen from the below table, the local peak noise level for non-continuous construction activity may reach as high as 96 dB(A), depending on the type of equipment. The impact, however, is expected to be temporary and localized.

Table 7-8: Noise levels generated by construction equipment (measured at 1 m distance)

Equipment	Noise Level dB (A)
Earth Movers	
Front Loaders	72-84
Backhoes	72-93
Tractors	76-96
Scrapers, Graders	80-93
Pavers	86-88
Bulldozer	86-88
Excavator	84-86
Trucks	82-94
Material Handlers	
Concrete Mixers	75-88
Concrete Pumps	81-83
Cranes	75-86
Winch	85-88
Stationary	
Generators (in the canopy)	71-82
Electric Saw	81-85
Wood Planer	81-85

Noise levels will have a compounding effect when multiple equipment and trucks operate at the same time. Thus, the actual noise level at the site and surroundings would be much more than given in the above table.

However, due to the shape of the site, the large-scale concentration of construction equipment may not happen. Thus, the compounding effect may not be very high.

In consideration of the aforementioned influencing factor, the magnitude of impacts of noise from construction and earthworks during the project construction phase is evaluated to be Minor (details in Table 7-9).

7.1.7.3.1.4 Mitigation Measures

Measures to avoid, minimize, and limit the magnitude of noise impacts caused by the project's pre-construction and construction phase are outlined in the following.

- Throughout the pre-construction and construction period, the schedule of the noisiest construction activities (in particular pilling) should be maintained at a specific period to minimize disturbance to the receptors. Operation times of noisy equipment and machinery should be limited, where possible.

- Regular maintenance of equipment including lubricating moving parts, tightening loose parts, and replacing worn-out components shall be conducted.
- Restrict public access to locations in close proximity i.e., 10 m to the construction work areas.
- Source for quieter models of construction equipment, where reasonably practicable.
- Equipment and vehicle engines are to be turned off when not in use.
- Workers are to be trained in noise reduction behaviors such as reducing the drop height of materials. Daily toolbox briefings should include reminders on the need to implement noise reduction behaviors, in particular during pilling activities.
- Instead of hoardings, erect acoustic barriers along the boundary between the construction work area and the existing other project areas. Where practicable, acoustic barriers shall be at a sufficient height to block the visibility of construction equipment from the receptors within the site.
- Acoustic covers for all equipment and machinery that generate excessive noise.
- Ensure that all equipment and machinery and its mufflers are regularly serviced and immediately serviced or replaced if damaged.
- The amount of equipment operating simultaneously shall be reduced as far as practicable.
- Mobile noise sources such as cranes and earth-moving equipment shall be routed in such a way that there is a minimum disturbance to receptors.
- Vehicle movement at night shall be strictly prohibited through the access road.
- Undertake daily inspection and carry out noise monitoring in accordance with the management and monitoring measures to ensure compliance against limits in the Noise Pollution (Control) Rules, 2006.

7.1.7.4 Soil

7.1.7.4.1 Impacts on Soil Quality

7.1.7.4.1.1 Sources

The proposed project will be constructed in Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District. The construction of the proposed project on this site would not affect the soil quality of the site. The potential source of impact on soil quality could arise due to spillage of fuel, lubricant, and paints from the storage site.

Pre-construction and Construction activities causing impacts to groundwater resources are likely to include the following:

- Soil contamination during the construction phase may result from filling activity, leaks, and spills of oil, lubricants, or fuel from heavy equipment and wastewater.
- Land clearance and grading for preparation of construction work areas.
- Diversion of underground utilities.
- Construction of aboveground and underground structures.

- Construction waste will comprise surplus or off-specification materials such as concrete, wooden pallets, steel cuttings/filings, packaging paper or plastic, wood, plastic pipes, metals, etc.
- Domestic-type wastes consisting of food waste, plastic, glass, aluminum cans, and wastepaper will also be generated by the construction workforce.
- Changes to soil quality within the study area may arise from chemical and waste storage and handling during the construction stage. It may result from spillage and leakage of oil, lubricants, fuel from heavy equipment, or leakage from chemical/ fuel storage.

7.1.7.4.1.2 Impacts

The soil at the project site is sandy clay. The soil strata have higher permeability, thus allowing contamination at greater depth. Storm water run-off from the contaminated area can pollute the downstream soil and water quality of the receiving water body. The soil characteristics of the native soil may also be changed due to the import of soil for filling and leveling purposes. It is envisaged that the filling activity may impact the native soil due to spillages during the transportation of soil and run-off during filling and compaction. Contamination from spillage and leakage can have a long-term impact on soil. Improper waste handling may cause direct, long-term negative impacts on soil quality.

Apart from the embedded controls to be included in the project design, the following mitigation measures will reduce the negative impacts of construction activities on the soil environment.

The magnitude of impacts on soil from construction and earthworks during the project construction phase is evaluated to be Minor (details in Table 7-9).

7.1.7.4.1.3 Mitigation Measures

The following mitigation measures will be adopted to minimize the impact on soil quality.

- Implement a regular maintenance program for all equipment and machinery to prevent fuel spillage or leakage during pre-construction and construction activities.
- Manage spills of soil contaminants using standard engineering practices.
- Storage areas for oil, fuel, and chemicals to be surrounded by bunds or other containment devices to prevent any spilled oil, fuel, or chemicals from contaminating soils, sediment, water, or groundwater.
- Use of spill or drip trays to contain spills and leaks, and use of spill control kits to clean small spills and leaks.
- Installation of oil/water separators to treat surface runoff from bunded areas prior to discharge to the stormwater system.
- Waste management measures should include provisions to contain and dispose of construction wastes, prohibit waste discharge on the ground, and practice recycling as far as practicable.
- Dispose of debris and waste in a designated area and as per plan to prevent degradation of soil. Combustible material can probably be used in the kiln.
- Provide dedicated storage areas for construction materials to minimize the potential for damage or contamination of the materials.

- Locate temporary stockpiles of spoils as far as possible from excavations.
- Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills.
- Ensure storage areas have impermeable floors and containment.
- Dispose of hazardous waste by licensed authorities.
- Fuel tanks and chemical storage areas are to be sited in sealed areas and provided with locks to prevent unauthorized entry.
- Preparation of guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel, or chemicals.
- Development of a site-specific emergency response plan for soil clean-up and decontamination.
- Vehicle maintenance and mechanical repairs are to occur in dedicated, designed locations, bounded to capture and control oil, grease, and other spills to prevent contamination in soil resources.
- Implementation of a training program to familiarize staff and workers with emergency procedures and practices related to contamination events.
- Training labor for waste disposal in designated areas and use of sanitation facilities.
- Implement a construction materials inventory management system to minimize the over-supply of construction materials, which may lead to the disposal of surplus materials at the end of the construction period.

7.1.7.5 Drainage

7.1.7.5.1 Impacts on Drainage System

7.1.7.5.1.1 Source

During the pre-construction and operation phase of the project, the drainage system's impact on the surrounding environment is noteworthy. Stormwater runoff poses a concern, as rainwater landing on impermeable surfaces within the project area can carry pollutants and debris along, leading to potential contamination of the drainage system. Additionally, the discharge of sewage and wastewater requires careful management to prevent these discharges from infiltrating and polluting the drainage system. Vigilant measures are necessary to mitigate these impacts, ensuring the preservation of the surrounding environment's integrity and water quality.

7.1.7.5.1.2 Receptors

The pre-construction and operation phase of the project introduces significant considerations for the drainage system's influence on the surrounding environment. Local water bodies, including rivers, streams, ponds, and wetlands, assume the role of receptors for stormwater runoff. This runoff has the potential to influence their water quality as it carries along contaminants and impurities. Simultaneously, both aquatic and terrestrial ecosystems in the vicinity bear the brunt of the consequences arising from urban runoff. This runoff often contains pollutants that can exert detrimental effects on these ecosystems, impacting the delicate balance of aquatic life and terrestrial vegetation. Addressing these potential impacts through strategic mitigation measures is essential to sustain the health and equilibrium of the environment surrounding the project.

7.1.7.5.1.3 Impacts:

During the pre-construction and operation phase of the project, the drainage system's impact on the surrounding environment becomes evident. Water quality degradation is a significant concern, as pollutants stemming from both stormwater runoff and sewage discharges have the potential to contaminate the drainage system. Consequently, this contamination can translate into a decline in water quality within the receiving bodies. Additionally, the excessive volume of stormwater runoff can initiate erosion and sediment accumulation within drainage channels, compromising their capacity and even giving rise to blockages. Furthermore, the introduction of pollutants into nearby natural water bodies poses a threat of habitat disruption. The pollutants can negatively affect aquatic life and disturb the equilibrium of local ecosystems, warranting the implementation of proactive measures to alleviate these impacts and ensure the preservation of the environment's health and balance. The magnitude of impacts on Drainage System from construction and earthworks during the project construction phase is evaluated to be Negligible (details in Table 7-9).

7.1.7.5.1.4 Mitigation Measures

The following mitigation measures are to be followed to reduce the impacts on Drainage System during the pre-construction and construction phase:

- Implement Best Management Practices (BMPs) such as existing lakes, retention ponds, permeable surfaces, and biofiltration systems to manage stormwater runoff and reduce pollutant loads.
- Incorporate green infrastructure elements like rain gardens and vegetated swales to capture and treat stormwater runoff.
- Properly manage and treat sewage and wastewater to prevent contamination of the drainage system and protect water quality.
- Raise awareness among residents about proper waste disposal and outdoor activities to minimize pollution.
- Conduct routine maintenance of drainage infrastructure to prevent blockages and ensure proper functioning.
- Establish a monitoring program to assess the quality of stormwater runoff and identify potential issues.
- Adhere to local regulations and permits related to stormwater management and pollution prevention.
- Encourage the use of native vegetation in landscaping to reduce stormwater runoff and enhance water absorption.
- Involve residents in drainage system maintenance and pollution prevention efforts.
- Develop plans for managing stormwater during extreme weather events to prevent flooding and pollution incidents.

7.1.7.6 Biodiversity

7.1.7.6.1 Impacts on Terrestrial and Aquatic Flora

7.1.7.6.1.1 Sources

Potential impact sources considering impacts on terrestrial and aquatic flora during the pre-construction and construction phase include vegetation clearance, damage to flora, dust emissions, etc.

Activities leading to impact sources are likely to include the following:

- Preparation of construction work areas and excavation for underground structures.
- Loading, unloading, and stockpiling of construction materials, and stockyard development for construction equipment and vehicles.
- Movement of construction vehicles and ignorance of construction workers.

7.1.7.6.1.2 Receptors

Terrestrial vegetation within the project site will be subjected to vegetation clearance. Also, terrestrial flora adjacent to the construction sites and approach roads is likely to be damaged due to the movement of construction vehicles and the ignorance of construction workers. The surrounding vegetation, both terrestrial and aquatic of the project site is likely to be exposed to impacts due to dust emission. However, dispersion and deposition of dust particles, as well as impacts on floral species, decrease over the distance considering wind speed, topography, and the presence of physical barriers.

7.1.7.6.1.3 Impacts

Vegetation removal will lead to the destruction of vegetation cover within the project site. Damages i.e., tearing off leaves, breaking off twigs and branches, etc. might have occurred from vehicle movement and workers' negligence. Deposition of dust particles on the plant leaves, twigs, and stems may hamper photosynthesis, respiration, and other physiological processes of plants. This might result in a decrease in plant growth, cause diseases, and affect the health of the vegetation adjacent to the project construction sites and approach roads.

Considering the aforementioned issues, the impact of construction and earthwork activities on terrestrial and aquatic flora during the project construction phase is evaluated to be negligible mentioned in Table 7-9.

7.1.7.6.1.4 Mitigation Measures

The following mitigation measures are to be followed to reduce the impacts on terrestrial and aquatic flora during the pre-construction and construction phase:

- Vegetation clearance should be minimal and within the designated areas.
- Mitigation measures for dust generation and dispersion should be followed.
- Regular water spaying should be done in the construction areas and approach roads.
- Workers should be aware of the importance of natural resources and should not unnecessarily clear any area or break branches, twigs, flowers, etc. of adjacent vegetation.

- The use of LPG/Kerosene for cooking needs to be provided/encouraged in order to reduce the impacts on vegetation from the vicinity of the project site.
- Plant health monitoring should be conducted.
- Wherever feasible, depending upon the availability of space within the project and/or along the access road, plantation activities shall be performed.

7.1.7.6.2 Impacts on Terrestrial Fauna

7.1.7.6.2.1 Sources

Potential impact sources considering impacts on terrestrial fauna during the pre-construction and construction phase include vegetation clearance, noise, light and dust emissions, vehicle movement, etc.

Activities leading to vegetation clearance, damage to flora, and dust generation include:

- Preparation of construction work areas and excavation for underground structures.
- Loading, unloading, and stockpiling of construction materials, and stockyard development for construction equipment and vehicles.
- Movement of construction vehicles and ignorance of construction workers.

Noise-generating activities during the project pre-construction and construction phase. The major source of light-generating activities includes the use of security lights and the use of lights to facilitate night work. Vehicle movement and workers' unawareness can also be sources of potential impacts.

7.1.7.6.2.2 Receptors

All wildlife might be affected by dust emissions. Primarily the birds are exposed to noise and all nocturnal animals are susceptible to excessive light. However, small mammals and reptiles often get accidental issues during road crossing. Vegetation clearance will present a threat to terrestrial fauna with habitat destruction as well.

7.1.7.6.2.3 Impacts

Noise and dust generation from loading and unloading of construction materials, construction of infrastructures, transportation of construction materials, etc. may lead to habitat degradation for wildlife.

Dust and noise may affect the ecology and behavior of terrestrial fauna residing in the adjacent areas of the project site. In addition, excessive light generated from the construction site will hamper the movement and behavior of nocturnal animals. In addition, accidental cases from vehicle movement on approach roads may cause physical damage or even death of wild animals, especially small mammals, and reptiles.

Considering the aforementioned issues, the impact of construction and earthwork activities on terrestrial fauna during the project construction phase is evaluated to be Minor mentioned in Table 7-9.

7.1.7.6.2.4 Mitigation Measures

The following mitigation measures are to be followed to reduce the impacts on terrestrial fauna during the pre-construction and construction phase:

- Noise mitigation measures should be followed and machinery with lesser noise production should be used.
- Night-time work should be limited and the use of lights at night should not disrupt the movement of nocturnal wildlife.
- Disturbance to wildlife should be monitored regularly.
- Workers should be aware of the importance of natural resources and should not do any harm or death to wildlife.
- A plantation plan should be developed and implemented for greenbelt development with appropriate indigenous species.
- Rescue, rehabilitation, and relocation should be done for terrestrial fauna when necessary.

7.1.7.6.3 Impacts on Fisheries and Aquatic Ecosystem

7.1.7.6.3.1 Sources

Potential impacts on surface water quality arising from site runoff, site discharges, and other unplanned events during pre-construction and construction phases have been discussed in Section 7.2.1.2.1.

7.1.7.6.3.2 Receptors

Tangon River, Bhulli River, Shuk River, Kulic River within water catchment areas, serve to provide major habitat for the aquatic ecosystem. Fish species and aquatic invertebrates will be under threat due to the impacts on surface water quality. Some reptiles and amphibians along with aquatic plant species might get exposed to accidental events.

7.1.7.6.3.3 Impacts

The primary impact will change in the chemical composition of surface water quality which may lead to degradation or even destruction of aquatic invertebrates. This might also trigger the eutrophication process and lead to the degradation of the aquatic ecosystem. A further impact will be on fisheries through habitat degradation and even habitat loss for them. The physiological processes and behavioral characteristics might get hampered or changed. The growth and production of fisheries might be reduced in the long run.

Considering the aforementioned issues, the impact of vessel movement, construction, and earthwork activities on fisheries and aquatic ecosystems during the project construction phase is evaluated to be negligible mentioned in Table 7-9.

7.1.7.6.3.4 Mitigation Measures

The following mitigation measures are to be followed to reduce the impacts on fisheries and aquatic ecosystems during the construction phase:

- EMP for effluent discharge, wastewater discharge, construction material disposal, and vessel movement should be followed.

- A plan for accidental oil spillage should be developed and implemented.
- Regular monitoring of aquatic ecosystem health and fish production should be done.
- Aware workers of the importance of natural resources and they should not do any harm or cause death to aquatic life.

7.1.7.7 Waste

7.1.7.7.1 Impacts Due to Waste Generation

7.1.7.7.1.1 Source

The main type of waste likely to be generated during construction activities is the pre-construction and construction debris resulting from the excavations for combined water structure foundations and irrigation canal, construction of the combined water structure, internal fittings, electrical installation, and external works. Other wastes that will be generated include waste food and packaging materials littered by workers.

Some of the waste streams include the following:

- Hazardous wastes such as solvents, thinners, cleaners, cutting oils, paints, contaminated rags, packaging and containers, adhesives, light bulbs, and batteries.
- Non-hazardous wastes such as food and canteen waste, scrap metal waste, wastepaper, wood, and cardboard packaging.
- Other wastes such as glass, uncontaminated soil, rubble, plastics, and rubber.

7.1.7.7.1.2 Impacts

There is potential for the spread of construction debris to areas outside that are marked for construction. The debris generated from construction activities can be carried along with ponds and rivers flowing in the proximity of the project. Construction debris can also contaminate wells, haors, etc. in the proximity of the activity.

The improper management of the above wastes may have potentially adverse impacts on the environment in the absence of appropriate mitigation measures.

Therefore, the magnitude of impacts of waste generated from construction activities during the project construction phase is evaluated to be Medium mentioned in **Error! Reference source not found.**.

7.1.7.7.1.3 Mitigation Measures

Measures to avoid, minimize, and limit the magnitude of waste generation impacts caused by the project's pre-construction and construction phase are outlined in the following.

- Any pre-construction and construction debris generated at the site will be removed from the site immediately after the completion of construction activities and the site will be leveled as the original.
- All storage areas must also be properly demarcated and, if the material is hazardous, there should be adequate labeling and security at the facility.

- Properly store and manage hazardous materials during construction activities. Chemicals and fuels must be properly labeled and stored in a bunded area. Storage of hazardous materials on-site should be limited to minimize the impacts of any spillage or mitigation failure.
- Dispose of debris and waste in designated areas. Combustible material can probably be used in the kiln.
- Workers will be strictly instructed about the random disposal of any waste generated from the construction activity. Arrangements will be made to collect and prevent littering by workers on site.

7.1.7.8 Transportation Infrastructure

7.1.7.8.1 Impacts due to Increase Traffic

7.1.7.8.1.1 Source

There will be movement of construction materials and manpower during the construction. The vehicle movements that will be required during the construction of the project will arise from two main activities:

- The delivery of the equipment, and materials for the construction; and
- The daily movements of personnel to and from the worksite.

7.1.7.8.1.2 Impacts

Based on the field observation, there existed a substantial number of heavy vehicles moving along the road. Additional construction vehicles for materials and equipment may create traffic congestion.

The traffic movement during the construction phase is likely to be occasional and very low resulting in insignificant impacts from the traffic. For this, the magnitude of impacts of traffic intensity during the project pre-construction and construction phase is evaluated to be Negligible mentioned in Table 7-9.

7.1.7.8.1.3 Mitigation Measures

The following mitigation measures will be adopted to minimize the impact on transportation infrastructure.

- Vehicles used for construction activities shall move along the already existing roads as far as possible.
- Avoiding peak hours for heavy vehicle movement where possible.
- Material transport shall be totally enclosed with an impervious sheet before traveling on public roads.
- No overloading is done shall be ensured.
- Enforcing speed limits. Speed restrictions on vehicles entering and leaving the site.
- The engines and exhaust systems of all vehicles and equipment used shall be maintained such that exhaust emissions are low and do not breach statutory limits set for the concerned vehicles or equipment type.

- Any increase in the traffic during the construction phase shall be short-lived and shall return to normal once the construction activity is complete.
- All vehicles shall be instructed to follow traffic norms strictly.

7.1.7.9 Health and Safety

7.1.7.9.1 Occupational Health and Safety

7.1.7.9.1.1 Source

Occupational health and safety impacts during the pre-construction and construction phase are anticipated primarily from the operation of construction machinery and equipment during site preparation, building construction, and handling of the construction equipment.

7.1.7.9.1.2 Impact on Occupational Health and Safety

During the construction phase, impacts on the occupational health and safety of workers are anticipated from exposure to high noise generated from the operation of heavy machinery and equipment, fugitive dust generated from material stockpiles, earthworks, and vehicular emissions. Continuous exposure of workers to high noise levels and fugitive dust may lead to adverse health impacts viz. headache, asthma, allergy, hearing loss, etc. However, considering the temporary nature of the construction phase activities, intermittent operation of machinery and equipment, and provision of proper PPEs for the workers, it may not cause any significant impact.

The project workforce will be housed in a labor camp located in the project area. It is proposed to provide adequate facilities in the labor camp like facilities with proper ventilation, electricity, separate kitchens, solid waste collection facility, drinking water facility, sanitation facility, etc. Inadequate facilities and unhygienic conditions may have impacts on the occupational health of the laborer.

It could be assessed that the magnitude of impacts on occupational health and safety during the project construction phase is evaluated to be Minor mentioned in Table 7-9.

7.1.7.9.1.3 Mitigation Measures

The mitigation measures for occupational health and safety are as follows:

- Adequate provision of healthy living conditions shall be ensured in the contractor labor camp.
- Provision of drinking water facilities, sanitation, and cooking facilities.
- Provision of proper PPEs for the contractor workers on site.
- The work permit shall be followed.
- Exposure of workers operating near high noise-generating sources shall be reduced to the extent possible.
- On-the-job training for the workers shall be carried out.
- Health surveillance of the contractor workforce shall be conducted.
- The occupational health and safety of the project workforce shall be assured through the formulation of an "Occupational Health and Safety Management Plan".

7.1.7.9.2 Community Health and Safety

7.1.7.9.2.1 Source

Possible sources of impacts on community health and safety during the pre-construction and construction phase are:

- Changes in environmental quality due to construction activities.
- Increased prevalence of disease arising from the influx of construction workers.
- Increased traffic movement.

7.1.7.9.2.2 Impact on Community Health and Safety

Changes in environmental quality: Health Impact associated with environmental conditions changes in the environmental quality of air, surface water, groundwater, and soil quality may occur as a result of construction activities. High noise levels are also expected from the operation of heavy machinery. An increase in dust and noise during the construction period has the potential to lead to health impacts associated with eye irritation and general disturbance to daily activities.

Inhabitants residing close to access roads will be affected due to noise and dust generated from vehicular movement during the construction phase. However, the access road is a paved road and the dust generation will be minimal.

The discharge of domestic waste effluent from sanitary facilities for construction workers may have the potential to cause contamination of surface water and groundwater in this area.

Waste will be generated during the construction including excavated material, construction waste, hazardous waste, sewage sludge, and general refuse. The impacts of waste are presented in detail in Section 7.1.7.7.

Transmission of infectious diseases: The influx of workers to the community may cause impacts on public health, especially an increase in the prevalence of diseases.

Improper sanitation facilities and disposal of waste from the construction labor camp can cause vector-borne diseases and other infectious diseases.

The greatest incidence is of food and water-borne diseases, arising from contamination by fecal elements, pests, and vectors and due to a lack of sanitation facilities. Furthermore, the construction will produce a certain amount of debris. All such waste if left on site would have the potential for breeding vectors and pests, in turn, causing vector-borne diseases. There is also the possibility of an increase in sexually transmitted diseases such as HIV/AIDS as a result of the expected influx of workers into the area. The impact will be significant if proper management is not taken.

Traffic movement on site approach road: The construction activities are expected to increase traffic load on the site approach road which may create public safety issues for local residents and school children of nearby primary schools. Potential impacts include pedestrian safety issues and safety aspects of slow-moving vehicles.

Additional construction vehicles for materials and equipment may create traffic congestion at the adjacent road that might be disturbing for the community, though it is likely to be occasional and Negligible resulting in insignificant impacts from the traffic upon the community.

7.1.7.9.2.3 Mitigation Measures

The possible mitigation measures to address the aforementioned impacts include:

- Dust control measures shall be taken along the site approach road.
- Put the noise barrier/wall in the high noise-generating area.
- Barriers shall be provided to prevent the ingress of persons into the construction site and also to protect public exposure to hazards associated with construction activities.
- Avoiding the formation of stagnant water pools in and around the site.
- Implementation of a vector control program in labor camps and surrounding areas.
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the waste types generated (e.g., enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimize odor nuisance).
- Educating area residents and workers on risks, prevention, and available treatment for vector-borne diseases.
- Domestic waste generated from the construction site shall be disposed of in the designated waste dumping site.
- Prevention of larval and adult mosquito propagation through sanitary improvements and elimination of breeding habitats close to human settlements in the close vicinity of the project site.
- Spread/transmission of communicable diseases from an influx of contractor workforce shall be mitigated.
- Formulation of a Health, Safety, and Security Plan prior to commencing work.

7.1.7.10 Land Environment

Since there is no existing habitation in the project area, there will be no displacement of people. The site is devoid of vegetation, eliminating the need for tree cutting or uprooting. Therefore, no significant impact is anticipated on the land environment of the project site. Additionally, no activities are planned beyond the project premises, ensuring no impact on the land environment outside the site.

7.1.7.11 Living and Livelihood

During the pre-construction and construction phase, there may have been a need to hire local labor, providing a potential opportunity for economic advancement for the local community. This could result in a short-term positive impact on the income-generating group during the construction phase, although it may not significantly alter their long-term livelihoods.

7.1.7.12 Vulnerable People

The proposed project will not have any effect on vulnerable groups or people from the locality. No major impacts are expected during the construction and operation phase, as the assessment was carried out including all the relevant components that can cause any effect to the people from vulnerable groups.

7.1.7.13 Local Conflict of Interest

While conflicts of interest occur in all aspects of public life, local and regional authorities are particularly at risk, by virtue of their proximity and closer contacts with citizens and local entrepreneurs. Greater impact can be achieved using a value-based approach, focusing on the matter of common interest. As per the observation and site visit, we found no common public interest can be formed at this stage. This is because the proposed project lies within the existing project boundary and does not require any land acquisition or relocation of households. Conflicts or the appearance of conflicts of interest occur in situations where an individual has direct or indirect personal interests that may interfere with the public interest. But in that case, there is no such issue that will appear to conflict with the interest of common people from the locality.

7.1.7.14 Misdistribution of Benefit and Damage

As we found the proposed project has no outside involvement for any kind of advantages except the official procedures, and no benefit or damage was assessed. The proposed project will create no benefit scheme for people except a few laborers assessing during the construction phase. Even, it will not cause any damage to the people from any social aspect. Therefore, the project has no chance for misdistribution of benefit and damage either.

7.1.8 Impacts during Operation Phase

7.1.8.1 Air Quality

7.1.8.1.1 Impacts from Dust Emissions

During the operation phase of the project, dust emissions may still occur but at a reduced scale compared to the construction phase. The impacts of dust during the operation phase are generally lower due to the absence of extensive earthworks and construction activities.

7.1.8.1.1.1 Sources

During the operation phase of the Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District project, potential sources of dust emissions may include:

- Movement of vehicles on unpaved surfaces within the project area, particularly in areas without paved roads or parking lots.
- Transport of construction materials or waste if any ongoing construction or renovation work is taking place within the project area.

7.1.8.1.1.2 Receptors

The receptors exposed to dust emissions during the operation phase are likely to be those in close proximity to the specific activities mentioned above. These receptors may include residents, workers, and visitors within the project area. The distance over which dust impact might occur can vary depending on factors such as wind, topography, and the presence of barriers like trees or structures.

7.1.8.1.1.3 Impacts

During the operation phase, the impacts of dust emissions are generally reduced compared to the construction phase. However, some potential impacts may include:

- Higher dust levels can irritate the respiratory system, especially for individuals with pre-existing respiratory conditions. However, the overall health impact is expected to be lower compared to the construction phase.
- Dust deposition on surfaces, such as buildings or vehicles, may cause soiling and aesthetic concerns for residents, workers, or visitors.
- Dust deposition on leaves and surfaces can affect the photosynthesis process of plants and trees within the project area, although the scale of impact is expected to be relatively limited during the operation phase.

Considering the aforementioned issues, the impact on air quality due to dust generation during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.1.1.4 Mitigation Measures

Measures to avoid, minimize, and limit the magnitude of dust impacts caused by the project's operation phase are outlined in the following.

- Ensure that roads, parking lots, and pathways within the project area are properly paved to minimize the generation of dust from vehicle movement.
- If there are areas within the project that remain unpaved, implement measures to control dust, such as applying dust suppressants, using gravel or stabilized surfaces, or employing dust control mats or barriers.
- Promote the use of vegetation, including trees, shrubs, and grass, as they can act as natural barriers to reduce dust dispersion. Implement landscaping practices that minimize exposed soil areas and promote the use of ground cover plants to stabilize the soil.
- Ensure regular maintenance of roads, pathways, and common areas to prevent the buildup of dust. This includes sweeping or wetting down surfaces to control dust accumulation and regular removal of debris or litter.
- Implement dust control measures during routine maintenance activities, such as landscaping or excavation. This can include wetting down soil or using dust control techniques like dust suppressants or enclosures during construction or renovation work.
- Promote awareness among residents, workers, and visitors about the importance of dust control measures. Encourage responsible practices such as proper waste management, covering loads during transportation, and minimizing vehicle speeds to reduce dust generation.
- Establish a monitoring system to regularly assess air quality and dust levels within the project area. Ensure compliance with local regulations and guidelines related to dust emissions and take prompt action to address any identified issues.
- Work closely with contractors, maintenance personnel, and other stakeholders involved in the project to ensure they are aware of and adhere to the dust control measures.

- Foster communication and collaboration to address any concerns or challenges related to dust emissions.

7.1.8.1.2 Impacts due to Increased Vehicular Emissions

During the operation phase of the proposed project, the impacts of increased vehicular emissions are expected to continue, albeit at a reduced scale compared to the construction phase.

7.1.8.1.2.1 Sources

During the operation phase of the project, sources of increased vehicular emissions may include:

- Vehicles involved in the transportation of goods, materials, or waste within the project area, such as delivery trucks or maintenance vehicles.
- Emissions from vehicles owned and operated by residents, including cars, motorcycles, or other modes of transportation used within the project.
- Emissions from service providers, such as delivery services, utility vehicles, or maintenance personnel vehicles, accessing the project area.

7.1.8.1.2.2 Receptors

The concentrations of pollutants from vehicular emissions are typically highest near roads and decrease as the distance from the road increases. The specific distance at which concentrations reduce to background levels can vary based on factors like wind speed, direction, and local conditions. Receptors affected by vehicular emissions during the operation phase mainly include residents, workers, and visitors within the project area.

7.1.8.1.2.3 Impacts

Vehicular emissions during the operation phase primarily contribute to the release of pollutants such as carbon monoxide (CO), fine particulate matter ($PM_{2.5}$ and PM_{10}), and nitrogen dioxide (NO_2). These pollutants are known criteria air pollutants due to their impact on human health, particularly for individuals who are more susceptible to changes in air quality, such as asthmatics, children, and the elderly.

Increased vehicular emissions can result from vehicle movement within the project area, including transportation activities and traffic congestion. The emission impacts include potential health effects on human receptors and the prevalence of these pollutants in the ambient environment. Therefore, the impact on air quality due to dust generation during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.1.2.4 Mitigation Measures

To mitigate the impacts of increased vehicular emissions during the operation phase, the following measures can be implemented:

- An approved Environmental Management and Monitoring Plan should be followed throughout the operation phase.
- Regular maintenance and inspection of vehicles to ensure emissions are within permissible limits.

- Encourage the use of low-emission vehicles, including promoting electric or hybrid vehicles among residents, workers, and service providers within the project area.
- Implement traffic management strategies to minimize congestion and idling of vehicles, thereby reducing emissions.
- Promote sustainable transportation options, such as carpooling, cycling, or using public transportation, to reduce the overall number of vehicles and emissions within the project area.
- Encourage proper vehicle maintenance practices to ensure optimal engine performance and reduced emissions.
- Educate residents, workers, and visitors about responsible driving habits and the importance of reducing vehicle emissions.

7.1.8.2 Water Quality

7.1.8.2.1 Impacts on Surface Water during the Operation Phase

During the operation phase of the proposed project, the potential impacts on surface water quantity and quality may continue, albeit at a reduced scale compared to the construction phase.

7.1.8.2.1.1 Sources

During the operation phase of the proposed project, sources of potential impacts on surface water quantity and quality may include:

- Improper handling and disposal of waste materials, chemicals, or hazardous substances that could enter surface water bodies if not managed correctly.
- Improper maintenance practices, such as inadequate containment and disposal of oils, fuels, or other contaminants from equipment and machinery, could result in their entry into nearby water bodies.

7.1.8.2.1.2 Receptors

The surface water-sensitive receptors during the operation phase mainly include the Tangon River, Bhulli River, Shuk River, Kulic River, and nearby water bodies. These water bodies are within the vicinity of the project and serve critical functions for water supply and support diverse ecosystems. They are highly sensitive due to their ecological importance and the need to protect water quality for various species that rely on these habitats.

7.1.8.2.1.3 Impacts

During the operation phase of the proposed project, potential impacts on surface water quality may arise from various sources. These include stormwater runoff carrying pollutants from the project area, improper waste management practices leading to the release of contaminants, and inadequate maintenance practices resulting in the entry of oils, fuels, or other pollutants into nearby water bodies.

Chemical and waste storage and handling during the operation phase, as well as unplanned events such as fuel spillage or overflow of existing surface runoff infrastructure, can further impact surface water quality.

Considering the aforementioned issues, the impact on surface water quality during the project operation phase is evaluated to be Minor mentioned in Table 7-10.

7.1.8.2.1.4 Mitigation Measures

Mitigation measures to protect surface water quality during the operation phase include the following:

- Follow the approved Environmental Management and Monitoring Plan throughout the operation phase.
- Implement proper waste management measures, including containment, disposal, and recycling of construction and operational waste to prevent their entry into surface water bodies.
- Ensure the proper maintenance and inspection of equipment and machinery to prevent fuel or oil spillage into surface water resources.
- Store and manage hazardous materials appropriately, keeping them away from surface water resources and using bunded areas for their storage.
- Provide spill kits and train personnel in hazardous materials handling and disposal.
- Use oil and grease separators for wastewater generated from cleaning activities.
- Minimize soil exposure and stabilize exposed ground by re-vegetation as soon as possible.
- Control water suppression during operational activities to minimize excess water and sediment disposal into surface water bodies.
- Prohibit the discharge of wastewater from operations directly into surface water bodies and use temporary storage tanks or treatment systems prior to discharge, if necessary.
- Strictly prohibit the disposal of construction and operational wastes into rivers, khal, or ponds.
- Minimize soil exposure time during operational activities and maintain regular preventive maintenance for vehicles used for transportation.
- Ensure vehicles are used for spoiled transportation.

7.1.8.2.2 Impacts on Ground Water during the Operation Phase

During the operation phase of the proposed project, potential impacts on groundwater resources may continue, although they are expected to be relatively minor compared to the construction phase.

7.1.8.2.2.1 Sources

During the operation phase of the project, potential sources of impacts on groundwater quality may include:

- Accidental spills or leaks of fuels, chemicals, or waste materials may occur during routine operations and maintenance activities.

7.1.8.2.2.2 Impacts

Changes to groundwater quality within the study area may arise from various sources, including chemical and waste storage and handling during the operation phase. Potential impacts on groundwater-dependent vegetation and surface water bodies hydraulically connected to the groundwater may also occur.

To prevent contamination of groundwater in nearby areas, the proposed project is designed to have sanitary facilities for workers, with domestic wastewater generated on-site treated in septic tanks followed by soak pits.

Considering the aforementioned issues, the impact on groundwater quality during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.2.2.3 Mitigation Measures

Mitigation measures to minimize impacts on groundwater quality during the operation phase include the following:

- Implement a regular maintenance program for all equipment and machinery to prevent fuel spillage or leakage during operational activities.
- Ensure proper management of sanitary facilities for workers, including appropriate waste disposal practices.
- Store and manage hazardous materials appropriately, locating temporary storage areas away from groundwater resources. Use bunded areas for the proper labeling and storage of chemicals and fuels. Provide spill kits and train personnel in hazardous materials handling and disposal.
- Use oil and grease separators for wastewater generated from cleaning activities to prevent their entry into groundwater.
- Locate temporary stockpiles of spoils away from excavations to minimize the potential for groundwater contamination.
- Conduct vehicle maintenance and mechanical repairs in dedicated, designed locations that are bound to capture and control spills, preventing infiltration into groundwater resources.

7.1.8.3 Noise

7.1.8.3.1 Impacts of Noise Emission

During the operation phase of the proposed project, noise impacts may arise from various sources.

7.1.8.3.1.1 Source

Noise may be generated during the operation phase of the proposed project from the following sources:

- Movement of vehicles such as maintenance trucks and delivery vehicles within the project area.
- Operational activities of equipment and machinery, including noise emitted from engines or safety alarms.
- Other activities such as maintenance work, waste management, and use of generators.

7.1.8.3.1.2 Receptors

Potential noise-sensitive receptors during the operation phase may include:

- Residents and workers in the project area.
- Residential areas located in close proximity to the project site.
- Nearby schools and mosques are located between 100 m to 380 m from the project site.
- Fauna within and around the project site.

7.1.8.3.1.3 Impacts

During the operation phase, noise may be generated by activities such as equipment operation, maintenance, and waste management. Operational conversations and traffic movement within the project area may also contribute to noise pollution. The impact of noise generation may affect the workers of adjacent establishments, surrounding people engaged in various activities, and the nearby residential settlements located within 2 km from the site area. Noise from generators, pumps, and other equipment can contribute to noise pollution, but their impact is expected to be temporary and localized.

Considering the aforementioned issues, the impact on noise level during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.3.1.4 Mitigation Measures

To mitigate noise impacts during the operation phase, the following measures should be implemented:

- Limit the operation times of noisy equipment and machinery whenever possible.
- Conduct regular maintenance of equipment to ensure proper functioning, including lubrication, tightening of loose parts, and replacement of worn-out components.
- Restrict public access within 10 m of construction work areas to minimize exposure to noise.
- Where feasible, select quieter models of construction equipment.
- Turn off equipment and vehicle engines when not in use.
- Provide noise reduction training to workers, emphasizing behaviors such as reducing the drop height of materials. Include reminders during daily toolbox briefings, particularly for activities such as piling.
- Install acoustic barriers along the boundary between the construction work area and existing plant areas, instead of hoardings. If possible, the acoustic barriers should be tall enough to block the visibility of construction equipment from receptors within the site.
- Equip all noisy equipment and machinery with acoustic covers to reduce noise emissions.
- Ensure regular servicing of equipment, machinery, and mufflers, promptly repairing or replacing any damaged components.
- Reduce the amount of equipment operating simultaneously, whenever practicable.
- Plan the routes for mobile noise sources, such as cranes and earth-moving equipment, to minimize disturbance to receptors.
- Prohibit nighttime vehicle movement through the access road.
- Conduct daily inspections and noise monitoring in compliance with the Noise Pollution (Control) Rules, 2006, to ensure adherence to noise limits.

7.1.8.4 Soil

7.1.8.4.1 Impacts on Soil Quality

During the operation phase of the project, the following information regarding soil quality impacts, sources, impacts, and mitigation measures can be summarized:

7.1.8.4.1.1 Sources

The operation phase of the project is not expected to significantly affect the soil quality at the site. However, potential sources of impact on soil quality during this phase may include spillage of fuel, lubricants, and paints from the storage site.

7.1.8.4.1.2 Impacts

The soil at the project site is sandy clay, with higher permeability that allows contamination to reach greater depths. Stormwater runoff from contaminated areas can potentially pollute downstream soil and water quality. Furthermore, the import of soil for filling and leveling purposes may alter the characteristics of the native soil. Spillages during soil transportation and runoff during filling and compaction activities could impact the native soil. Contamination from spillage and leakage can have long-term effects on soil quality. Improper waste handling can also have direct and long-term negative impacts on soil quality.

Considering the aforementioned issues, the impact on soil quality during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.4.1.3 Mitigation Measures

To minimize the impact on soil quality during the operation phase, the following mitigation measures will be implemented:

- Establish a regular maintenance program for all equipment and machinery to prevent fuel spillage or leakage.
- Manage spills of soil contaminants using standard engineering practices.
- Surround storage areas for oil, fuel, and chemicals with bunds or containment devices to prevent contamination of soils, sediment, water, or groundwater in case of spills.
- Utilize spill or drip trays to contain spills and leaks and employ spill control kits to clean up small spills and leaks.
- Install oil/water separators to treat surface runoff from bunded areas before discharge into the stormwater system.
- Implement effective waste management measures to contain and dispose of waste properly, prohibiting waste discharge on the ground, and practicing recycling whenever feasible.
- Dispose of debris and waste in designated areas according to the plan to prevent soil degradation. Combustible materials may be used in kilns if appropriate.
- Locate temporary stockpiles of spoils as far as possible from excavations.
- Allow enough space between waste containers for inspection to identify any leaks or spills.
- Ensure storage areas have impermeable floors and containment measures.
- Dispose of hazardous waste through licensed authorities.

- Site fuel tanks and chemical storage areas on sealed surfaces and provide locks to prevent unauthorized entry.
- Develop guidelines and procedures for immediate clean-up actions following any spillage of oil, fuel, or chemicals.
- Establish a site-specific emergency response plan for soil clean-up and decontamination.
- Carry out vehicle maintenance and mechanical repairs in dedicated and designed locations, bound to capture and control oil, grease, and other spills to prevent soil contamination.
- Implement a training program to familiarize staff and workers with emergency procedures and practices related to contamination events.
- Train labor on proper waste disposal in designated areas and the use of sanitation facilities.
- Implement a construction materials inventory management system to minimize oversupply of construction materials, which could lead to the disposal of surplus materials at the end of the construction period.

7.1.8.5 Drainage

7.1.8.5.1 Impact on Drainage System

7.1.8.5.1.1 Source

During the operation phase of a project, several sources of impact on the drainage system come into play. Stormwater runoff, stemming from rain and runoff on impermeable surfaces within the project, can transport pollutants and debris into the drainage system. Effective mitigation strategies are essential to counter these impacts and safeguard the drainage system's functionality and the overall environmental health of the area.

7.1.8.5.1.2 Receptors

During the project's operation phase, the stormwater drainage system is at risk from increased runoff and potential pollutants. Nearby water bodies like rivers and wetlands receive runoff, impacting water quality, while local ecosystems suffer from pollutants in urban runoff, affecting aquatic and terrestrial life. Mitigation measures are vital for maintaining the drainage system's integrity and ecological balance.

7.1.8.5.1.3 Impacts:

During the operation phase of the project, water quality degradation becomes a concern due to pollutants originating from stormwater runoff. These contaminants infiltrate the drainage system, ultimately affecting the water quality of the receiving bodies. Additionally, the excessive influx of stormwater runoff has the potential to trigger erosion and sedimentation within drainage channels, resulting in decreased capacity and the possibility of blockages. The consequences extend to habitat disruption, with pollutants introduced into natural water bodies harming aquatic life and triggering disturbances in local ecosystems. Considering the aforementioned issues, the impact on drainage system during the project operation phase is evaluated to be Minor mentioned in Table 7-10.

7.1.8.5.1.4 Mitigation Measures

To reduce impacts on the drainage system during the operation phase, the following mitigation measures should be implemented:

- Integrate green infrastructure like rain gardens, permeable pavement, and vegetated swales to capture and treat stormwater runoff.
- Educate residents about proper waste disposal, car washing practices, and the importance of reducing pollution entering the drainage system.
- Schedule routine maintenance of drainage infrastructure to ensure proper functioning and prevent blockages.
- Implement a monitoring program to assess the quality of stormwater runoff and identify potential issues.
- Adhere to local regulations and permits related to stormwater management and pollution prevention.
- Encourage native vegetation and landscape practices that reduce stormwater runoff and promote water infiltration.
- Involve residents in drainage system maintenance and pollution prevention efforts.
- Develop plans for managing stormwater during extreme weather events to prevent flooding and pollution incidents.

7.1.8.6 Biodiversity

7.1.8.6.1 Impacts on Terrestrial and Aquatic Flora

7.1.8.6.1.1 Sources

During the operation phase of a proposed project, the impacts on terrestrial and aquatic flora can arise from sources such as landscaping and maintenance activities, improper stormwater management, chemical usage, water management practices, tree removal or pruning, and the introduction of invasive species.

7.1.8.6.1.2 Receptors

Terrestrial and aquatic flora adjacent to the operational areas and approach roads may be subject to damage from the movement of vehicles and negligence of personnel. The surrounding vegetation, both terrestrial and aquatic, may also be exposed to dust emissions. However, the dispersion and deposition of dust particles, as well as impacts on floral species, tend to decrease with distance, considering factors such as wind speed, topography, and the presence of physical barriers.

7.1.8.6.1.3 Impacts

Damage to flora, such as tearing off leaves, and breaking twigs, and branches, may occur due to vehicle movement and negligence of personnel. Deposition of dust particles on plant surfaces can hinder photosynthesis, respiration, and other physiological processes, potentially resulting in decreased plant growth, susceptibility to diseases, and overall health impacts on vegetation near the operational areas and approach roads.

Considering the aforementioned issues, the impact on terrestrial and aquatic flora during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.6.1.4 Mitigation Measures

To reduce impacts on terrestrial and aquatic flora during the operation phase, the following mitigation measures should be implemented:

- Follow measures to mitigate dust generation and dispersion.
- Regularly spray water in construction areas and approach roads to minimize dust.
- Raise awareness among workers about the importance of natural resources and instruct them not to unnecessarily clear any area or cause damage to adjacent vegetation, including branches, twigs, flowers, etc.
- Encourage the use of LPG/Kerosene for cooking purposes to reduce impacts on vegetation in the vicinity of the project site.
- Conduct plant health monitoring activities.
- Implement plantation activities wherever feasible, utilizing available space within the plant premises and along access roads.

7.1.8.6.2 Impacts on Terrestrial Fauna

7.1.8.6.2.1 Sources

- Regular maintenance and landscaping activities within the complex can disrupt natural habitats for terrestrial fauna.
- Excessive use of artificial lighting during nighttime within the complex may disturb the behavior and movement of nocturnal animals.
- Operational activities, such as construction repairs or facility maintenance, may generate noise that could affect wildlife residing in and around the area.
- Increased vehicle movement within the complex can pose risks to small mammals and reptiles through accidental collisions.

7.1.8.6.2.2 Impacts

- Ongoing landscaping and maintenance activities may lead to habitat degradation and displacement of terrestrial fauna.
- Artificial lighting and noise can alter the natural behavior and activities of wildlife, particularly nocturnal species.
- Vehicle movement within the complex could result in accidental harm or mortality to small mammals and reptiles crossing roads or paths.

Considering the aforementioned issues, the impact on terrestrial fauna during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.6.2.3 Mitigation Measures

To minimize the impacts on terrestrial fauna during the operation phase, the following mitigation measures should be implemented:

- Implement practices that prioritize the preservation of natural habitats and green spaces within the complex to support local wildlife.

- Use directed and shielded lighting to reduce the disruption of nocturnal animals and maintain dark areas for their movement.
- Implement measures to control noise levels during operational activities and minimize disturbances to wildlife.
- Educate residents and staff about the importance of coexisting with local wildlife and avoiding harm to animals.
- Enforce speed limits within the complex to prevent collisions with wildlife and enhance road safety.
- Regularly monitor wildlife interactions within the complex and report any issues to appropriate authorities for timely action.

7.1.8.6.3 Impacts on Fisheries and Aquatic Ecosystem

7.1.8.6.3.1 Sources

During the operation phase of the project, potential impacts on fisheries and aquatic ecosystems can arise from sources such as wastewater discharge, chemical contamination, habitat alteration, sedimentation, noise and vibrations, invasive species, and overfishing. These impacts can result in water pollution, habitat degradation, disruption of fish populations, and ecological imbalance. It is essential to consider site-specific factors and follow appropriate environmental regulations and mitigation measures to minimize these impacts and protect fisheries and aquatic ecosystems.

7.1.8.6.3.2 Receptors

During the operation phase of the project, the Tangon River, Bhulli River, Shuk River, Kulic River within water catchment areas continue to serve as major habitats for the aquatic ecosystem. Fish species, aquatic invertebrates, reptiles, amphibians, and aquatic plant species remain susceptible to potential impacts on surface water quality.

7.1.8.6.3.3 Impacts

The primary impact during the operation phase is the alteration of the chemical composition of surface water, leading to the degradation or destruction of aquatic invertebrates. This can trigger the process of eutrophication, further degrading the aquatic ecosystem. Fisheries will also be impacted due to habitat degradation and potential habitat loss, affecting their growth, production, and overall sustainability. Changes in water quality can disrupt physiological processes and alter the behavioral characteristics of aquatic life.

Considering the aforementioned issues, the impact on fisheries and aquatic ecosystems during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.6.3.4 Mitigation Measures

To mitigate the impacts on fisheries and aquatic ecosystems during the operation phase, the following measures should be implemented:

- Adhere to Environmental Management Plans (EMP) for effluent discharge, wastewater discharge, construction material disposal, and vessel movement.
- Develop and implement an oil spillage response plan to address any accidental spills.

- Conduct regular monitoring of the health of the aquatic ecosystem and fish production.
- Ensure workers are educated about the importance of natural resources and instructed not to harm or cause death to aquatic life.

7.1.8.7 Waste

7.1.8.7.1 Impact due to Solid Waste Generation

7.1.8.7.1.1 Source

Varieties of solid waste are generated from the daily operation of the project. This includes-

- Electrical and mechanical wastes
- Oil containers and Chemical containers/bags

Generation of Solid Waste

The generation of solid waste is a result of natural, human, and animal activities. Knowledge of the generation of solid waste is important in the planning, designing, and operation of solid waste management systems. Generation has two aspects: One is the quality of solid waste and the other is the quantity of solid waste. Quality includes the sources, types, and typical composition of solid waste along with its properties whereas the quantity represents the generation rates and total quantities and volumes of waste generated.

7.1.8.7.1.2 Impacts

- Poorly managed electrical, mechanical, and chemical wastes can pollute soil, water, and air.

Considering the aforementioned issues, the impact of waste during the project operation phase is evaluated to be Minor mentioned in Table 7-10.

7.1.8.7.1.3 Mitigation Measures

To reduce the impacts of waste during the operation phase, the following mitigation measures should be implemented:

- Develop a comprehensive waste management plan that outlines procedures for waste segregation, collection, transportation, and disposal. Educate residents and staff on proper waste management practices.
- Partner with local waste management authorities to ensure compliance with waste disposal regulations. Explore opportunities for community recycling programs and waste collection initiatives.
- Establish a monitoring and evaluation system to track waste generation and measure the effectiveness of implemented measures. Use the data to identify areas for improvement and adjust waste management strategies accordingly.

7.1.8.8 Transportation Infrastructure

7.1.8.8.1 Impacts due to Increases Traffic

7.1.8.8.1.1 Source

There will be movement of different kinds of vehicles during the operation period for the proposed project.

7.1.8.8.1.2 Impacts

- Higher traffic volumes can lead to increased congestion and delays on surrounding roads. This can inconvenience residents and commuters in the area.
- Increased traffic can result in higher levels of noise and air pollution, affecting the quality of life for residents and potentially impacting the environment.
- More vehicles on the road can increase the risk of accidents and safety concerns for pedestrians, cyclists, and drivers.
- With increased traffic, there may be higher demand for parking spaces within and around the project.
- Increased traffic can impact the sense of community within the project, potentially affecting the quality of life for residents.

Considering the aforementioned issues, the impact due to increased traffic during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.8.1.3 Mitigation Measures

To reduce the impacts of increased traffic during the operation phase, the following mitigation measures should be implemented:

- Conduct a traffic impact assessment to identify potential congestion hotspots.
- Coordinate with local transportation authorities to improve road infrastructure, such as widening roads, adding turning lanes, or optimizing traffic signal timings.
- Encourage alternative transportation modes, such as walking, cycling, and public transit, by providing well-designed pedestrian and cycling paths and convenient access to public transportation.
- Implement noise barriers and landscaping features to reduce noise levels.
- Promote eco-friendly transportation options, such as electric vehicle charging stations and designated carpooling areas, to reduce emissions.
- Encourage residents to use sustainable transportation methods and offer incentives for carpooling or using public transit.
- Implement traffic calming measures, such as speed bumps, traffic islands, or raised pedestrian crossings, to enhance safety.
- Install adequate signage, road markings, and proper lighting to improve visibility and guide drivers.
- Educate residents and enforce traffic rules and regulations to ensure responsible driving behavior.

- Designate sufficient parking spaces within the project to accommodate residents and visitors.
- Promote car-sharing programs or encourage residents to use off-site parking facilities to reduce on-site parking demand.
- Consider incorporating bicycle parking areas to encourage cycling as an alternative mode of transportation.
- Foster a community-centered approach by creating spaces for social interaction and pedestrian-friendly environments.
- Organize community events, such as car-free days or street festivals, to encourage interaction among residents and promote alternative transportation modes.
- Establish a residents' association to address traffic-related concerns and collaborate with local authorities on traffic management initiatives.

7.1.8.9 Land Environment

7.1.8.9.1 Impacts on Land Environment

7.1.8.9.1.1 Source

Potential impact on soil quality could arise due to the:

- Accidental discharge of waste and untreated effluent into nearby agricultural land.

7.1.8.9.1.2 Impacts

The contamination of soil can happen only due to accidental spillage of chemicals and oils from storage areas. The surface runoff from the spillage site to nearby land may lead to contamination of soil. In addition, improper handling and storage may cause spillage or leachate generation, which in turn can contaminate the land. Considering the aforementioned issues, the impact on the land environment during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.9.1.3 Mitigation Measures

Measures to avoid, minimize, and limit the magnitude of land environment impacts caused by the project's operation phase are outlined in the following.

- Regularly spray water on the open surface of the project site.
- Dispose of debris and waste in a designated area and as per plan to prevent degradation of soil and to prevent flow and infiltration into water resources.
- Ensure proper spill control and management at the site.
- Good housekeeping to prevent spillage and runoff from the site.
- Greenbelt shall be developed in an additional area in and outside the project area.

7.1.8.10 Health and Safety

7.1.8.10.1 Occupational Health and Safety

7.1.8.10.1.1 Source

During the operation phase, occupational health and safety considerations primarily arise from the use and maintenance of operational machinery and equipment, as well as the handling of any associated materials or substances.

7.1.8.10.1.2 Impact on Occupational Health and Safety

Throughout the operation phase, workers may be exposed to potential occupational health and safety risks. These risks can include hazards such as noise generated from machinery, emissions from operational equipment, and exposure to dust or other airborne pollutants. Prolonged exposure to high noise levels and air pollution may lead to various health issues, including hearing loss, respiratory problems, and other related illnesses. However, given that the operation phase involves more continuous and predictable activities, appropriate measures can be implemented to mitigate these impacts effectively. Considering the aforementioned issues, the impact on occupational health and safety during the project operation phase is evaluated to be Negligible mentioned in Table 7-10.

7.1.8.10.1.3 Mitigation Measures

To address occupational health and safety concerns during the operation phase, the following mitigation measures should be implemented:

- Ensure the provision of healthy living conditions for the workforce, including suitable accommodation with proper amenities.
- Establish facilities for drinking water, sanitation, and cooking to promote good hygiene practices.
- Provide appropriate personal protective equipment (PPE) for workers to ensure their safety during operational tasks.
- Adhere to proper work permit procedures to regulate and control activities on-site.
- Minimize the exposure of workers to high noise sources through noise control measures, such as the use of noise barriers or scheduling noisy operations during off-peak hours.
- Conduct regular on-the-job training to enhance workers' awareness of occupational health and safety practices and procedures.
- Implement health surveillance programs to monitor the well-being of the workforce, including periodic health check-ups and monitoring of potential occupational health risks.
- Develop and implement an "Occupational Health and Safety Management Plan" to ensure the continuous monitoring and improvement of occupational health and safety practices throughout the operation phase.

7.1.8.10.2 Community Health and Safety

7.1.8.10.2.1 Source

Potential sources of impacts on community health and safety during the operation phase include:

- Environmental changes resulting from operational activities.

- Increased risks of diseases associated with the presence of operational personnel.
- Heightened traffic movement and associated safety concerns.

7.1.8.10.2.2 Impact on Community Health and Safety

Environmental changes: Operational activities may lead to alterations in environmental conditions, including air quality, surface water quality, groundwater quality, and soil quality. Noise levels may also increase due to the operation of machinery and equipment. These changes have the potential to cause health impacts such as eye irritation and disturbances in daily activities due to noise and dust.

Residents residing near access roads may experience noise and dust generated by vehicular movement during the operation phase. However, it should be noted that the access road is paved, which minimizes dust generation.

Transmission of diseases: The presence of operational personnel within the community may increase the risk of certain diseases.

Improper sanitation facilities and waste disposal from the operational site can contribute to the spread of vector-borne diseases and other infectious diseases.

Food and waterborne diseases are of particular concern, resulting from fecal contamination, pests, vectors, and inadequate sanitation facilities. Additionally, the accumulation of waste on-site can create breeding grounds for vectors and pests, leading to an increased risk of vector-borne diseases. The influx of workers into the area may also raise the possibility of an increase in sexually transmitted diseases, such as HIV/AIDS. Proper management is essential to mitigate these impacts effectively.

Traffic movement: Operational activities are likely to cause an increase in traffic on the site approach road, which can raise safety concerns for local residents and school children attending nearby primary schools. Potential impacts include pedestrian safety issues and safety aspects related to slow-moving vehicles.

The presence of additional construction vehicles for material and equipment transportation may result in occasional traffic congestion, which could be disruptive to the community. However, the frequency and severity of these impacts are expected to be low and insignificant.

Considering the aforementioned issues, the impact on community health due to environmental change during the project operation phase is evaluated to be low and the impact on health due to the increasing prevalence of diseases during the project operation phase is evaluated to Minor mentioned in Table 7-10.

7.1.8.10.2.3 Mitigation Measures

To address the impacts mentioned above and ensure community health and safety during the operation phase, the following mitigation measures should be implemented:

- Implement dust control measures along the site approach road.
- Install noise barriers or walls in areas with high noise levels.

- Provide barriers to restrict access to the operational site, ensuring public safety and preventing exposure to construction hazards.
- Prevent the formation of stagnant water pools on-site and in the surrounding areas.
- Establish a vector control program in the operational site and labor camps to mitigate the risk of vector-borne diseases.
- Segregate hazardous and non-hazardous waste and provide appropriate containers for different waste types to minimize odor nuisance and prevent attracting pests and vermin.
- Educate area residents and operational personnel about the risks, prevention, and available treatments for vector-borne diseases.
- Ensure proper disposal of domestic waste generated from the operational site in designated waste dumping sites.
- Implement sanitary improvements and eliminate breeding habitats near human settlements to prevent larval and adult mosquito propagation.
- Implement measures to mitigate the spread/transmission of communicable diseases resulting from the presence of operational personnel.
- Develop and implement a comprehensive Health, Safety, and Security Plan before commencing.

7.1.8.11 Positive Impacts and Benefits of the Proposed Project

There are Four Water Control Structure and Two Irrigation Channel in the proposed project. The benefits and positive impact of the project are given bellow.

7.1.8.11.1 Benefits of Combined Water Control Structure at Nischintapur on the Tangon River

- If the combined water control structure is constructed, it will be possible to irrigate 2000 hectares of land.
- The drinking water crisis of thousands of families adjacent to the project will be solved by raising the level of ground water.
- If the combined water control infrastructure is constructed, there will always be 2.5 meters to 3.0 meters of water throughout the year, which will create a fish sanctuary and enhance the beauty of the city.
- As a result of the construction of the combined water control structure, the project area will be developed as a tourist area.
- Due to the construction of the structure, it will be possible to hold rainwater in the 14.00 km of Tangon River, 10.00 km of Senua River, 11.00 km of Charaban Canal, 9.00 km of Chhoto Senua River and 6 km of other sub-canals a total of 50.00 km.
- The construction of the structure will improve the communication system.
- As a result of the construction of the structure, it will be possible to provide irrigation using surface water, which will lead to the savings of fuel.

7.1.8.11.2 Benefits of Combined Water Control structure at Bangroad on the Bhulli River

- If the combined water control structure is constructed, it will be possible to irrigate 1300 hectares of land.
- The drinking water crisis of thousands of families adjacent to the project will be solved by raising the level of ground water.
- If the combined water control infrastructure is constructed, there will always be 2.5 meters to 3.0 meters of water throughout the year, which will create a fish sanctuary and enhance the beauty of the city.
- As a result of the construction of the combined water control structure, the project area will be developed as a tourist area.
- The construction of the structure will improve the communication system.
- As a result of the construction of the structure, it will be possible to provide irrigation using surface water, which will lead to the savings of fuel.

7.1.8.11.3 Benefits of Combined Water Control structure at Beltola on the Shuk River

- If the combined water control structure is constructed, it will be possible to irrigate 1200 hectares of land.
- The drinking water crisis of thousands of families adjacent to the project will be solved by raising the level of ground water.
- If the combined water control infrastructure is constructed, there will always be 2.5 meters to 3.0 meters of water throughout the year, which will create a fish sanctuary and enhance the beauty of the city.
- As a result of the construction of the combined water control structure, the project area will be developed as a tourist area.
- The construction of the structure will improve the communication system.
- As a result of the construction of the structure, it will be possible to provide irrigation using surface water, which will lead to the savings of fuel.

7.1.8.11.4 Benefits of Combined Water Control structure at Rautnagar on the Kulic River

- If the combined water control structure is constructed, it will be possible to irrigate 1500 hectares of land.
- The drinking water crisis of thousands of families adjacent to the project will be solved by raising the level of ground water.
- If the combined water control infrastructure is constructed, there will always be 2.5 meters to 3.0 meters of water throughout the year, which will create a fish sanctuary and enhance the beauty of the city.
- As a result of the construction of the combined water control structure, the project area will be developed as a tourist area.
- The construction of the structure will improve the communication system.

- As a result of the construction of the structure, it will be possible to provide irrigation using surface water, which will lead to the savings of fuel.

7.1.8.11.5 Benefits of Extension of Left and Right Bhulli Irrigation canal

- If the irrigation canal is constructed then it will be possible to increase irrigation coverage.
- The construction of the Irrigation canal will improve the communication system.
- As a result of the construction of the irrigation canal, it will be possible to provide irrigation using surface water, which will lead to the savings of fuel as well as reduce the use of underground water.

7.2 Impact Evaluation

Impact evaluation due to the proposed project during the construction and operation phases has been shown in Table 7-9 and Table 7-10, respectively.

Table 7-9: Impact Significance During the Pre-construction and Construction Phase

Issues/ Components	Impacts	Scenario	Impact Nature	Geographical Extent	Duration	Scale	Probability	Significance
Air Quality	Dust generation and exhaust emissions	Without Mitigation	Direct	Local	Short-term	Medium	High	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
	Increased Vehicular Emissions	Without Mitigation	Direct	Local	Short-term	Medium	Medium	Negligible
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Water Resources	Surface water quality	Without Mitigation	Direct	Local	Short-term	Medium	High	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
	Groundwater quality	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Ambient Noise	Noise from construction activity and vehicle movement	Without Mitigation	Direct	Local	Short-term	Medium	High	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Soil Quality	Soil contamination from waste and spillage	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Drainage	Impact on Drainage System	Without Mitigation	Direct	Local	Short-term	Medium	Medium	Negligible
		With Mitigation	Direct	Project Site	Medium-term	Low	Low	Negligible
Biodiversity	Terrestrial and aquatic flora	Without Mitigation	Direct	Local	Short-term	Low	Medium	Negligible
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
	Terrestrial fauna	Without Mitigation	Direct	Local	Short-term	Medium	High	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
	Fisheries and aquatic	Without Mitigation	Direct	Local	Short-term	Medium	Low	Negligible

Issues/ Components	Impacts	Scenario	Impact Nature	Geographical Extent	Duration	Scale	Probability	Significance
	ecosystem	With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Impacts Due to Waste Generation	Soil and water pollution	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Impacts due to Increase Traffic	Traffic Condition	Without Mitigation	Direct	Local	Short-term	Low	Medium	Negligible
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible
Occupational Health and Safety	Worker's health, sanitation, and safety	Without Mitigation	Direct	Project site	Long-term	High	High	Minor
		With Mitigation	Direct	Project site	Short-term	Low	Low	Negligible
Community Health and Safety	• Changes in environmental quality • Transmission of infectious diseases • Traffic movement on the site approach road	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Short-term	Low	Low	Negligible

Table 7-10: Impact significance during the operation phase

Issues/ Components	Impacts	Scenario	Impact Nature	Geographical Extent	Duration	Scale	Probability	Significance
Air Quality	Dust generation and exhaust emissions	Without Mitigation	Direct	Local	Long-term	Low	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Insignificant	Unlikely	Negligible
	Increased Vehicular Emissions	Without Mitigation	Direct	Local	Long-term	Low	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Insignificant	Unlikely	Negligible

Issues/ Components	Impacts	Scenario	Impact Nature	Geographical Extent	Duration	Scale	Probability	Significance
Water Resources	Surface water quality	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
	Groundwater quality	Without Mitigation	Direct	Local	Long-term	Low	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Insignificant	Low	Negligible
Ambient Noise	Noise from vehicle movement	Without Mitigation	Direct	Local	Long-term	Low	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Insignificant	Unlikely	Negligible
Soil Quality	Soil contamination from waste and spillage	Without Mitigation	Direct	Local	Long-term	Medium	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Unlikely	Negligible
Drainage	Impact on Drainage System	Without Mitigation	Direct	Local	Medium-term	Medium	High	Minor
		With Mitigation	Direct	Local	Medium-term	Low	Low	Negligible
Biodiversity	Terrestrial and aquatic flora	Without Mitigation	Direct	Local	Long-term	Medium	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
	Terrestrial fauna	Without Mitigation	Direct	Local	Long-term	Medium	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
	Fisheries and aquatic ecosystem	Without Mitigation	Direct	Local	Long-term	Medium	Low	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
Impacts Due to Waste Generation	Soil and water pollution	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
Impacts Due to Increases in Traffic	Traffic Congestion	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible

Issues/ Components	Impacts	Scenario	Impact Nature	Geographical Extent	Duration	Scale	Probability	Significance
Impact on Land Environment	Soil pollution by waste and spillage of chemical (Oil)	Without Mitigation	Direct	Local	Long-term	Low	Medium	Minor
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
Occupational Health and Safety	Worker's health, sanitation, and safety	Without Mitigation	Direct	Project site	Long-term	Insignificant	High	Minor
		With Mitigation	Direct	Project site	Long-term	Insignificant	Low	Negligible
Community Health and Safety	Impact on community health due to environmental change	Without Mitigation	Direct	Local	Long-term	Low	Medium	Negligible
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible
	Impact on health due to increasing prevalence of diseases	Without Mitigation	Direct	Local	Long-term	Medium	Medium	Minor
		With Mitigation	Direct	Local	Long-term	Low	Low	Negligible

Chapter 8

Environmental and Social Management Plan

8 Environmental and Social Management Plan

8.1 Introduction

The main purpose of the Environmental Management Plan (EMP) is to identify project-specific actions that will be undertaken by the project authority for mitigation of the specific impacts identified in the proposed project. These actions will be incorporated into the project management system and integrated into the implementation at various stages of project development. The EMP describes both generic good practice measures and site-specific measures, the implementation of which is aimed at mitigating the potential impact associated with the project activity.

8.2 Objectives of the Environmental Management Plan

The main objective of the EMP is to warrant that the development in an identified particular study area needs to be entangled with judicious utilization of non-renewable resources and to ensure that the stress/load on the ecosystem is within its permissible assimilative capacity i.e., its' carrying capacity. In the above context assimilative capacity refers to the maximum amount of pollution load that can be discharged into the environment without affecting the designated use of various environmental attributes and is governed by dilution, dispersion, and removal due to physicochemical and biological processes. An effective EMP ensures that these environmental requirements and objectives are satisfied during all phases of the project. The long-term objectives of the EMP for all the environmental attributes are as follows:

- To comply with all the regulations/applicable laws stipulated by the DOE;
- To create good working conditions for employees;
- To encourage and achieve the highest performance and response from individual employees and contractors;
- To plan out the complete strategy to take care of stakeholder engagement;
- Budgeting and allocation of funds for environmental management;
- Continuous development and search for innovative technologies for a cleaner and better future environment; and
- To contribute significantly to sustainable development.
- To provide a system for incorporating the Project EIA outcomes into the construction process;
- To establish relevant systems and processes which will support compliance with applicable legislation as well as BWDB’s own internal standards;
- To detail construction monitoring, reporting and auditing requirements;
- To identify environmentally sensitive areas to assist the construction team in avoiding and/or reducing potential impacts;
- To incorporate the environmental mitigation measures into a comprehensive framework to facilitate the application of appropriate environmental management throughout the Project;
- To provide a tool to assist in tracking compliance with environmental obligations; and
- To clarify areas of responsibility during Project activities

8.3 Environmental Management Plan During the Pre-Construction and Construction Phase

8.3.1 Construction Site Management Plan

The construction yard and the site should be managed in such a way that would cause minimum degradation or damage to the surrounding environment. Adequate numbers of bins, sanitary toilets, water supply systems, run-on and run-off drains, fire safety, and fighting system, etc. should be available on the site. However, good housekeeping is necessary for preventing environmental damage. All the construction materials and stockpiles should be maintained within the project area and provided with rain and wind protection. An Environment Manager should be employed with the responsibility of monitoring the activities that cause any environmental effects and ensuring enforcement of EMP during construction activities.

8.3.2 Air Quality Management Plan

Construction activities generate a large volume of particulate matter and sometimes a significant volume of greenhouse gases. However, with these project activities, a large amount of particulate matter might be generated. Hence, an efficient air quality management plan has to be adopted. The mitigation plan includes limiting particulate matter-generating activities, adopting a dust suppression system, limiting vegetation clearance activities, avoiding earthen roads for traffic movement, covering stockpiles, traffic management, etc.

8.3.3 Noise Management Plan

Noise will be emitted from the construction site during site preparation, construction activities, and the movement of vehicles and construction machinery. Noise during the site preparatory phase will primarily be contributed by heavy construction machinery operating on-site and vehicular sources.

Noise to be generated from different mechanical equipment machinery and vehicle used in construction activities shall have to be managed to ensure the Noise Pollution Control Rules, 2006, and defined standards. Adopting the necessary mitigation measures might reduce the generation of noise. The monitoring of noise level in the construction site should be monitored following the monitoring plan.

8.3.4 Water Resources Management Plan

Water required during the construction phase of the proposed project only surface water will be used. Water resources should be conserved and prevented from any pollution and hydrological alteration. The nearby river, khal, and pond should be kept away from any obstruction and waste dumping.

To control the drawdown of groundwater level, surface concreting may be minimized as minimum as possible to allow natural recharge. Construction wastewater management would control the discharge of waste into the river. Proper training might be provided involving the monitoring professionals during construction work.

8.3.5 Construction Waste Management Plan

The construction waste management plan establishes specific measures to ensure proper collection, storage, treatment, and disposal in accordance with the applicable national regulations and guidelines.

The rate of waste generation should be reduced by adopting efficient technics and limiting waste-generating activities. The measures for controlling construction waste may include limiting site clearance activities, well-planned stocking and gathering of construction materials and equipment, fencing around the construction yard, maintaining existing right of way to carry construction materials, adopting proper sanitation system for employees, banning waste burning, and quality housekeeping. A waste dumping place should be provided with efficient waste collection and disposal techniques. No waste should be dumped into the surrounding land or water resources.

Appropriate measures provided with run-on and run-off systems might be constructed by controlling runoff from a construction yard and liquid waste. Initiatives must be taken to reuse and recycle waste materials. Hazardous material including fuel and other combustible materials shall have to be stored with the highest care and safety. Spillage, the accidental release must be controlled by adopting hazardous material handling guidelines.

8.4 Environmental Management Plan During Operation Phase

8.4.1 Air Quality Management Plan

During the operation phase of the project, the air quality management plan will ensure regulatory compliance, monitor pollutants, conduct emission inventories, implement mitigation measures, perform regular maintenance and inspections, engage stakeholders through education and sustainable practices, establish an emergency response plan, and continuously review and improve the plan based on data and feedback.

8.4.2 Noise Management Plan

Exposure to high noise levels to workers for a long duration may lead to certain occupational diseases. To control the high noise level, the following steps shall be adopted.

- The walls and ceilings of the concerned buildings shall be lined with sound-absorbing materials.
- Properly insulated enclosures shall be provided to operators working close to the high noise sources.
- Noise attenuating devices like earplugs and earmuffs shall be provided to the workers exposed to the high noise levels.
- A sufficient greenbelt shall be maintained around the project area.
- Regular monitoring of noise levels shall be carried out and corrective measures in the concerned machinery should be adopted accordingly.
- Improved silencers shall be provided in the machinery generating high noise.
- Provision of a thick green belt to attenuate the noise levels.

8.4.3 Natural Resource Conservation

The project will be operated on the principle of conservation of natural resources. Reduce, reuse and recycling might be adopted in the project.

8.4.3.1 Conservation of Water

Efforts shall be made to minimize water requirements in the process. Due care shall be taken to avoid water losses through leakages. Domestic effluent from project premises will be treated in STP and treated water will be reused for greenbelt, thereby reducing water demand.

- 100% recycling of the treated water from STP shall be practiced to conserve water resources in the area.
- A rainwater harvesting system can be installed to conserve rainwater and replenish groundwater resources of the area for the long-term sustenance of the proposed project.
- Surface rainwater runoff available from paved areas, green areas, and open land shall be used for recharging through injection wells.
- Natural rainfall recharges to open land.

8.4.4 Wastewater Management Plan

During the operation phase of the project, onsite wastewater treatment systems, wastewater reuse and recycling, stormwater management, public education, monitoring and compliance, emergency response preparedness, and continuous improvement to ensure sustainable and responsible management of wastewater.

8.4.5 Solid Waste Management Plan

During the operation phase of the project, the solid waste management plan aims to establish an effective and sustainable system for waste collection, segregation, transportation, and disposal. The plan will include strategies for promoting waste reduction, recycling, and composting, as well as proper disposal methods for non-recyclable and hazardous waste. Continuous monitoring, public education, and collaboration with waste management agencies will be integral to ensuring the success of the solid waste management plan.

8.4.6 Transportation Management Plan

The transportation management plan for the proposed project during the operation phase shall focus on promoting sustainable and efficient transportation practices. The plan shall include measures such as encouraging the use of public transport, promoting walking and cycling infrastructure, implementing carpooling and ridesharing programs, and providing electric vehicle charging infrastructure. Additionally, it will prioritize traffic management, parking solutions, and integration with the existing transportation network to minimize congestion and ensure smooth mobility within the project area.

8.4.7 Occupational Health and Safety

The proposed project activities shall ensure protection against hazardous accidents for workers. Further workers shall use personal protective equipment as appropriate. The provision of proper maintenance of workplace conditions in compliance with local and international laws shall be ensured.

8.4.8 Fire Emergency Response Plan

The fire emergency response plan will outline protocols and procedures to swiftly respond to fire incidents. The plan will include measures such as establishing fire detection and alarm systems, conducting regular fire drills, and training sessions, ensuring proper placement and accessibility of firefighting equipment, establishing evacuation routes and assembly points, coordinating with local fire departments, and implementing communication protocols to ensure the safety and well-being of residents and personnel in the event of a fire emergency.

8.5 Environmental Mitigation Measures

8.5.1 Pre-Construction and Construction Phase

The possible environmental impacts during the Pre-Construction and Construction Phase have been already identified and assessed in Chapter-7 in this EIA report. For mitigating the possible environmental impacts, mitigation measures for the Pre-Construction and Construction Phase are proposed in Table 8-1.

Table 8-1: Environmental Management Plan During the Pre-Construction and Construction Phase

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Air Quality	Dust generation	• Follow the approved Environmental Management and Monitoring Plan throughout the pre-construction and construction activities. • Phase dust-generating activities such as land clearance, earthworks, and building construction to minimize the area of ground exposed and the volume of soil and construction material handled at any one time. • Land grading, improvement, or moving of materials should be undertaken during periods of low winds. • Ensure availability of water for dust suppression at suitable locations, in particular the excavation sites. Use water suppression during excavation and earth handling at exposed areas. • Soil and other materials that shall be stored in specifically designated areas will be properly stored at the site and shall be water-sprayed or covered. • Cover stockpiles with well-maintained tarpaulin when not in use or as soon as practicable, in particular during dry periods. Stockpiles are to be maintained below a maximum height of 2 m. • Maintain the maximum possible distance between stockpiles and receptors.	Appointed contractor	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	**Supervision**
		• To minimize the volume of spoil stockpiled, scheduled removal of spoil or waste material shall be prepared. • Wherever reasonable and practicable, re-vegetate exposed ground as soon as possible to stabilize surfaces and minimize re-entrainment of dust. • During construction, the access road shall be regularly maintained to keep it clean, and free from mud and slurry. • Material transport shall be enclosed with impervious sheeting and wheel washing shall be carried out at the site. • Enforcing speed limits. Speed restrictions on vehicles entering and leaving the site. • Workers undertake proper housekeeping of the site and roadways linked to the construction area, at the end of each day. This is to ensure that roadways, vehicle wheels, and equipment tracks are clear of dust or mud and that appropriate barriers, tarpaulin covers/erosion blankets have been repaired and/or reinstated.		
	Exhaust emissions	• All equipment and machinery used at the construction worksites should be maintained and operated in a manner such that they will not give rise to smoke emissions and will comply with the regulations. • Implement regular checks of vehicles to ensure that emissions are within the prescribed limits.	Appointed contractor	Department of Environment (DOE) Bangladesh Water

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Avoid the use of diesel- or petrol-powered equipment by using electricity or battery-powered equipment where possible and if safety concerns can be overcome. Regularly maintain all diesel-powered equipment. • Vehicles and equipment should not be left idle when not in use to minimize exhaust emissions of NO_2, PM_{10}, and SO_2. • No waste shall be burnt on or around the project site.		Development Board (BWDB)
Noise	Increased ambient noise	• Throughout the construction period, the schedule of the noisiest construction activities (in particular pilling) should be maintained at a specific period to minimize disturbance to the receptors. Operation times of noisy equipment and machinery should be limited, where possible. • Regular maintenance of equipment including lubricating moving parts, tightening loose parts, and replacing worn-out components shall be conducted. • Restrict public access to locations in close proximity i.e., 10 m to the construction work areas. • Source for quieter models of construction equipment, were reasonably practicable. • Equipment and vehicle engines are to be turned off when not in use. • Workers are to be trained in noise reduction behaviors such as reducing the drop height of materials. Daily toolbox briefings	Appointed contractor	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

<table>
<tr><th rowspan="2">Affected Aspect</th><th rowspan="2">Potential Impacts</th><th rowspan="2">Proposed Mitigation/Enhancement Measures</th><th colspan="2">Responsibility</th></tr>
<tr><th>Implementation</th><th>Supervision</th></tr>
<tr><td></td><td></td><td>should include reminders on the need to implement noise reduction behaviors, in particular during pilling activities.
• Instead of hoardings, erect acoustic barriers along the boundary between the construction work area and the existing other project areas. Where practicable, acoustic barriers shall be at a sufficient height to block the visibility of construction equipment from the receptors within the site.
• Acoustic covers for all equipment and machinery that generate excessive noise.
• Ensure that all equipment and machinery and its mufflers are regularly serviced and immediately serviced or replaced if damaged.
• The amount of equipment operating simultaneously shall be reduced as far as practicable.
• Mobile noise sources such as cranes and earth-moving equipment shall be routed in such a way that there is a minimum disturbance to receptors.
• Vehicle movement at night shall be strictly prohibited through the access road.
• Undertake daily inspection and carry out noise monitoring in accordance with the management and monitoring measures to ensure compliance against limits in the Noise Pollution (Control) Rules, 2006.</td><td></td><td></td></tr>
</table>

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Water Resources	Surface water and groundwater contamination	**Surface Water** • Follow the approved Environmental Management and Monitoring Plan throughout the pre-construction and construction activities. • Dust-generating activities such as land clearance, earthworks, and building construction minimize the area of ground exposed and the volume of soil and construction material handled at any one time. • Waste management measures should include provisions to contain and dispose of construction wastes, prohibit waste discharge on the ground or any surface watercourse, and practice recycling as far as practicable. • Combustible material can probably be used in the kiln. • Implement a regular maintenance program for all equipment and machinery to prevent fuel spillage or leakage during construction activities. • Properly store and manage hazardous materials during construction activities. Strategically locate areas for the temporary storage of hazardous materials away from surface water resources (at least 100 m away) and preferably down the topographic gradient of watercourses. Chemicals and fuels must be properly labeled and stored in a bunded area. Storage of hazardous materials on-site should be limited to minimize the impacts of any spillage or mitigation failure.	Appointed contractor	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Spill kits should be provided and all personnel managing hazardous materials should be adequately trained in hazardous materials handling and disposal. Such spill kits should be available where equipment and machinery are temporarily stored and used. • Oil and grease separators shall be used for wastewater generated from cleaning activities. • Locate temporary stockpiles of spoils as far as possible from drainage swales (at least 100 m away) and preferably down the topographic gradient of watercourses. • Cover temporary stockpiles with tarpaulin when not in use. • Wherever reasonable and practicable, re-vegetate exposed ground as soon as possible to stabilize surfaces. • Control water suppression during excavation and earth handling to minimize excess water and sediment disposal into surface water. • Discharge of wastewater from excavation to the surface water bodies shall be strictly prohibited due to ecological sensitivities. The discharge shall either be temporary storage tanks for removal or a temporary treatment system prior to discharge to a discharge point. • Disposal of construction wastes into the river, khal, or ponds shall be strictly prohibited. • Minimize soil exposure time during construction activities. • Inspect and schedule preventive maintenance to all vehicles		

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		used to transport excavated and construction material. • Vehicles used to transport spoil have tarpaulin securely covering the load. • Vehicles should pass through a bunded wheel wash station upon exiting the construction work areas in order to control and manage wastewater and sediment. • Vehicle maintenance and mechanical repairs are to occur in dedicated, designed locations, bounded to capture, and control oil, grease, and other spills to prevent flow into surface water resources. • Adequate sanitary facilities, i.e., toilets provided for the construction workforce. • Workers trained in the use of designated areas/bins for waste disposal and encouraged to use toilets. • Sanitary wastewater shall be treated in STP; and all sewage and liquid effluent treated to meet the standards specified in the ECR, 2023. **Ground Water** • Implement a regular maintenance program for all equipment and machinery to prevent fuel spillage or leakage during construction activities. • Protect groundwater sources during construction by ensuring sanitary facilities for workers are available. Waste from such facilities should be properly managed.		

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Properly store and manage hazardous materials during construction activities. Locate areas for the temporary storage of hazardous materials away from groundwater resources. Chemicals and fuels must be properly labeled and stored in a bunded area. Spill kits should be provided and all personnel managing hazardous materials should be adequately trained in hazardous materials handling and disposal. • Oil and grease separators shall be used for wastewater generated from cleaning activities. • Locate temporary stockpiles of spoils as far as possible from excavations. • Vehicle maintenance and mechanical repairs are to occur in dedicated, designed locations, bunded to capture and control oil, grease, and other spills to prevent infiltration into groundwater resources.		
Soil Quality	Soil contamination Soil erosion	• Implement a regular maintenance program for all equipment and machinery to prevent fuel spillage or leakage during construction activities. • Manage spills of soil contaminants using standard engineering practices. • Storage areas for oil, fuel, and chemicals to be surrounded by bunds or other containment devices to prevent any spilled oil, fuel, or chemicals from contaminating soils, sediment, water, or	Appointed contractor	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		groundwater. • Use of spill or drip trays to contain spills and leaks, and use of spill control kits to clean small spills and leaks. • Installation of oil/water separators to treat surface runoff from bunded areas prior to discharge to the stormwater system. • Waste management measures should include provisions to contain and dispose of construction wastes, prohibit waste discharge on the ground, and practice recycling as far as practicable. • Dispose of debris and waste in a designated area and as per plan to prevent degradation of soil. Combustible material can probably be used in the kiln. • Provide dedicated storage areas for construction materials to minimize the potential for damage or contamination of the materials. • Locate temporary stockpiles of spoils as far as possible from excavations. • Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills. • Ensure storage areas have impermeable floors and containment. • Dispose of hazardous waste by licensed authorities. • Fuel tanks and chemical storage areas are to be sited in sealed		

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		areas and provided with locks to prevent unauthorized entry. • Preparation of guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel, or chemicals. • Development of a site-specific emergency response plan for soil clean-up and decontamination. • Vehicle maintenance and mechanical repairs are to occur in dedicated, designed locations, bounded to capture, and control oil, grease, and other spills to prevent contamination in soil resources. • Implementation of a training program to familiarize staff and workers with emergency procedures and practices related to contamination events. • Training labor for waste disposal in designated areas and use of sanitation facilities. • Implement a construction materials inventory management system to minimize the over-supply of construction materials, which may lead to the disposal of surplus materials at the end of the construction period.		
Terrestrial/Aquatic Flora and Fauna	Habitat disturbance	• Vegetation clearance should be minimal and within the designated areas. • Mitigation measures for dust generation and dispersion should be followed. • Regular water spaying should be done in the construction areas	Appointed contractor	Department of Environment (DOE) Bangladesh

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		and approach roads. • Workers should be aware of the importance of natural resources and should not unnecessarily clear any area or break branches, twigs, flowers, etc. of adjacent vegetation. • The use of LPG/Kerosene for cooking needs to be provided/encouraged in order to reduce the impacts on vegetation from the vicinity of the project site. • Plant health monitoring should be conducted. • Wherever feasible, depending upon the availability of space within the project and/or along the access road, plantation activities shall be performed. • Noise mitigation measures should be followed and machinery with lesser noise production should be used. • Night-time work should be limited and the use of lights at night should not disrupt the movement of nocturnal wildlife. • Disturbance to wildlife should be monitored regularly. • Workers should be aware of the importance of natural resources and should not do any harm or death to wildlife. • A plantation plan should be developed and implemented for greenbelt development with appropriate indigenous species. • Rescue, rehabilitation, and relocation should be done for terrestrial fauna when necessary.		Water Development Board (BWDB)

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• EMP for effluent discharge, wastewater discharge, construction material disposal, and vessel movement should be followed. • A plan for accidental oil spillage should be developed and implemented. • Regular monitoring of aquatic ecosystem health and fish production should be done. • Aware workers of the importance of natural resources and they should not do any harm or cause death to aquatic life.		
Transportation	Disturbance to existing road users through an increase in road traffic	• Vehicles used for construction activities shall move along the already existing roads as far as possible. • Avoiding peak hours for heavy vehicle movement where possible. • Material transport shall be totally enclosed with an impervious sheet before traveling on public roads. • No overloading is done shall be ensured. • Enforcing speed limits. Speed restrictions on vehicles entering and leaving the site. • The engines and exhaust systems of all vehicles and equipment used shall be maintained such that exhaust emissions are low and do not breach statutory limits set for the concerned vehicles or equipment type. • Any increase in the traffic during the construction phase shall	Appointed contractor	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

<table>
<tr><th rowspan="2">Affected Aspect</th><th rowspan="2">Potential Impacts</th><th rowspan="2">Proposed Mitigation/Enhancement Measures</th><th colspan="2">Responsibility</th></tr>
<tr><th>Implementation</th><th>Supervision</th></tr>
<tr><td></td><td></td><td>be short-lived and shall return to normal once the construction activity is complete.
• All vehicles shall be instructed to follow traffic norms strictly.</td><td></td><td></td></tr>
<tr><td rowspan="2">Health and Safety</td><td>Occupational Health and Safety</td><td>• Adequate provision of healthy living conditions shall be ensured in the contractor labor camp.
• Provision of drinking water facilities, sanitation, and cooking facilities.
• Provision of proper PPEs for the contractor workers on site.
• The work permit shall be followed.
• Exposure of workers operating near high noise-generating sources shall be reduced to the extent possible.
• On-the-job training for the workers shall be carried out.
• Health surveillance of the contractor workforce shall be conducted.
• The occupational health and safety of the project workforce shall be assured through the formulation of an "Occupational Health and Safety Management Plan".</td><td>Appointed contractor</td><td>Department of Environment (DOE)

Bangladesh Water Development Board (BWDB)</td></tr>
<tr><td>Community Health and Safety</td><td>• Dust control measures shall be taken along the site approach road.
• Put the noise barrier/wall in the high noise-generating area.
• Barriers shall be provided to prevent the ingress of persons into the construction site and also to protect public exposure to</td><td>Appointed contractor</td><td>Department of Environment (DOE)

Bangladesh</td></tr>
</table>

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		hazards associated with construction activities. • Avoiding the formation of stagnant water pools in and around the site. • Implementation of a vector control program in labor camps and surrounding areas. • Segregate hazardous and non-hazardous waste and provide appropriate containers for the waste types generated (e.g., enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimize odor nuisance). • Educating area residents and workers on risks, prevention, and available treatment for vector-borne diseases. • Domestic waste generated from the construction site shall be disposed of in the designated waste dumping site. • Prevention of larval and adult mosquito propagation through sanitary improvements and elimination of breeding habitats close to human settlements in the close vicinity of the project site. • Spread/transmission of communicable diseases from an influx of contractor workforce shall be mitigated. • Formulation of a Health, Safety, and Security Plan prior to commencing work.		Water Development Board (BWDB)

8.5.2 Operation Phase

The possible environmental impacts during the Operation Phase have been already identified and assessed in Chapter-7 in this EIA report. For mitigating the possible environmental impacts, mitigation measures for the Operation Phase are proposed in Table 8-2**.**

Table 8-2: Environmental Management Plan During the Operation Phase

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Air Quality	Dust generation	• Ensure that roads, parking lots, and pathways within the project area are properly paved to minimize the generation of dust from vehicle movement. • If there are areas within the project that remain unpaved, implement measures to control dust, such as applying dust suppressants, using gravel or stabilized surfaces, or employing dust control mats or barriers. • Promote the use of vegetation, including trees, shrubs, and grass, as they can act as natural barriers to reduce dust dispersion. Implement landscaping practices that minimize exposed soil areas and promote the use of ground cover project area to stabilize the soil. • Ensure regular maintenance of roads, pathways, and common areas to prevent the buildup of dust. This includes sweeping or wetting down surfaces to control dust accumulation and regular removal of debris or litter. • Implement dust control measures during routine maintenance activities, such as landscaping or excavation. This can include wetting down soil or using dust control techniques like dust	A 3rd Party Environmental Organization	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		suppressants or enclosures during construction or renovation work. • Promote awareness among residents, workers, and visitors about the importance of dust control measures. Encourage responsible practices such as proper waste management, covering loads during transportation, and minimizing vehicle speeds to reduce dust generation. • Establish a monitoring system to regularly assess air quality and dust levels within the project area. Ensure compliance with local regulations and guidelines related to dust emissions and take prompt action to address any identified issues. • Work closely with contractors, maintenance personnel, and other stakeholders involved in the project to ensure they are aware of and adhere to the dust control measures. Foster communication and collaboration to address any concerns or challenges related to dust emissions.		
	Exhaust emissions	• An approved Environmental Management and Monitoring Plan should be followed throughout the operation phase. • Regular maintenance and inspection of vehicles to ensure emissions are within permissible limits. • Encourage the use of low-emission vehicles, including promoting electric or hybrid vehicles among residents, workers, and service providers within the project area.	A 3rd Party Environmental Organization	Department of Environment (DOE) Bangladesh Water Development

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Implement traffic management strategies to minimize congestion and idling of vehicles, thereby reducing emissions. • Promote sustainable transportation options, such as carpooling, cycling, or using public transportation, to reduce the overall number of vehicles and emissions within the project area. • Encourage proper vehicle maintenance practices to ensure optimal engine performance and reduced emissions. • Educate residents, workers, and visitors about responsible driving habits and the importance of reducing vehicle emissions.		Board (BWDB)
Noise	Increased ambient noise	• Limit the operation times of noisy equipment and machinery whenever possible. • Limit the vehicle horn within the project area. • Conduct regular maintenance of equipment to ensure proper functioning, including lubrication, tightening of loose parts, and replacement of worn-out components. • Restrict public access within 10 m of construction work areas to minimize exposure to noise. • Where feasible, select quieter models of construction equipment. • Turn off equipment and vehicle engines when not in use.	A 3rd Party Environmental Organization	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Provide noise reduction training to workers, emphasizing behaviors such as reducing the drop height of materials. Include reminders during daily toolbox briefings, particularly for activities such as piling. • Install acoustic barriers along the boundary between the construction work area and existing project areas, instead of hoardings. If possible, the acoustic barriers should be tall enough to block the visibility of construction equipment from receptors within the site. • Equip all noisy equipment and machinery with acoustic covers to reduce noise emissions. • Ensure regular servicing of equipment, machinery, and mufflers, promptly repairing or replacing any damaged components. • Reduce the amount of equipment operating simultaneously, whenever practicable. • Plan the routes for mobile noise sources, such as cranes and earth-moving equipment, to minimize disturbance to receptors. • Prohibit nighttime vehicle movement through the access road. • Conduct daily inspections and noise monitoring in compliance with the Noise Pollution (Control) Rules, 2006, to ensure adherence to noise limits.		

<table>
<tr><th rowspan="2">Affected Aspect</th><th rowspan="2">Potential Impacts</th><th rowspan="2">Proposed Mitigation/Enhancement Measures</th><th colspan="2">Responsibility</th></tr>
<tr><th>Implementation</th><th>Supervision</th></tr>
<tr><td>Water Resources</td><td>Surface water and groundwater contamination</td><td>Surface Water
• Follow the approved Environmental Management and Monitoring Plan throughout the operation phase.
• Implement proper waste management measures, including containment, disposal, and recycling of construction and operational waste to prevent their entry into surface water bodies.
• Ensure the proper maintenance and inspection of equipment and machinery to prevent fuel or oil spillage into surface water resources.
• Store and manage hazardous materials appropriately, keeping them away from surface water resources and using bunded areas for their storage.
• Provide spill kits and train personnel in hazardous materials handling and disposal.
• Use oil and grease separators for wastewater generated from cleaning activities.
• Minimize soil exposure and stabilize exposed ground by re-vegetation as soon as possible.
• Control water suppression during operational activities to minimize excess water and sediment disposal into surface water bodies.
• Prohibit the discharge of wastewater from operations directly</td><td>A 3rd Party Environmental Organization</td><td>Department of Environment (DOE)

Bangladesh Water Development Board (BWDB)</td></tr>
</table>

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		into surface water bodies and use temporary storage tanks or treatment systems prior to discharge, if necessary. • Strictly prohibit the disposal of construction and operational wastes into rivers, khal, or ponds. • Minimize soil exposure time during operational activities and maintain regular preventive maintenance for vehicles used for transportation. • Ensure vehicles are used for spoiled transportation. **Ground Water** • Implement a regular maintenance program for all equipment and machinery to prevent fuel spillage or leakage during operational activities. • Ensure proper management of sanitary facilities for workers, including appropriate waste disposal practices. • Store and manage hazardous materials appropriately, locating temporary storage areas away from groundwater resources. Use bunded areas for the proper labeling and storage of chemicals and fuels. Provide spill kits and train personnel in hazardous materials handling and disposal. • Use oil and grease separators for wastewater generated from cleaning activities to prevent their entry into groundwater. • Locate temporary stockpiles of spoils away from excavations to minimize the potential for groundwater contamination.		

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Conduct vehicle maintenance and mechanical repairs in dedicated, designed locations that are bunded to capture and control spills, preventing infiltration into groundwater resources.		
Soil Quality	Soil contamination	• Establish a regular maintenance program for all equipment and machinery to prevent fuel spillage or leakage. • Manage spills of soil contaminants using standard engineering practices. • Surround storage areas for oil, fuel, and chemicals with bunds or containment devices to prevent contamination of soils, sediment, water, or groundwater in case of spills. • Utilize spill or drip trays to contain spills and leaks and employ spill control kits to clean up small spills and leaks. • Install oil/water separators to treat surface runoff from bunded areas before discharge into the stormwater system. • Implement effective waste management measures to contain and dispose of waste properly, prohibiting waste discharge on the ground, and practicing recycling whenever feasible. • Dispose of debris and waste in designated areas according to the plan to prevent soil degradation. Combustible materials may be used in kilns if appropriate. • Locate temporary stockpiles of spoils as far as possible from excavations.	A 3rd Party Environmental Organization	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Allow enough space between waste containers for inspection to identify any leaks or spills. • Ensure storage areas have impermeable floors and containment measures. • Dispose of hazardous waste through licensed authorities. • Site fuel tanks and chemical storage areas on sealed surfaces and provide locks to prevent unauthorized entry. • Develop guidelines and procedures for immediate clean-up actions following any spillage of oil, fuel, or chemicals. • Establish a site-specific emergency response plan for soil clean-up and decontamination. • Carry out vehicle maintenance and mechanical repairs in dedicated and designed locations, bound to capture and control oil, grease, and other spills to prevent soil contamination. • Implement a training program to familiarize staff and workers with emergency procedures and practices related to contamination events. • Train labor on proper waste disposal in designated areas and the use of sanitation facilities. • Implement a construction materials inventory management system to minimize oversupply of construction materials, which could lead to the disposal of surplus materials at the end		

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		of the construction period.		
Terrestrial Flora and Fauna	Habitat disturbance	• Regularly spray water in construction areas and approach roads to minimize dust. • Raise awareness among workers about the importance of natural resources and instruct them not to unnecessarily clear any area or cause damage to adjacent vegetation, including branches, twigs, flowers, etc. • Encourage the use of LPG/Kerosene for cooking purposes to reduce impacts on vegetation in the vicinity of the project site. • Conduct plant health monitoring activities. • Implement plantation activities wherever feasible, utilizing available space within the project premises and along access roads. • Implement practices that prioritize the preservation of natural habitats and green spaces within the complex to support local wildlife. • Use directed and shielded lighting to reduce the disruption of nocturnal animals and maintain dark areas for their movement. • Implement measures to control noise levels during operational activities and minimize disturbances to wildlife. • Educate residents and staff about the importance of coexisting	A 3rd Party Environmental Organization	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		with local wildlife and avoiding harm to animals. • Enforce speed limits within the complex to prevent collisions with wildlife and enhance road safety. • Regularly monitor wildlife interactions within the complex and report any issues to appropriate authorities for timely action.		
Aquatic Ecosystems	Disturbance to fisheries and ecosystems	• Adhere to Environmental Management Plans (EMP) for effluent discharge, wastewater discharge, construction material disposal, and vessel movement. • Develop and implement an oil spillage response plan to address any accidental spills. • Conduct regular monitoring of the health of the aquatic ecosystem and fish production. • Ensure workers are educated about the importance of natural resources and instructed not to harm or cause death to aquatic life.	A 3rd Party Environmental Organization	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)
Transportation	Disturbance to waterway traffic	• Conduct a traffic impact assessment to identify potential congestion hotspots. • Coordinate with local transportation authorities to improve road infrastructure, such as widening roads, adding turning lanes, or optimizing traffic signal timings. • Encourage alternative transportation modes, such as walking, cycling, and public transit, by providing well-designed		

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		pedestrian and cycling paths and convenient access to public transportation. • Implement noise barriers and landscaping features to reduce noise levels. • Promote eco-friendly transportation options, such as electric vehicle charging stations and designated carpooling areas, to reduce emissions. • Encourage residents to use sustainable transportation methods and offer incentives for carpooling or using public transit. • Implement traffic calming measures, such as speed bumps, traffic islands, or raised pedestrian crossings, to enhance safety. • Install adequate signage, road markings, and proper lighting to improve visibility and guide drivers. • Educate residents and enforce traffic rules and regulations to ensure responsible driving behavior. • Designate sufficient parking spaces within the project to accommodate residents and visitors. • Promote car-sharing programs or encourage residents to use off-site parking facilities to reduce on-site parking demand. • Consider incorporating bicycle parking areas to encourage cycling as an alternative mode of transportation. • Foster a community-centered approach by creating spaces for		

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		social interaction and pedestrian-friendly environments. • Organize community events, such as car-free days or street festivals, to encourage interaction among residents and promote alternative transportation modes. • Establish a residents' association to address traffic-related concerns and collaborate with local authorities on traffic management initiatives.		
Health and Safety	Occupational health and safety	• Ensure the provision of healthy living conditions for the workforce, including suitable accommodation with proper amenities. • Establish facilities for drinking water, sanitation, and cooking to promote good hygiene practices. • Provide appropriate personal protective equipment (PPE) for workers to ensure their safety during operational tasks. • Adhere to proper work permit procedures to regulate and control activities on-site. • Minimize the exposure of workers to high noise sources through noise control measures, such as the use of noise barriers or scheduling noisy operations during off-peak hours. • Conduct regular on-the-job training to enhance workers' awareness of occupational health and safety practices and procedures. • Implement health surveillance programs to monitor the well-	A 3rd Party Environmental Organization	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		being of the workforce, including periodic health check-ups and monitoring of potential occupational health risks. • Develop and implement an "Occupational Health and Safety Management Plan" to ensure the continuous monitoring and improvement of occupational health and safety practices throughout the operation phase.		
	Community health and safety	• Implement dust control measures along the site approach road. • Install noise barriers or walls in areas with high noise levels. • Provide barriers to restrict access to the operational site, ensuring public safety and preventing exposure to construction hazards. • Prevent the formation of stagnant water pools on-site and in the surrounding areas. • Establish a vector control program in the operational site and labor camps to mitigate the risk of vector-borne diseases. • Segregate hazardous and non-hazardous waste and provide appropriate containers for different waste types to minimize odor nuisance and prevent attracting pests and vermin. • Educate area residents and operational personnel about the risks, prevention, and available treatments for vector-borne diseases. • Ensure proper disposal of domestic waste generated from the	A 3rd Party Environmental Organization	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		operational site in designated waste dumping sites. • Implement sanitary improvements and eliminate breeding habitats near human settlements to prevent larval and adult mosquito propagation. • Implement measures to mitigate the spread/transmission of communicable diseases resulting from the presence of operational personnel. • Develop and implement a comprehensive Health, Safety, and Security Plan before commencing.		
Land Environment	Contamination of Land	• Regularly spray water on the open surface of the project site. • Dispose of debris and waste in a designated area and as per plan to prevent degradation of soil and to prevent flow and infiltration into water resources. • Ensure proper spill control and management at the site. • Good housekeeping to prevent spillage and runoff from the site. • Greenbelt shall be developed in an additional area in and outside the project area.	A 3rd Party Environmental Organization	Department of Environment (DOE) Bangladesh Water Development Board (BWDB)

8.6 Greenbelt Development

Increasing vegetation in the form of a greenbelt is one of the preferred methods to keep pollution under control. Plants serve as a sink for pollutants, act as a barrier to break the wind speed as well, and allow the dust and other particulates to settle out there. It also helps to reduce the noise level to some extent. The main objective of the greenbelt is to provide a buffer/barrier between the sources of pollution and the surrounding areas. The green belt helps to capture fugitive emissions and attenuate the noise apart from improving the aesthetic quality of the region. The greenbelt will be developed both side of the irrigation canal and road side of the combined water control structure.

8.6.1 Criteria for Selection of Tree Species

Local or indigenous species shall be preferred and the species that have dust and noise-tolerant capacity, enhance aesthetics, and develop a habitat for wildlife, especially for avifauna shall be introduced.

Species suitable for greenbelt development need to be selected based on the following criteria:

- Tolerance to specific conditions alternatively wide adaptability to eco-physiological conditions.
- Plants suitable local/native fast-growing trees.
- Low water demand and resistance to extreme climatic conditions.
- Species that can minimize noise levels, absorb dust and maintain the ecological, land, and hydrological balance of the region.
- Different heights and growth habits.
- Pleasing appearances.
- Dense canopy cover.
- Ability to fix atmospheric nitrogen.
- Improving soil quality.

Trees would be planted around the approach road area to minimize dust pollution.

8.7 Budget for Environmental Management Plan (EMP)

Bangladesh Water Development Board will allocate a separate budget for environmental management plan implementation, training, analysis and reporting, verification monitoring, and capacity building. It should be noted that costs for many in-built mitigation measures, such as acoustic enclosures for noise control, water, and wastewater treatment, must be included in the contract cost estimation and operating cost estimation. The Construction and operation stage (Three Stages) environmental management budget is **BDT 520,000 BDT/year**. Still, it does not include the budget for consultants for EMP implementation.

The environmental management budget estimation for the construction and operation phase of the Project is provided in Table 8-3.

Table 8-3: Environmental Management Cost (A) for Three Stages of the Project

No.	Description of Item	Unit	Item Total (BDT)

Pre-construction/Construction Stage/year			
1.	Dust management by water sprayer	LS	100,000
2.	Maintenance and protection of traffic, including the construction of diversion roads, warning signs, and posting of signboards detaining project activities	LS	90,000
3.	Camp site waste disposal facilities	Nos.	40,000
4.	First aid box for treatment of injuries in emergencies	Nos.	40,000
5.	Water Supply	Nos.	100,000
6.	Sanitary facilities	Nos.	100,000
7.	Water quality protection measures: soil erosion and sedimentation control at the construction site and prevention of spillages, leakages of polluting materials, etc., to be at the satisfaction of the engineer.	LS	50,000
8.	Orientation to the technical personnel/ Construction worker associated with the project about the key issues of EMP	LS	Included in the construction cost
Total Environmental Management Cost (A)			**520,000**

8.8 Environmental Monitoring Plan

The effectiveness of various mitigation measures described will be monitored through a well-defined environmental monitoring program. This will be done by direct measurement of parameters related to environmental quality, emissions, discharges, etc. An environmental monitoring program is important as it provides useful information on the following aspects:

- It helps to verify the predictions on the environmental impacts presented in this study.
- It helps to indicate warnings of the development of any alarming environmental situations, and thus, provides opportunities for adopting appropriate control measures.

The monitoring program in different areas of the environment, outlined in the next few sections, has been based on the findings of the impact assessment studies, described earlier

8.8.1 Monitoring and Recording Conditions

a) The date (s) on which the sample was taken;
b) The Time (s) at which the sample was collected;
c) The point at which the sample was taken; and
d) The name of the person who was collected the sample;

8.8.2 Requirement to Monitor Concentration of Pollutants Discharged

For each monitoring, the Proponent must monitor the environmental parameters (such as Air Quality, Noise Level, Soil Quality & Water Quality from the project impact site)

Reporting Conditions: Environmental Monitoring Reports shall be made available simultaneously to DOE Head Office and Rangpur Offices of DOE on a quarterly during the whole period of the project.

8.8.3 Notification of Environmental Harm

The Clearance Certificate holder on its employees must notify the DOE of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident.

8.8.4 Recoding of Pollution Complaints

The record must include details of the following:

a) The date and time of the complaint;
b) The method by which the complaint was made;
c) Any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note of the effect;
d) The nature of the complaint;
e) The action taken by the certificate holder in relation to the complaint, including any follow-up contact with the complainant; and
f) If no action was taken by the certificate holder, the reason why no action was taken;

The record of a complaint must be kept for least 4 years the complaint was made. The record must be produced to any authorized officer of the DOE who asks to see them.

8.8.5 Monitoring Plan

The proposed environmental monitoring plan can be incorporated in the three stages of the project. The following Table 8-4 presents the environmental monitoring plan for the project.

Table 8-4: Environmental Monitoring Plan

Aspect	Proposed Monitoring Parameters	Number and location of sampling stations	Frequency of Monitoring	Responsible Party
Stage 1: Pre-construction Phase (Duration 6 months)				
Air Quality	SPM, PM_{10}, $PM_{2.5}$, SOx, NOx, CO	One location of Project site,	Once	Third party consultant/Contractor
Ground water quality	pH, DO, BOD, COD, TDS, Lead, Hg, Fe	One location of Project site.	Once	Third party consultant/Contractor
Surface Water Quality	DO, BOD, EC, Turbidity, TDS, pH, AS, Fe, Total Hardness, Chloride, FC	one location Pond adjacent to the project site	Once	Third party consultant/Contractor

Aspect	Proposed Monitoring Parameters	Number and location of sampling stations	Frequency of Monitoring	Responsible Party
Stage 2: Construction Phase (Duration 3.5 Years)				
Air Quality	SPM, PM_{10}, $PM_{2.5}$, SOx, NOx, CO	one location Project site:	Once	Third party consultant/Contractor
Noise	L_{day}	5 locations Project ground	10 minutes interval per hour Once	Third party consultant/Contractor
Soil	pH, texture, NH4+, total P, heavy metals, Organic Matter	One Location Project site	Once	Third party consultant/Contractor
Ground water quality	pH, DO, BOD, COD, TDS, Lead, Hg, Fe	One location	Once	Third party consultant/Contractor
Surface Water Quality	DO, BOD, EC, Turbidity, TDS, pH, AS, Fe, Total Hardness, Chloride, FC	one location Pond adjacent to the project site	Once	Third party consultant/Contractor
Stage 3: Operations Phase				
Air Quality	SPM, PM_{10}, $PM_{2.5}$, SOx, NOx, CO	1 location Project site	Half Yearly	Third party consultant/Contractor
Noise	L_{day}	5 locations Project ground	10 minutes interval per hour Half Yearly	Third party consultant/Contractor
Soil	pH, texture, NH4+, total P, heavy metals, Organic Matter	One Location Project site	Yearly	Third party consultant/Contractor
Ground water quality	pH, DO, BOD, COD, TDS, Lead, Hg, Fe	One location	Half Yearly	Third party consultant/Contractor
Surface Water Quality	DO, BOD, EC, Turbidity, TDS, pH, AS, Fe, Total Hardness,	one location Pond adjacent to the project site	Half Yearly	Third party consultant/Contractor

Aspect	Proposed Monitoring Parameters	Number and location of sampling stations	Frequency of Monitoring	Responsible Party
	Chloride, FC			

8.9 Budget Plan for Environmental Mitigation Measures and Monitoring

Bangladesh Water Development Board will allocate a separate budget for environmental monitoring, analysis and reporting, verification monitoring, and capacity building. It should be noted that costs for many in-built mitigation measures, such as acoustic enclosures for noise control, water, and wastewater treatment, must be included in the contract cost estimation and operating cost estimation. The estimated budget for environmental monitoring for the three phases 4,80,000 BDT per year.

The environmental monitoring budget estimation for the three phases of the Project is provided in Table 8-5.

8.10 Monitoring Budget

The ESMP monitoring budget estimates for different phases of the Project have been provided in Table 8-5.

Table 8-5: ESMP Monitoring Budget of the Project

Activities/item	Frequency	No. of Location	Unit No	Rate (BDT)	Amount (BDT)
A. Stage 1: Pre-construction Phase (Duration 6 months)					
Air Quality Testing (SPM, PM10 and PM2.5, SO2, NOx, and CO)	Once	1	1	40,000	40,000
Surface Water Quality (DO, BOD, EC, Turbidity, TDS, pH, AS, Fe, Total Hardness, Chloride, FC)	Once	1	1	30,000	30,000
Ground Water Quality (pH, DO, BOD, COD, TDS, Lead, Hg, Fe)	Once	1	1	30,000	30,000
Sub Total					**100,000**
B. Stage 2: Construction Phase (Duration 3.5 Years)					
Air Quality (SPM, PM10 and PM2.5, SO2, NOx, and CO)	Once	1	1	40,000	40,000
Noise level monitoring	Once	5	5	7,000	35,000
Ground Water Quality (pH, DO, BOD, COD, TDS, Lead, Hg, Fe)	Once	1	1	30,000	30,000
Surface Water Quality (DO, BOD, EC, Turbidity, TDS, pH, AS, Fe, Total Hardness, Chloride, FC)	Once	1	1	30,000	30,000
Soil Quality (pH, texture, NH4+, total P, heavy metals, Organic Matter)	Once	1	1	35,000	35,000
Sub Total					**170,000**
C. Stage 3: Operations Phase Cost/year					
Air Quality (SPM, PM10 and PM2.5, SO2, NOx, and CO)	Yearly	1	1	40,000	30,000
Noise level monitoring	Yearly	5	5	7,000	35,000
Ground Water Quality (pH, DO, BOD, COD, TDS, Lead, Fe)	Yearly	1	1	30,000	30,000

Activities/item	Frequency	No. of Location	Unit No	Rate (BDT)	Amount (BDT)
Surface Water Quality (DO, BOD, EC, Turbidity, TDS, pH, AS, Fe, Total Hardness, Chloride, FC)	Yearly	1	1	30,000	30,000
Soil Quality (pH, texture, NH4+, total P, heavy metals, Organic Matter)	Yearly	1	1	35,000	35,000
Community Development	LS				50,000
Sub Total					**210,000**
Total (A+B+C)					**480,000**

8.11 Institutional Setting and Implementation Arrangement

The effective implementation and operation of the EMP depend on the regular monitoring of environmental and social components in the proposed project area. During the three stages of the project the Environment, Health, and Safety officer of the contractor will be responsible for the implementation of the EMP and the project developer's staff, specifically the EHS officer, will supervise the implementation of these mitigation measures by the contractors at the site. The flow diagram showing the institutional arrangement for the implementation of the EMP during the pre-construction, construction and operation period is presented in Table 8-6.

Table 8-6: Organogram Structure for the EMP Implementation

Serial No	Name of Officers and Post	Position in the Committee
01	Umme Mahfuza Haque Superintendent Engineer Design Circrle-06 BWDB, Dhaka	Convener
02	Salma Begum Deputy Chief (Sociology) Office of the Chief Water Management BWDB, Dhaka	Member
03	Mohhammed Ali Rubel Research Officer (Environment and forest) Office of the Chief Planning-1 BWDB, Dhaka	Member
04	Md. Majedul Islam Research Officer (Economics) Office of the Chief Engineer Northern Zone, BWDB, Rangpur	Member
05	Md. Rubayet Imtiaz Executive Engineer Thakurgaon Mechanical Division BWDB, Thakurgaon	Member
06	Swapan Kumar Das Senior Water Resource Specialist, IWM	Member
07	Sanjib Sarker Shawon Research Consultant CEGIS, Bangladesh.	Member
08	Md. Golam Zakaria Executive Engineer Thakurgaon O & M Division BWDB, Thakurgaon	Member-Secretary

Source: Bangladesh Water Development Board (BWDB), 2024

Chapter 9

Consultation with Stakeholders

9 Consultation with Stakeholders

Participation is a process, through which stakeholders influence and share control over development initiatives and the decisions and the resources which affect them. The effectiveness of the environment and social management plan is directly related to the degree of continuing involvement of stakeholders in the Project development process. Participation of stakeholders in the Project is also a primary requirement in developing an appropriate EMP that addresses Project's requirement and is suited to the needs of the stakeholders. Stakeholder's involvement also vastly increases the probability of successful implementation of the management plan. In order to make the consultation and disclosure process effective and fruitful, comprehensive planning is required to assure that the impacted community, local government, NGOs, host population and Project staff interacts regularly and purposefully, throughout all stages of the Project and contribute toward a common goal.

The stakeholder consultations were held to ensure that interested and affected parties were informed of the project. The consultations allowed stakeholders to present their views concerning the proposed project. Recording stakeholders' views and preferences were essential to inform the identification of impacts and drawing effective mitigation measures that are presented in this report.

9.1 Approach and Methodology for Consultation

The approach undertaken for information sharing and consultation involved the following key processes.

- Mapping and identification of key stakeholders such as primary (directly influenced by the Project) and secondary (indirectly influenced by the Project) stakeholders;
- Undertaking expert consultations, interviews and focused group discussions (FGD) with the respective stakeholders;
- Assessing the influence and impact of the Project on these stakeholder groups;
- Summarizing key findings and observations from the consultations; and
- Preparing a future stakeholder engagement strategy for a more detailed assessments at a more detailed level taking into account the various Project lifecycle phases and their implications on the stakeholder.

9.2 Stakeholder Assessment

A stakeholder is defined as "a person, group, or organization that has direct or indirect stake in a Project/organization because it can affect or be affected by the Project or its Proponent's actions, objectives, and policies". Stakeholders vary in terms of degree of interest, influence and control they have over the Project or the proponent. In the present study, all the stakeholders have been primarily categorized into two categories that have been identified as:

- **Primary Stakeholders:** include people, groups, institutions that either have a direct influence on the Project or are directly impacted (positively or adversely) by the Project and its activities; and
- **Secondary Stakeholders:** are those that have a bearing on the Project and its activities by the virtue of their being closely linked or associated with the primary stakeholders and due to the influence, they have on the primary stakeholder groups.

Apart from categorization, stakeholders have also been classified in accordance with the level of influence they have over the Project as well as their priority to the Project proponent in terms of importance.

The influence and priority have both been primarily rates as:

- High Influence/Priority: Which implies a high degree of influence of the stakeholder on the Project in terms of participation and decision making or a high priority for the Project proponent to engage that stakeholder
- Medium Influence/Priority: Which implies a moderate level of influence and participation of the stakeholder in the Project as well as a priority level for the Project proponent to engage the stakeholder who are neither highly critical nor are insignificant in terms of influence.
- Low Influence/Priority: Which implies a low degree of influence of the stakeholder on the Project in terms of participation and decision making or a low priority for the Project proponent to engage that stakeholder

Based on the above attributes, Table 8.1 delineates the stakeholders identified for the Project and their analysis.

Table 9-1: Stakeholder Mapping for the Proposed Project

Stakeholders	Category of Stakeholder	Brief Profile	Overall Influence on the Project	Basis of Influence Rating
Project Management				
BWDB	Primary	• BWBD is the primary project proponent who owns a controlling stake of 100% in the project.	Highest	- The primary project proponents; - Responsible for all the project related risks and impact liabilities; - Primary financial beneficiaries; - Responsible for the entire project-related risks and impact liabilities.
Community				
Local Community	Primary	• Primarily includes the adjacent community to the project site.	Medium	- The project will bring development to the area; - Improvement in infrastructure in the area; - Increase in employment opportunities and preference in the job; - Business or economic conditions, access to health facilities, and education will be improved.
Vulnerable Groups (poor, old aged, and destitute, ethnic minority)	Primary	• The marginal groups within the project area primarily comprise landless households as a result of the land loss, households below the poverty threshold, women-headed households, old aged and	Low	- Employment opportunity during the pre-construction and construction phase; - Prioritization for getting further assistance if any; - Compensation paid to a male member of the family; - Little control over the compensation amount.

Stakeholders	Category of Stakeholder	Brief Profile	Overall Influence on the Project	Basis of Influence Rating
		destitute.		
Fisherman	Secondary	• Fishermen in the area are primarily engaging in small-scale fishing in the river.	Low	- Low scale for self-consumption and selling;
Local workers and laborers	Primary	• Laborers and workers were recruited from the area of influence mostly during the pre-construction and construction phase of the project.	Medium	- Responsible for undertaking mostly un-skill and semiskilled based work during the pre-construction and construction phase of the project; - Engagement level primary in the civil construction part of the work.
Regulatory/Administrative Authorities and Agencies				
Department of Environment (DOE), Bangladesh	Primary	• The Department of Environment (DOE) is the primary government regulatory authority for environmental protection in Bangladesh.	High	- Government Regulatory agency to provide Environmental Clearance (EC) to the project based on evaluation and approval of the Environmental Impact Assessment (EIA) study; - Responsible for monitoring the project's Environmental compliance throughout the project lifecycle; - High influence and high interest.
Department of Agriculture Extension (DAE)	Secondary	• DAE is responsible for agricultural development.	Low	- No major influence on project-related activities.
Department of	Secondary	• DoF is responsible for fisheries	Medium	- No major influence on project-related activities;

Stakeholders	Category of Stakeholder	Brief Profile	Overall Influence on the Project	Basis of Influence Rating
Fisheries (DoF)		development, conservation, maintenance of the fish sanctuary.		- Influence can be increased if the project proponent engages directly with the implementation of the proposed project.
Department of Social Welfare	Secondary	• The local governmental agency is responsible for the implementation of government social welfare schemes.	Low	- No major influence on project-related activities; - However, participation level and influence may increase in case community welfare activities proposed by the project proponent are implemented in coordination with this agency.
Other Regulatory and Permitting Authorities	Primary	-	High	- Primary involvement during the pre-construction, construction, and operation phases.
Political Administration				
Thana/Upazila Political Administration	Secondary	• Elected representative of people at Thana/Upazila level for a fixed tenure.	Medium	- The key linkage between the community and the project proponent; - Low interest with high influence.
Ward leaders and local representatives	Primary	• An elected representative at ward level for a fixed tenure.	Medium	- Issuance of no objection certificate as the representative of the local level representative; - Plays an important role in providing public opinion and sentiment on the project; - Empowered to provide consent and authorization for the establishment of the project on behalf of the community.
Other Institutional Stakeholders Groups				

Stakeholders	Category of Stakeholder	Brief Profile	Overall Influence on the Project	Basis of Influence Rating
Local NGOs and Community and Social Welfare Groups (CSWG)	Secondary	• Microfinance agencies, social welfare groups, and charitable organizations working in the area.	Low	- No major involvement in the project as of today; - Possible inclusion during future stages of the project with respect to project-related community welfare activities.
Printed and Electronic Media	Secondary	-	Medium	- Public watchdog on the project-related activities; - No major influence on the project.

9.3 Information Disclosure and Consultation

Numbers of consultation exercises were conducted during the field visit and baseline data collection for EIA study report preparation. The stakeholders that were consulted include local people, the community in the vicinity of the project area, local elected representatives, and other external stakeholders such as government officials. The details of consultations held with issues raised or discussed and suggestions provided by the respective stakeholders are presented in the following sub-sections.

A combination of mixed methods of information disclosure and consultation process was adopted at this stage of EIA preparation. The method selected for consultation was designed keeping in mind the profile of the stakeholders, types of information desired, and the level of engagement required. In each consultation session, the consultant introduced themselves, introduced the project, and the purpose of engagement with the respective stakeholder. The primary methods followed in the consultation process are:

- Individual-level consultation/discussion;
- Key Informant Interview (KII);
- Focus Group Discussion (FGD); and
- Public Consultation.

Table 9-2: Details of Consultation held for the project.

Date	Stakeholder Details	Details of Participants	Issues Discussed/Raised
15.05.2024	Chairman		**General Discussion** • Company will collect Trade License from Municipality/Union Parishad; **Law and Security** • Few incidents might have happened inside the project boundary but there is no such case reported outside or within the locality. **Local Economy** • Due to the operation of the project, the local economy will be flourished, as a mass volume of the construction will be over locally grown businesses have become feeble; • Few locals have got jobs at prior to this project which makes those families economically stable. **Recommendations** • Assess labor from the locality on a priority basis; • As an elected representative, I will be available at your service any time if it requires for the development of • Need to control pollution. • Ensure door-to-door PAP's visit to assess any special cases that occurred due to the project activity.
23.05.2024	Department of Fishery	Mrs. Ayesha Akter Upazila Fisheries Officer	**General Discussion** • Carp, Pangas, Telapia, Catfish, Pabda, and Gulsha are the main fishes in local aquaculture. • Rui and Katla is the available species of fish in this locality;

<table>
<tr><th>Date</th><th>Stakeholder Details</th><th>Details of Participants</th><th>Issues Discussed/Raised</th></tr>
<tr><td></td><td></td><td></td><td>Fisherman communities are much more aware of fishing and restriction issues;
No major changes were made in the fishing pattern;
Recommendations
In the Thakurgaon Upazila there are 2875 fisher Man and 5138 Fish Cultivator, we suggest giving them benefitable impacts from the projects.
At present there are 12708 Tons of fish produces from the Thakurgaon Sadar, we hope proposed project may increased the production of fish in Thakurgaon Upazila.
To grow fish production, we can do more release of Carp into open pond;
Start Beel Nursery also known as Caged fishing;
Do expedition to reduce catching small fish and stop using banned fishing gear and nets;
Disposed of any waste material in a controlled way;
No treated water should discharge in the river or open pond without prior concern of DOE & River Commission.</td></tr>
<tr><td>23.05.2024</td><td>Department of Agriculture</td><td>Krisno Ray
Upazila Agriculture Officer</td><td>Crop Pattern
Thakurgaon produces a variety of agricultural products, including rice, wheat, sugarcane, seasonal vegetables, and fruits
151593 Hector arable land in Thakurgaon;
Total number of Farmer Family 363318 are in Thakurgaon;
Estimated 963835 Tons of Food produced from Thkaurgaon;
Irrigation Facility are not adequate in project area
Impacts
Due to massive clay collection arable land are alarmingly decreased within this Upazila;</td></tr>
</table>

Date	Stakeholder Details	Details of Participants	Issues Discussed/Raised
			• Farmers are changing their profession due to the acquisition of land. **Suggestions** • Proper monitoring from respective department and DoE; • Proper maintenance of waste and wastewater; • Do not collect clay from any arable agricultural land. • Not adverse impacts on Agriculture from the project
23.05.2023	Department Public Health Engineering (DPHE)	Md. Ahosan Habib Executive Engineer	**Area of Influence** • Water source/ Safe water supply and Sanitation. **Depth of Groundwater Table** • Currently 650-720 feet. **Arsenic and Iron** • No harmful elements and no arsenic were reported from the locality; **What are the Alternative Sources of Water?** • Ringway was used previously during the water crisis.
23.05.2024	Department of Primary Education	Mrs. Runa Laila Upazila Education Officer	**Safety Measures for the Schools** • There must be traffic personnel appointed during school open and close time as well tiffin period if any vehicular movement occurs near to the school; • Noise control if any scope, during school time; • Dust control as there is huge vehicular movement; • Maintain speed limit near the school area. **Is there any reported accident due to BWDB?** • Occasionally reported cases were found, but not because of BWDB operation **Suggestions for BWDB**

Date	Stakeholder Details	Details of Participants	Issues Discussed/Raised
			• Form a strong administration for School; • If possible, promote the primary school to secondary; • Allocate stiffen for poor students'; • Appoint qualified teachers for school; • CSR activity should increase from BWDB's side; • BWDB can decorate classrooms for nearer schools; • Maintain regular communication with the education office.

9.4 Public Consultation Meeting

Three public consultation meeting (PCM) was held on Bangroad, Rautnaga and Beltola project locations. The proceedings commenced at 12:30 PM on 15/05/2024 at Beltola and at 11.30AM on 16/05/2024 at Bangroad and at 2.30PM on 18/05/2024 at Rautnaga. The meeting was attended by a total of 60 people for three PCM, which represent local people, student, farmer, teacher, senior citizen and local administrative representative. The public consultation meeting minutes has been given in Table 9-2. The photographs of the public consultation meeting are shown in Figure 9-1 and the attendance sheet is given in Annex-J in this EIA report.

Figure 9-1: Photos of PCM at Bangroad, Rautnaga and Beltola

	
Comments and suggestions from participants for Combined Water control structure in Bangroad	
	
Comments and suggestions from participants for Combined Water Control Structure in Beltola	


Comments and suggestions from participants for Combined Water Control Structure in Rautnaga

Table 9-3: Brief overview of the Public Consultation Meeting

SL#	Name	Occupation	Comment/Suggestions
1	Shemanto Kumar Borman	Teacher	• They are aware of Combined Water Control Structure in Beltola; • Land acquisition problem will be solved with no confliction. • Environmental impact will be less during the construction and operation;
2	Kanto Dash	Farmer	• Aman and Boro rice has been cultivated near the project location, so special care needs to be taken. • Road connectivity in the project location should be open for local people for their passing with safety; • Local people should get first priority in terms of job opportunity
3	Md. Amirul Islam	Teacher	• No objection for project establishment • Job opportunity for local people • Local security and safety concern • Less sound is their one of the major concerns • Land acquisition problem should deal with proper care
4	Kasem Ali	Fisher Man	• People are depending on deep tube well in this area, so water quality must be good quality • Gas, water and electricity supply should be adequate amount
5	Md. Ayob Ali	Farmer	• Proper mitigation for environmental impact needs to follow
6.	Asok Chandra Borman	Agriculture	• Proper construction and environmental, safety management should be given priority • Agricultural land should be managed properly

SL#	Name	Occupation	Comment/Suggestions
7	Ataur Rahman	Agriculture	• No discharge of water in the agricultural land.

9.5 Focus Group Discussion

Four Focus Group Discussions were held with the local people at Bangroad, Rautnaga, Nischintapur and Beltola. The summary of Focus Group Discussion (FGD) is shown in Table 9-4. Photographs is shown in Figure 9-2 and attendance sheets of FGDs are shown in Annex-J.

Figure 9-2: FGD at Bangroad, Rautnaga, Nischintapur and Beltola

FGD participants for Combined Water Control Structure in Bangroad

FGD participants for Combined Water Control Structure in Beltola


FGD participants for Combined Water Control Structure in Nischintapur


FGD participants for Combined Water Control Structure in Rautnagar


Discussions with upazila fisheries officer, Thakurgaon Sadar


Discussions with upazila agriculture officer, Thakurgaon Sadar

Table 9-4: Summary of FGD

Issues Discussed	Participant's Opinion, comments, and Suggestions	Response to Questions/Action Point
General perception about the proposed project and the awareness	Most of the participants are in favor of the project and have been made aware of the proposed project through the various surveys that have taken place.	Acceptance of the project.
Support of local people for the proposed project?	Almost everybody said that they will support the project and advised the consultants to take precautions in the environmental mitigation to avoid the various impacts anticipated during the pre-construction, construction, and operation stages of the project and to ensure the protection of the natural water bodies of the areas.	The consultants informed that during the study, the design and layout of all infrastructures have been considered the anticipated adverse impacts.
Does the proposed project create any problem with ambient air, noise quality, and water quality?	People of the project area site were aware of this problem especially the air, noise, and water pollution.	The impact of the project upon ambient air, noise, and water quality is assessed in the EIA study.
Any critical issues or concerns by the local people regarding the project? Or Any criteria you would like to see considered during the project design, construction, and operation stage?	Respondents requested that environmental hotspots (like settlements, schools, temples, mosques, etc.) should be avoided as much as possible.	Dust pollution, Noise mitigation, water pollution, community health, and safety are considered in the EMP.

Issues Discussed	Participant's Opinion, comments, and Suggestions	Response to Questions/Action Point
Protected areas (national parks protected the forest, historical or archaeological sites), if any	There is no protected forest, national park, historical or archaeological sites in the proposed study area.	Adequate mitigation measures are included in the EMP.
Employment Status: percentage of employment/ unemployment	Employment is expected in the project area.	Job chance and employment will be enhanced and promoted during the pre-construction and construction period.
If this project is improved, there may be large groups of workers living temporarily in the area and construction operations that generate noise and other pollutants. Are there any other issues?	The respondents welcome project construction activities. Many observed that the measures are temporary and besides there will be more chances for local communities to be employed during pre-construction, construction, providing skilled, semi-skilled, and unskilled labor. Participants did not mention any other problems, which might bother them other than following basic safety rules.	Residents understand that construction impacts can be expected and do not have an issue with these, provided safety measures are taken.

Chapter 10

Emergency Response Plan and Occupational Health and Safety

10 Emergency Response Plan and Occupational Health and Safety

10.1 Emergency Response Plan

An Emergency Response Plan (ERP) is a written document, which is required for an organization according to occupational health safety standards and must be displayed at every job site with a certain number of employees (usually five to ten). It is a detail step-by-step procedure to follow in an emergency such as fire, chemical spill or a major accident. An emergency response plan also includes information such as whom to notify, who should do what, and location of emergency stock. The Emergency Response Plan includes any measures that should be in place at all facilities to combat an accident resulting from fire, explosion or due to any natural calamities (e.g., Earthquake, cyclones and flood).

10.1.1 Purpose

This Emergency Response Plan has been developed to provide an organizational and procedural framework for the management of emergencies in the project. The purpose of an ERP is to facilitate and organize employer and employee actions during workplace emergencies. Well-developed emergency plans and proper employee training (such that employee understands their roles and responsibilities within the plan) will result in fewer and less severe employee injuries and less structural damage to the facility during emergencies. A poorly prepared plan likely will lead to a disorganized evacuation or emergency response, resulting in confusion, injury and property damage. To respond immediately for any kind of emergency/ hazardous condition as well as to take proper action immediately/ in a short time to normalize or minimize the situation as soon as possible.

10.1.2 Scope

This Emergency Response Plan covers those designated actions managers and employees must take to ensure employee and consumer safety from technological and natural hazards as well as other emergencies. This plan includes emergency escape procedures andmergency escape route assignments, procedures for employees who have to stay to operate critical project operations after they evacuate, procedures to account for employees after emergency evacuation has been completed, rescue and medical duties for those employees who are to perform them, the preferred means of reporting fires and other emergencies; and individuals who can be contacted for further information about the plan. All of this operation depends on site and surrounding environment and Senior Manager, ERP coordinators, HOD.

10.1.3 Objectives

In general, the objectives of a plan describe what we expect to achieve by a plan. Even if the nature of the research or plan has not been clear to a person from the hypotheses, s/he should be able to understand the research from the objectives. An emergency plan specifies the aim and procedures for handling sudden or unexpected situations. For Emergency Response Plan some select outstanding objectives are given below-

1. To identify the various types of natural, manmade and technological disasters and hazards, this may impact on the project;
2. The consequence of these hazards in the project;
3. To propose some necessary action plan for minimizing the worst situations;
4. To conduct safety operation to save life and properties;
5. To build up awareness among employee to prevent fatalities and injuries;
6. To ensure proper duty at the hazardous period and communication system;
7. To ensure the duty of management to take emergency action in a short time;
8. Reduce damage to buildings, stock and equipment. Acceleration the resumption of normal operation;
9. To find out the means are available to stop or prevent the situation;
10. To ensure Occupational Health & Safety.

10.1.4 Potential Emergencies

Any incident affecting the project area, which may place life and property in a disaster and hazard, is considered an emergency. Outside emergency services will be required, as will major efforts from various governmental agencies. Various kinds of emergencies are as follows:

Examples of technological hazards are:

11. Fire
12. Explosion
13. Gas Leak
14. Electric power or gas cut
15. Building collapse
16. Chemical hazard
17. Major structure failure
18. Spills of flammable liquids
19. Accidental release of toxic substances
20. Terrorist activities, riot, bomb threat, hostage incident, sabotage
21. Exposure to ionizing radiation
22. Loss of water supply
23. Loss of communication
24. Crash or collision.

Examples of natural hazards are:

1. Earthquakes
2. Flood
3. Landslide
4. Sever extremes of in temperature (cold or hot)

10.1.5 Plan for Sudden Fire in the Project area

Warn and gather assembly point in the project area. Ensure one operator is always present at Hydrant system area when using the fire Hydrant system and ensure the last person has come out from the project area. Remain available to give vital information to Crisis Management Team professional firefighters about location, size, occupants, and shut off valves.

Steps to Safety in the fire incident

- Call to the Control room or Emergency Response Team
- Isolate the area by shutting doors when exiting.
- Never attempt to re-enter the project area unless cleared to do so by the Fire Department.
- If able, assist people with special needs.

If Caught in Smoke

- Drop to hands and knees and crawl towards the nearest exit.
- Hold your breath as much as possible; breathe through your nose and use a filter such as a shirt, towel or handkerchief.

If Trapped in a Room for Smoke

- Close as many doors as possible between you and the fire.
- Wet and place cloth material around or under the door to help prevent smoke from entering the room.
- If the room has an outside window, be prepared to signal to someone outside.

Clothing on Fire (Stop, Drop and Roll):

- Direct or assist a person to roll around on the floor to smoother the flames.
- Only drench with water is immediately available.
- Obtain medical attention.
- Call Control Room
- Report incident to Senior Authority

10.1.6 Emergency Procedure

Safety Operating Procedure of Emergency Response Plan means executing the systematic operation of any Emergency, which can occur inside the project area.

Based on these events, the required actions are determined. For Example

25. Declare emergency
26. Siren/Sound and alert
27. Evacuate danger zone
28. Close main shutoffs
29. Call for external aid
30. Initiate rescue operation
31. Attend to casualties
32. Fight against the hazard.

The final consideration is a list and the location of resources needed:

1. Medical supplies
2. Emergency protective clothing
3. Mobile equipment
4. Firefighting equipment
5. Ambulance
6. Rescue equipment

7. Trained personnel

Any person noticing the emergency shall report to their Department Head/Shift Executive/Shift Supervisor either in person or through the intercom. The Department Head/Shift Executive/Shift Supervisor on receipt of the emergency shall visit the site to assess the situation. If the situation is an emergency, then he/she calls for an emergency.

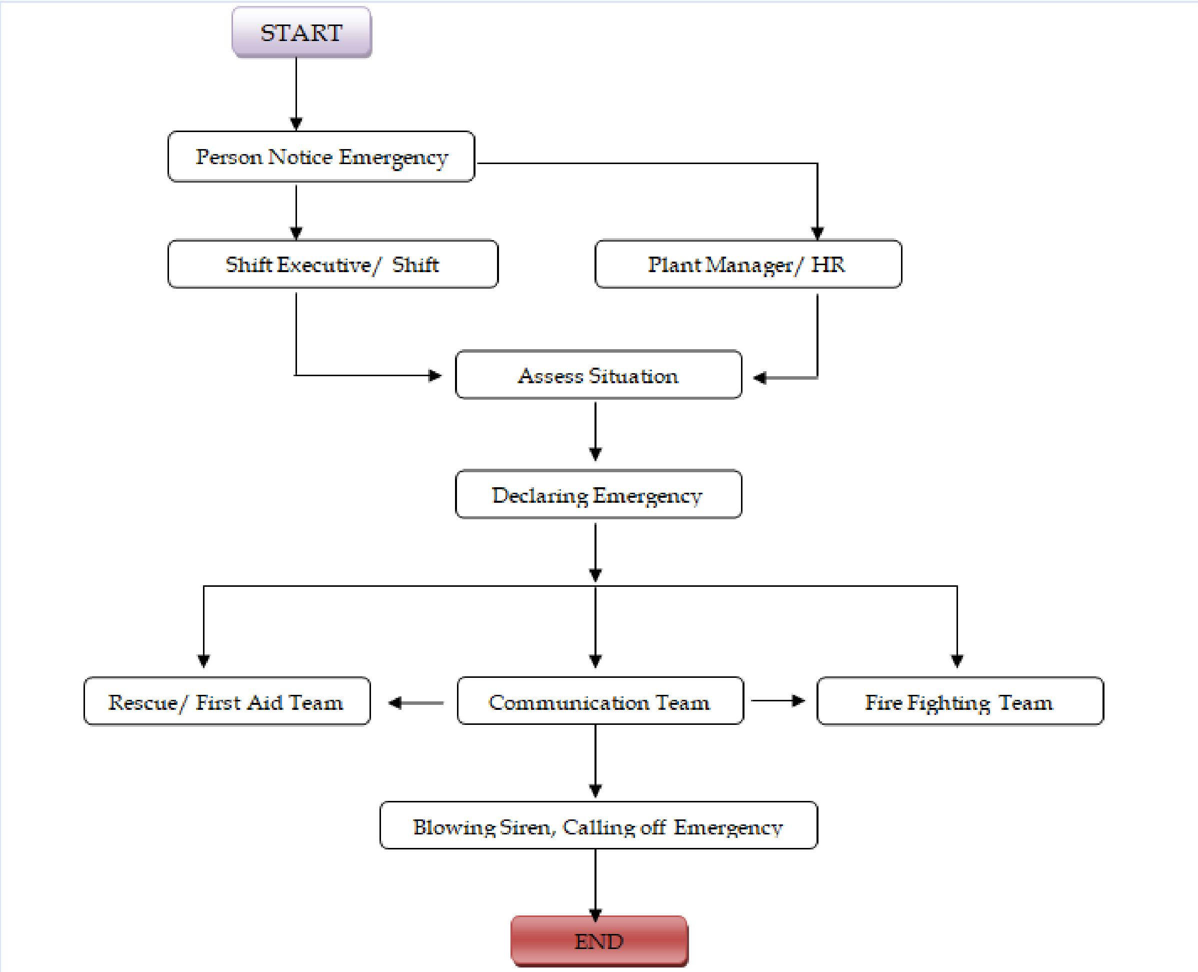
10.1.7 Emergency Communication

Emergency communication is a system that is organized for the primary purpose of supporting one way or two-way communications of emergency messages between both individuals and groups of individuals. These systems are commonly designed to integrate the cross-communication of messages between a variety of communication technologies, forming a unified communication system intended to optimize communications during emergencies.

At the emergency, period needs to communicate with the Control Room or Emergency Response Team for informing hazard nature, affected persons/materials quantity, location etc. The person should report activity to emergency responders when they arrive on the scene.

- Keep all kind of electronic communication system functions like mobile phone and computer networking system;
- Notify the emergency according to its degree;
- Notice the emergencies to the emergency response team;
- Use alarm bells, visual alarms or other forms of communication to reliably alert employees to an emergency;
- Mark specific areas where employees should gather during an alarm or an emergency announcement;
- The effective rescue operation to save lives and properties;
- Only responsible team (Emergency Rescue Team) will conduct the operation.
- If any case of failure or additional help a definite number of persons can move on according to call for Emergency Rescue Team;
- Ensure availability of rescue equipment list;
- The sound communication system of the road;
- No need to overcrowd in incident area and it is needed for a sound communication;
- Need to review incident reports for the past five years;
- Ensure a vital Evacuation Plan;
- Availability of medical equipment.

Figure 10-1: Emergency Communication System



10.1.8 Activities Due to Emergency

The following activities involves in emergency situation

- The attendee of the incident place shall inform the Control Room & Emergency Response Team in case of emergency.
- Stop work immediately and vacate the workplace.
- Shut down the electrical connection.
- All employees will go to the designated Fire Assembly Point located & mark in the specific area of the project.
- Emergency Response Team members or designated person shall notify the fire department and fire service and important person by phone.
- Once the fire department has been notified, and it is safe to do so, trained Fire Fighting team may attempt to extinguish small fires. All fires need to be reported to the senior authority
- When the incident place has been evacuated a head count shall be done by the designated person accounting for all employees on place including those who may be trying to extinguish the fire.

- A List of personnel on the place, updated and current will be kept in the Personnel office.
- The Emergency Response Team is responsible for ensuring the requirements of the fire department and gives all pertinent information.
- The facility should provide first aid attendants as well as medical equipment suitable for the people if any injury took place during the incident and quickly react to give maximum medical facility.

10.1.9 Record Keeping

The record is a combination of information and helps employers and workers to understand industrial hazards its causes and implementation of the proper task. Record keeping of any incident shows requires steps need to be taken and weakness of the previous incident. For proper recordkeeping need to maintain some regular procedure as-

- Emergency Response Plan
- Emergency training records
- Previous incident record
- Module and materials used for training
- Emergency preparedness drill/rehearsal
- Evaluation feedback from training and emergency drills;
- Records and information about previous incidents

10.1.10 Responsibility

ERP Coordinators: Any person on the Emergency Response Team can act as a responsible person during the working day. They are responsible for handling any types of emergencies individually and follow up the all-preventive procedure followed by the respective team. They communicate with all the industries, all local administrative personnel or offices during emergencies.

Shift Executive: Shift Executive is acting as a site controller's role during night shift operation and will be continuing the role until any abovementioned person comes to the project area. Security supervisor is to assess all types of emergency work with the shift executive**.**

Security supervisor: Security supervisor is acting as a site controller role during Holiday or weekly off day, and he will be continuing the role until any abovementioned persons come to the project area.

First Aid Team: The members of the first aid team are very responsive to handle any type of personal injury / accident, communicate the same to the crisis management team, and follow up their guidance and procedure as illustrated avobe**.**

10.1.11 Emergency Response for Natural Hazards

10.1.11.1 Earthquake

- Isolate electrical supply where ever it is possible.
- All electric connection of the project area should be cut off on that time. In addition, the important thing is that everybody will go to a safe place from the project area.

- Have to follow the instruction regarding earthquake
- Have to evacuate as per evacuation plan
- We should have Rescue Team to help the injured employees or who get down. And they will also take the injured employees in a safe place
- Isolate all pipelines of steam, gas pipeline, compressed air, fuel and CO2 when they are not in use.
- Check availability of security personnel and have a chat with them in view of likely immediate action to be taken;
- Empty such tanks which are installed in vertical and relatively unstable conditions;
- Take a review of material storage and ensure that maximum of such material is removed from places from where it can fall down. Uniform Material distribution at the lowest height from floor is the safest way of storage.
- Ensure caps on all compressed gas cylinders,
- Immediate ready to use all Emergency equipment like stretchers, breathing equipment, PPEs, Dewatering, portable welding gas cutting equipment, Spill kits, emergency lights, Battery-operated public-address equipment, Ropes, lifting tackles, trolleys, emergency medical equipment, etc.
- Emergency transport vehicle shall be parked in open so that it is free from any falling object;
- Check storage of Hazardous Chemicals to comply with normal storage safety requirements.
- Keep Fire Hydrant accessible, Keep newest and good conditioned fire hoses and Fire extinguishers readily available.
- Remove unwanted combustible material.
- Review that room heater, electric hotplates and other sources of ignition that are normally used in winter situations are operated, handled and stored safely;
- Ensure that flammable liquids, i.e. Petrol, Diesel and other petroleum products are stored under secondary containment with due precautions.
- Over and above ensure that personnel are alert and do not panic;
- Ensure the average 6 feet height of raw materials and finish good.

10.1.11.2 Flood

- Evacuate the people from the flooded area and send them to a safe area.
- The switch of the power supply from the affected area.
- Remove all types of obstructions from the drainage system.
- Coordinate with the Emergency Response Team and take action as per their guideline.
- In cases of any accident in human life, please call first aid team and get medical attention as soon as possible.
- Call local fire brigade through the communication system in case of worst or out of control situation.

- In case of over flood polyethene and sandbag to protect adverse effect

10.1.11.3 Landslides

- Be prepared to evacuate and do so immediately if necessary.
- If you are inside, remain where you are and take cover under a sturdy piece of furniture.
- If you are outside, run to the nearest high ground away from the landslide or debris flow.
- If escape is not possible, curl into a tight ball to protect your head.

10.1.12 Emergency Response Plan for Other Hazards

10.1.12.1 Fatal Accidents

- During emergency operation, if there is any injured person, carry out victim /causality to the security room and Conference Room also OHS Room beside the support of company recommended the nursing home.
- Call First Aid Team and carry out the first aid with the help of first aid item.
- Inform Emergency Response Team.
- If the accident is severe, then call emergency vehicle and immediately rush the injured person to a local hospital or company recommended nursing home. Phone numbers are available bellow.
- Fill in the accident report form with the help of a witness and deposit the same to the Emergency Response Team.

10.1.12.2 Utility Failure

Examples of utility failure that may occur are an electrical outage, plumbing failure/flooding, natural gas leak, steam line break, ventilation problems etc. In the event of a failure, immediately notify the Emergency Response Team.

- For emergencies and potential danger or after hours call to the Control room
- In a situation where a building needs to be evacuated, please proceed to the building specific evacuation area.
- Turn off the equipment, machines and computers.
- Assist disabled persons as needed.
- Stay at the designated evacuation area until the fire department or designated representative has given the “all clear” to re-enter the building.

10.2 Occupational Health and Safety Procedure

Occupational Health and Safety (OHS) programs are a legal requirement, and every workplace must have an OHS program to help prevent accidents and injuries. An effective program will also help deal with any incidents that do occur.

The occupational health and safety services in Bangladesh are still in the developmental stage. Here, occupational health and safety refers mainly to the needs of workers of industries or some manufacturing processes but does not completely cover all occupations of the country. The main laws related to occupational health and safety in this country is the Factory Act 1965, the Factory Rule of 1979, the Fatal Accidents Act, 1855, the Fire Resist and Extinguish Act 2003, the Fire Prevention and Protection Act, 2003, the Boiler Act 1923, and the Bangladesh Labor Law 2006, etc. Some several other laws and regulations also have some provisions related to occupational health and safety. These laws have provisions on occupational hygiene, occupational diseases, industrial accidents, protection of women and young persons in dangerous occupations, and also cover conditions of work, working hours, welfare facilities, holidays, leave, etc. But most of the laws are lacking in standard values and not specific rather general in nature.

In Bangladesh, numerous national and international institutions and initiatives promote occupational safety and health issues. The existing systems include structures and bodies initiated by the government, non-government organizations, civil society, trade unions, and international organizations. Department of Labor (DOL), Department of Inspection for Factories and Establishments (DIFE), Labor Courts, Department of Disaster Management (DDM), Department of Public Health Engineering (DPHE), Fire Service and Civil Defense (FSCD), International Labor Organization (ILO) are the administrative department reserving the rights of OSH functions in Bangladesh.

10.2.1 General Occupational Health and Safety Aspects

The general occupational health and safety aspects are as follows -

- Heating, ventilation, and light
- Falling/impact with an object
- Types of vehicles: crane, trailer, forklift, covered van, container truck, truck, etc.
- Types of storage materials: pipes, valves, cables, etc.
- Wastewater, drainage, and solid waste
- Good order, storage areas, and waste materials
- Site access, site boundaries
- Welfare facilities
- Sanitary and toilet facilities
- Washing facilities
- Rest facilities
- Standards for nutrition and food safety.

10.2.2 Occupational Health Safety and Hazard

The Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure facility experiences the risk of several hazards inherent to the construction and operating process. The following hazards may occur in the proposed project life cycle.

- Physical hazards
- Fire
- Explosion

- Electrocution
- Natural and manmade hazards.

These mainly impact those working within the project site, although health hazards can also impact local communities. The potentially hazardous areas and the likely accidents with the concerned area have been enlisted in Table 10-1.

Table 10-1: Possible hazard location onsite

Hazard Area	Likely Accident
Electrical rooms	Fire and electrocution
Storage yard	Sliding
Combined Water Control Structure operation unit	Fatal accident

10.2.3 Physical Hazards

Injuries during the project operation are typically related to slips, tips, and falls; contact with falling/moving objects, and lifting/over-exertion. Other injuries may occur due to contact with, or capture in, moving machinery (e.g., dump trucks, front loaders, forklifts). Activities related to the maintenance of equipment represent a significant source of exposure to physical hazards. Such hazards may include the following:

- Falling/impact with objects.
- Transportation.
- Contact with allergic substances.
- Management measures to prevent physical hazards in the project.
- Any person working on equipment with moving parts will personally ensure the equipment is de-energized, isolated, and locked/tagged out.
- Any person working from a position with the potential risk for fall from a height will use fall protection.
- Any person doing flame welding, cutting, or brazing in the proximity of any flammable material will obtain PPE.
- Safety helmets to be used to protect workers below against falling material.
- Barriers like toe boards or mesh guards are to be provided to prevent items from slipping or being knocked off the edge of a structure.
- An exclusion zone is to be created beneath areas where work is taking place.
- Danger areas are to be marked clearly with suitable safety signs indicating that access is restricted to essential personnel wearing hard hats while the work is in progress.
- In case of any accident immediate and proper medical care is being/will be provided at the project site.

10.2.4 Fire

Fire can be observed in the storage yard, construction area and refilling area.

10.2.5 Explosion

Explosions may lead to the release of heat energy and pressure waves. Table 10-2 shows the tentative list of damages envisaged due to different heat loads.

Table 10-2: List of Damage Envisaged at Various Heat Loads

Heat loads (kW/m^2)	Type of Damage Intensity	
	Damage to Equipment	Damage to Equipment
37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10 sec
25.0	Minimum energy required to ignite wood	50% Lethality in 1 min. Significant injury in 10 sec
19.0	Maximum thermal radiation intensity allowed on thermally unprotected equipment	-
12.5	Minimum energy required to melt plastic tubing	1% lethality in 1 min
4.0	-	First-degree burns cause pain for an exposure longer than 10 sec
1.6	-	Causes no discomfort on long exposures

Source: World Bank, 1988

10.2.6 Electrocution

Fatal accidents due to carelessness during working hours may lead to electrocution. Probable areas where chances prevail are enlisted in Table 10-2.

10.2.7 Measures for Controlling of Occupational Health Hazards

The measures for controlling occupational health and safety are as follows.

- Check the effectiveness of preventive and control measures on a regular basis.
- Where there is potential for exposure to harmful dust by ingestion, arrangements are to be made for clean eating areas, where workers are not exposed to the hazardous or noxious substances.
- Periodic medical hearing checks are to be performed on workers exposed to high noise levels.
- Provisions are to be made to provide OHS orientation training to all new employees to ensure that they are apprised of the basic site rules of work at/on the site and of personal protection and preventing injury to fellow employees.
- Contractors that have the technical capability to manage the occupational health and safety issues of their employees are to be hired, extending the application of the hazard management activities through formal procurement agreements.

- Ambulances and First aid treatment facilities are made available for any emergency.

10.2.8 Personnel Safety

Personnel safety includes protecting clothes, helmets, goggles, or other garments and equipment to protect the wearer's body from injury or infection. All these safety measures will be provided to the employee. The safe and good occupational health status of the employees and workers is important for not only the persons working in the project site but also the better protect operation and maintenance. Protective clothing the accessories should be provided to the workers, who would be subjected to exposure to hazardous substances and situations. A list of personnel protective equipment is given in Table 10-3.

Table 10-3: Summary of recommended PPE according to hazard onsite

Protection for	Workplace Hazard	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation	Safety glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords	Plastic helmets with top and side-impact protection
Hearing protection	Noise, ultra-sound	Hearing protectors (earplugs or earmuffs)
Foot protection	Failing or rolling objects or point objects. Corrosive or hot liquids	Safety shoes and boots for protection against moving and falling objects, liquids, and chemicals
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures	Gloves made of rubber or synthetic material (Neoprene), leather, steel, insulation materials, etc.
Respiratory protection	Respiratory protection	Facemasks with appropriate filters for dust removal and air purification (chemical, mist, vapors, and gases). Single or multi-gas personal monitors, if available
	Oxygen deficiency	Portable or supplied air (fixed lines). Onsite rescue equipment
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration	Insulating clothing, body suits, aprons, etc. of appropriate materials

Apart from this, all the employees need to be provided with helmets and safety shoes. It is statutory on the part of the company employees to wear the appropriate safety gear given while attending duty in the project area.

10.2.9 Medical Surveillance

A regular medical check-up is to be done to ensure the soundness of health of the employee and workers. Pollution control measures are to be duly adopted as necessary, including noise and emission control, so that there would be no negative occupational health impact. Insurance for all employees should be taken out. A senior medical officer with sufficient background and experience in occupational health problems should coordinate this issue and would be responsible for drawing up and implementing a detailed and regular program for ensuring health safety for all the workers in the industrial unit.

10.2.10 Fire Safety

The proponent also will construct an underground water reservoir for firefighting. A training session needs to be organized to train the employee on how to use the fire extinguisher. They should also maintain regular communication with the local fire service station and monthly inspection for the fire extinguisher will be conducted in a regular basis. Moreover, the inspection tag should be updated.

Chapter 11

Conclusion and Recommendation

11 Conclusion and Recommendations

11.1 Conclusion

The project involves a proposal to implement Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District under Bangladesh Water Development Board. This EIA presents a comprehensive assessment of the potential impacts associated with the project. The EIA also identifies and develops specific management and mitigation measures to address each potential impact. Residual risks have then been assessed and quantified to determine the potential effectiveness of the proposed management and mitigations, focusing on reducing the significance of the identified potential impact.

Feedback about the project from consultation with government and community stakeholders has been generally positive. Support for the Project and useful information was provided by government stakeholders and there was a consensus amongst the community that the proposed project is in the nation's interest.

This EIA has identified that there are minor negative environmental and social impacts as a result of the project. However, this EIA has also determined that if comprehensive and effective management and mitigation measures are implemented as proposed, the negative impacts should be reduced to non-significant level.

This EIA has been developed to identify and comply with relevant GoB legislation, specifically the Environment Conservation Act 1995 and the Environment Conservation Rules 2023.

Based on the analysis conducted in this environmental and social assessment, it is concluded that overall, the Project will result in positive socio-economic benefits and the negative environmental impacts that have been identified are mostly short-term and localized in nature, and can be minimized adequately through good design, appropriate application of mitigation measures, monitoring and regular supervision of implementation.

An Environmental Clearance Certificate (ECC) will be required for the Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District in favor of Bangladesh Water Development Board (BWDB).

11.2 Recommendations

The following recommendations are made based on EIA study that should be considered for achieving the goal of minimum environmental and social impact and maximum benefits:

- Findings and suggestions of the EIA study of the proposed project should be considered and implement in different stage of the project with strong monitoring.
- Income and employment opportunities for the local community and strengthen the CSR activities for the local community.
- Environmental Management Plan and Hazard and Safety Management Plan should be implemented at every suggested step of project construction and operation.

- Establishing Institutional arrangement with proper logistics and training for Environment, Health and Safety in Project Management Unit during three phases of the project.
- Discharge of wastewater should be in accordance with DOE, Environment Conservation Rules 2023.

Appendix

Appendix A: References

Appendix A: References

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Appendix B: Approved TOR for the Study

Government of the People's Republic of Bangladesh
Ministry of Environment, Forest and Climate Change
Department of Environment
Environment Clearance Section
www.doe.gov.bd

Record Number: 22.02.0000.018.72.036.24.46 Date: 02/07/2024

Subject: **Approval of Terms of Reference (ToR) for the EIA of Construction of 4 Nos. Combined Water Control Structure and 2.30 Km Irrigation Canal under Rehabilitation of Tangon Barrage, Buri Bundh and Bhully Bundh Irrigation Projects, River bank protection and Construction of combined Water Control Structure**

Reference: 42.01.9400.181.32.001.21; Dated: 23.05.2024

With reference to the subject mentioned above, the Department of Environment hereby givesapproval of the Terms of Reference (ToR) for the Environmental Impact Assessment (EIA) of **Construction of 4 Nos. Combined Water Control Structure and 2.30 Km Irrigation Canal under Rehabilitation of Tangon Barrage, Buri Bundh and Bhully Bundh Irrigation Projects, River bank protection and Construction of combined Water Control Structure** by Bangladesh Water Development Board subject to fulfilling the following terms and conditions:

I. The project authority shall conduct a comprehensive Environmental Impact Assessment (EIA) considering the overall activity of the said project in accordance with the ToR submitted to the Department of Environment (DoE). The EIA study shall be conducted as per the provision laid down in the Environmental Conservation Rules, 2023.
II. The EIA report shall be prepared in accordance with the guidelines provided in Schedule 11 and Rules-15, 16 of the ECR, 2023.
III. Consultation with Stakeholders/Public Consultation should be done in accordance with Rule 16 of the Environmental Conservation Rules, 2023.
IV. The project authority shall submit the EIA report to the Head Office of DoE in Dhaka.
V. Without approval of EIA report by the Department of Environment, the project authority shall not make any land and infrastructure development.

02-07-2024
Masud Iqbal Md Shameem
Director
222218342
direc@doe.gov.bd

Executive Engineer (Civil), Water Development Board, Thakurgaon O&M Division Bangladesh, Bangladesh Water Development Board, Thakurgaon.

Record Number: 22.02.0000.018.72.036.24.46/1 (2) Date: 02/07/2024

(Not in the order of

Copy for Kind Information and Necessary Action seniority) :

1. Director, Department of Environment, Rangpur Divisional Office, House # 90/1, Road # 6, Ward # 18, Keranipara, Kotwali, Rangpur and
2. Assistant Director, Office of the Director General, Department of Environment, E-16, Agargaon, Sher-E-Bangla Nagar, Dhaka..

02-07-2024
Masud Iqbal Md Shameem
Director

Appendix C: No Objection Certificate (NOC) from Local Authority

শেখ হাসিনার বাংলাদেশ
পরিচ্ছন্ন পরিবেশ

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিবেশ অধিদপ্তর
পরিবেশ ভবন
ই-১৬, আগারগাঁও, শেরে বাংলা নগর, ঢাকা-১২০৭
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স্মারক নং-২২.০২.০০০০.০১৮.৯৯.০০৭.২৪ - ১২

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তারিখ: ---------------------- ।
২৮/০২/২০২৪ খ্রিস্টাব্দ

বিষয় ঃ "ঠাকুরগাঁও জেলার টাংগন ব্যারেজ, বুড়ি বাঁধ ও ভূল্লি বাঁধ সেচ প্রকল্পসমূহ পুনর্বাসন নদীতীর সংরক্ষণ ও সম্মিলিত পানি নিয়ন্ত্রণ অবকাঠামো নির্মাণ (১ম সংশোধনী)" শীর্ষক প্রকল্পের আওতায় ভূল্লি বাঁধ সেচ প্রকল্পের নতুন সেচখাল নির্মাণের জন্য ঠাকুরগাঁও জেলার রাণীশংকৈল ও সদর উপজেলার বিভিন্ন মৌজায় ২১.৬১ একর বা ৮.৭৫ হেক্টর ভূমি অধিগ্রহণের নিমিত্তে অনাপত্তি প্রদান।

সূত্র ঃ ১। নির্বাহী প্রকৌশলীর কার্যালয়, ঠাকুরগাঁও পওর বিভাগ, বাপাউবো, ঠাকুরগাঁও -এর স্মারক নং-৪২.০১.৯৪০০.১৮১.৩২.০০১.২১-১২৩, তারিখ ঃ ২৮/০১/২০২৪ খ্রিঃ
২। পরিবেশ অধিদপ্তর, রংপুর বিভাগীয় কার্যালয়ের স্মারক নং-২২.০২.৮৫০০.৩৭৫.৭১.০১০.২৪.৯৯,তারিখ:১৪/০২/২০২৪খ্রিঃ।

উপর্যুক্ত বিষয় ও সূত্রের পরিপ্রেক্ষিতে জানানো যাচ্ছে যে, "ঠাকুরগাঁও জেলার টাংগন ব্যারেজ, বুড়ি বাঁধ ও ভূল্লি বাঁধ সেচ প্রকল্পসমূহ পুনর্বাসন নদীতীর সংরক্ষণ ও সম্মিলিত পানি নিয়ন্ত্রণ অবকাঠামো নির্মাণ (১ম সংশোধনী)" শীর্ষক প্রকল্পের আওতায় ভূল্লি বাঁধ সেচ প্রকল্পের নতুন সেচখাল নির্মাণের জন্য ঠাকুরগাঁও জেলার রাণীশংকৈল ও সদর উপজেলার বিভিন্ন মৌজায় ২১.৬১ একর বা ৮.৭৫ হেক্টর ভূমি অধিগ্রহণের জন্য নিম্নবর্ণিত বিষয়াদি প্রতিপালনের শর্তে অত্র দপ্তর হতে নির্দেশক্রমে অনাপত্তি প্রদান করা হলো ঃ

শর্তাবলী ঃ

(ক) বর্ণিত প্রকল্পের অনুকূলে পরিবেশ সংরক্ষণ বিধিমালা, ২০২৩ অনুযায়ী পরিবেশ অধিদপ্তর কর্তৃক অনুমোদিত কার্যপরিধি (TOR)-এর ভিত্তিতে পরিবেশগত প্রভাব নিরূপন (EIA) প্রতিবেদন অনুমোদনপূর্বক প্রথমে অবস্থানগত ছাড়পত্র গ্রহণ এবং পরবর্তীতে পরিবেশগত ছাড়পত্র গ্রহণ করতে হবে।

(খ) পরিবেশ অধিদপ্তর হতে ছাড়পত্র গ্রহণ ব্যতিরেকে আলোচ্য প্রকল্পের কার্যক্রম শুরু করা যাবে না।

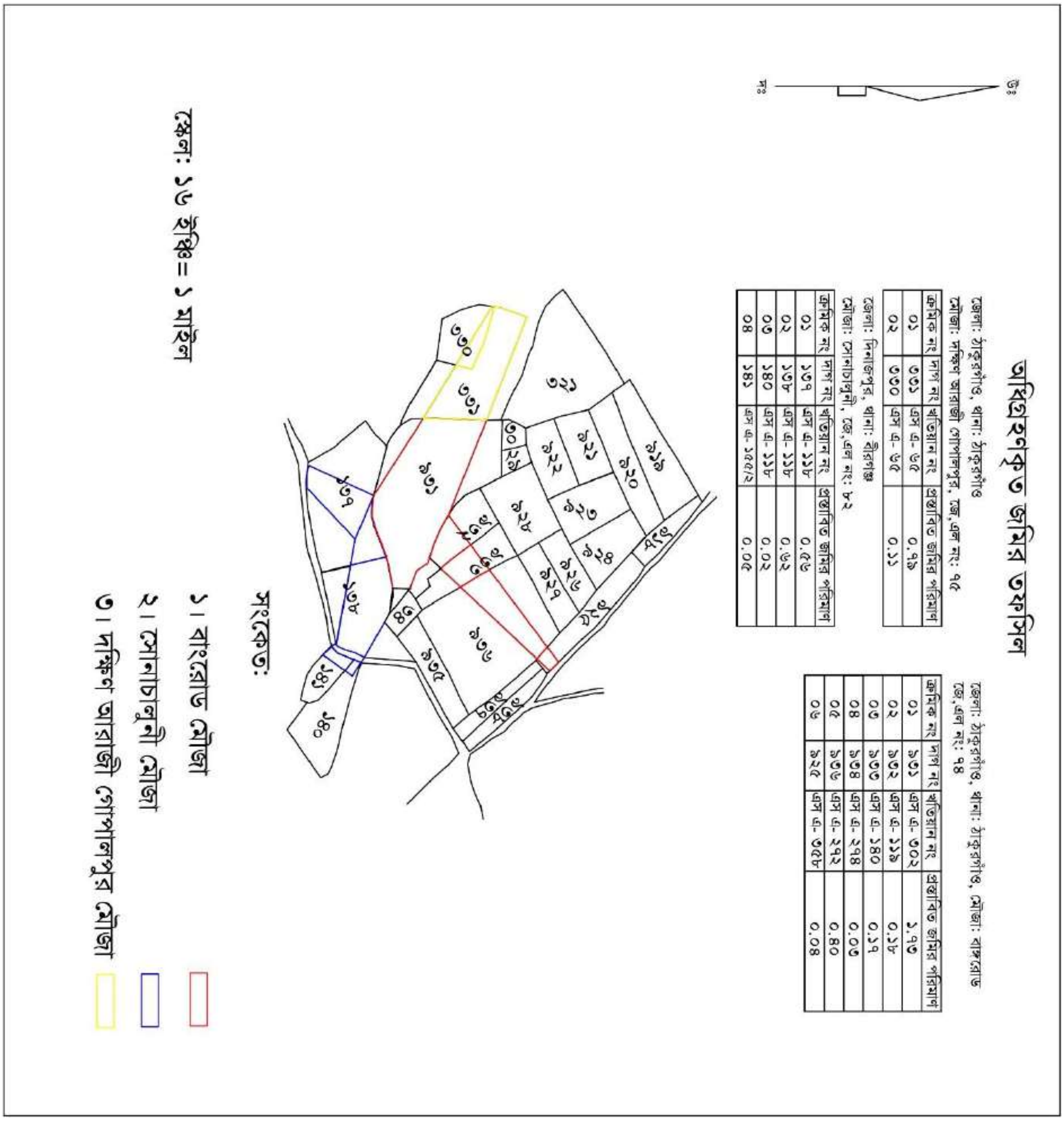
(গ) আলোচ্য প্রকল্পের মাধ্যমে কোন পুকুর/ডোবা/খাল/বিল/জলাশয় ভরাট করা যাবে না।

২৮/০২/২৪
মাসুদ ইকবাল মোঃ শামীম
পরিচালক (পরিবেশগত ছাড়পত্র)
ফোন ঃ ০২-২২২২১৮৩৪২

নির্বাহী প্রকৌশলী
বাংলাদেশ পানি উন্নয়ন বোর্ড
ঠাকুরগাঁও পওর বিভাগ, ঠাকুরগাঁও।

অনুলিপি ঃ অবগতির জন্য।
১। পরিচালক, পরিবেশ অধিদপ্তর, রংপুর বিভাগীয় কার্যালয়, রংপুর।
২। সহকারী পরিচালক, মহাপরিচালক মহোদয়ের শাখা, পরিবেশ অধিদপ্তর, ঢাকা।

Appendix D: Mouza Map of the Project Site



জেলা: ঠাকুরগাঁও, থানা: ঠাকুরগাঁও
মৌজা: দক্ষিণ আরাজী গোপালপুর, জে,এল নং: ৭৫

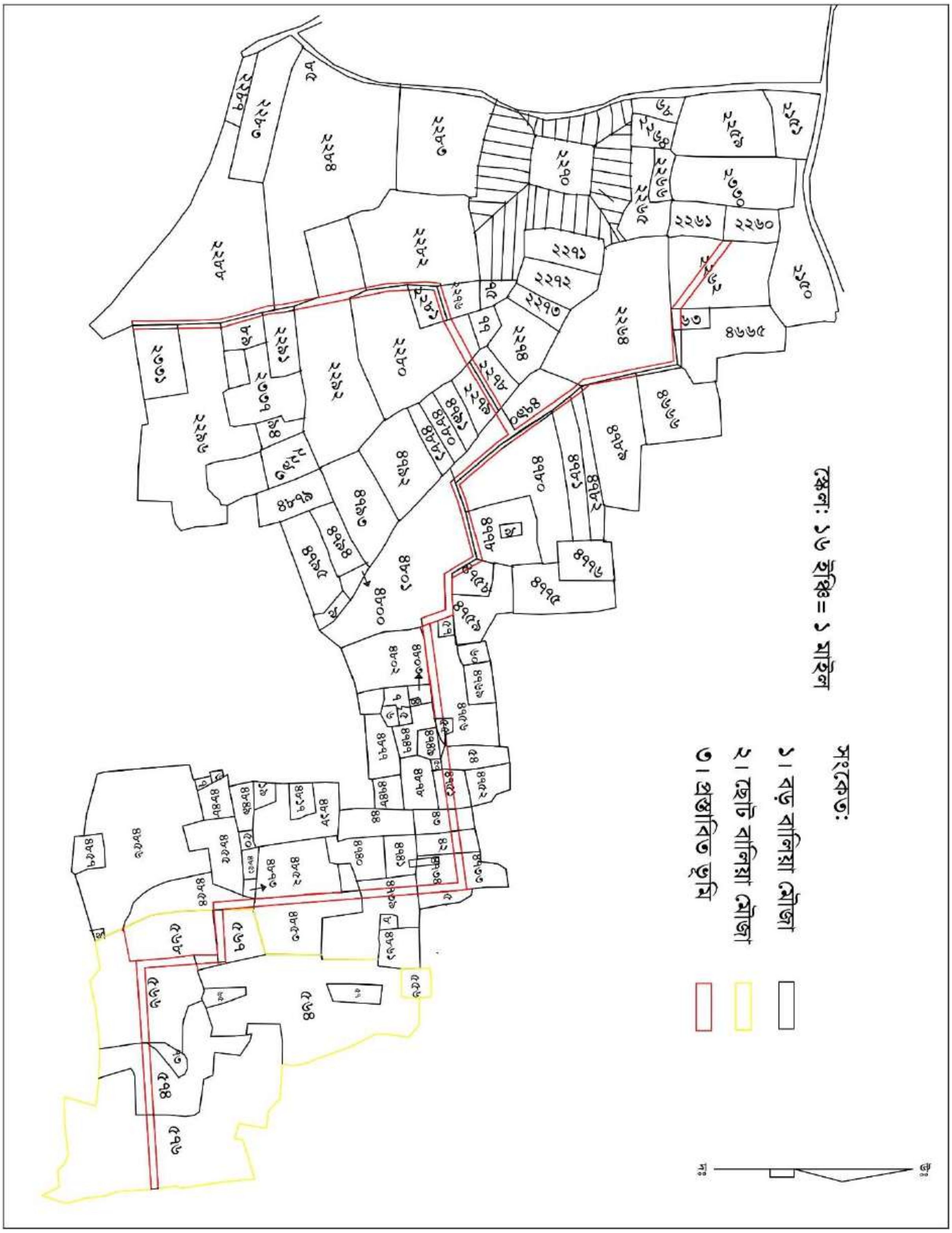
ক্রমিক নং	দাগ নং	খতিয়ান নং	প্রস্তাবিত জমির পরিমাণ
০১	৩৩১	এস এ- ৬৫	০.৭৯
০২	৩৩০	এস এ- ৬৫	০.১১

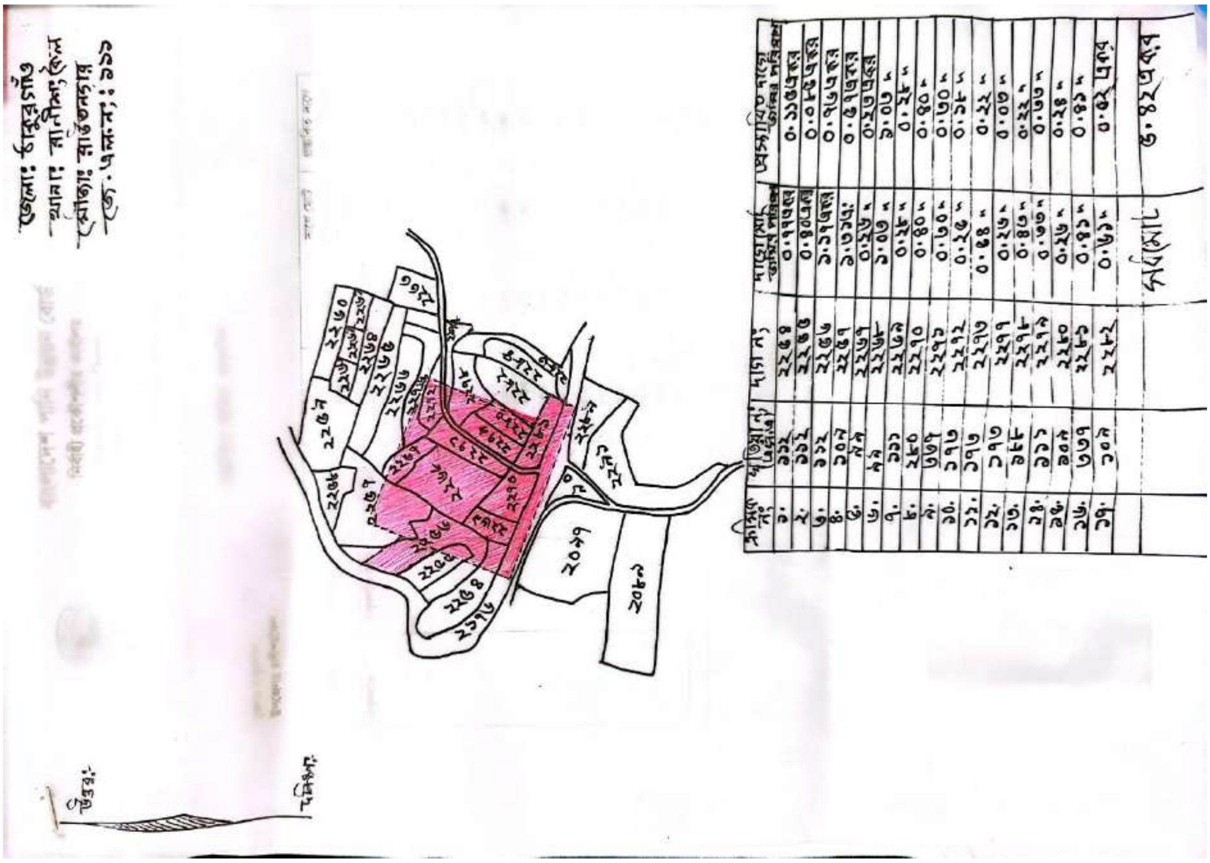
জেলা: দিনাজপুর, থানা: বীরগঞ্জ
মৌজা: সোনাচালুনী, জে,এল নং: ৮২

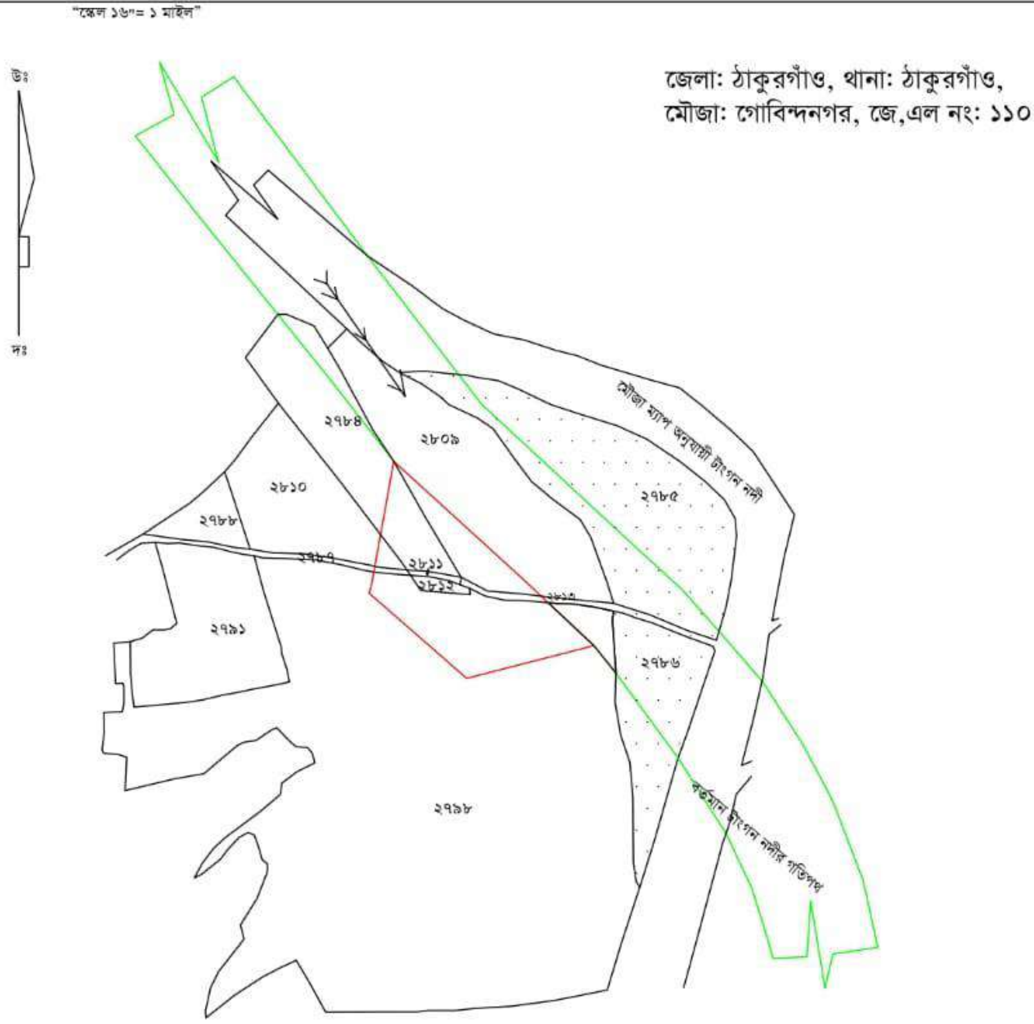
ক্রমিক নং	দাগ নং	খতিয়ান নং	প্রস্তাবিত জমির পরিমাণ
০১	১৩৭	এস এ- ১১৮	০.৫৬
০২	১৩৮	এস এ- ১১৮	০.৬২
০৩	১৪০	এস এ- ১১৮	০.০২
০৪	১৪১	এস এ- ১৫৫/২	০.০৫

জেলা: ঠাকুরগাঁও, থানা: ঠাকুরগাঁও, মৌজা: বাঙ্গরোড
জে,এল নং: ৭৪

ক্রমিক নং	দাগ নং	খতিয়ান নং	প্রস্তাবিত জমির পরিমাণ
০১	৯৩১	এস এ- ৩০২	১.৭৩
০২	৯৩২	এস এ- ১১৯	০.১৮
০৩	৯৩৩	এস এ- ১৪০	০.১৭
০৪	৯৩৪	এস এ- ২৭৪	০.০৩
০৫	৯৩৬	এস এ- ২৭২	০.৪০
০৬	৯২৫	এস এ- ৩৫৮	০.০৪


স্কেল: ১৬ ইঞ্চি= ১ মাইল
সংকেত:
১। বড় বালিয়া মৌজা
২। ছোট বালিয়া মৌজা
৩। প্রস্তাবিত ভূমি





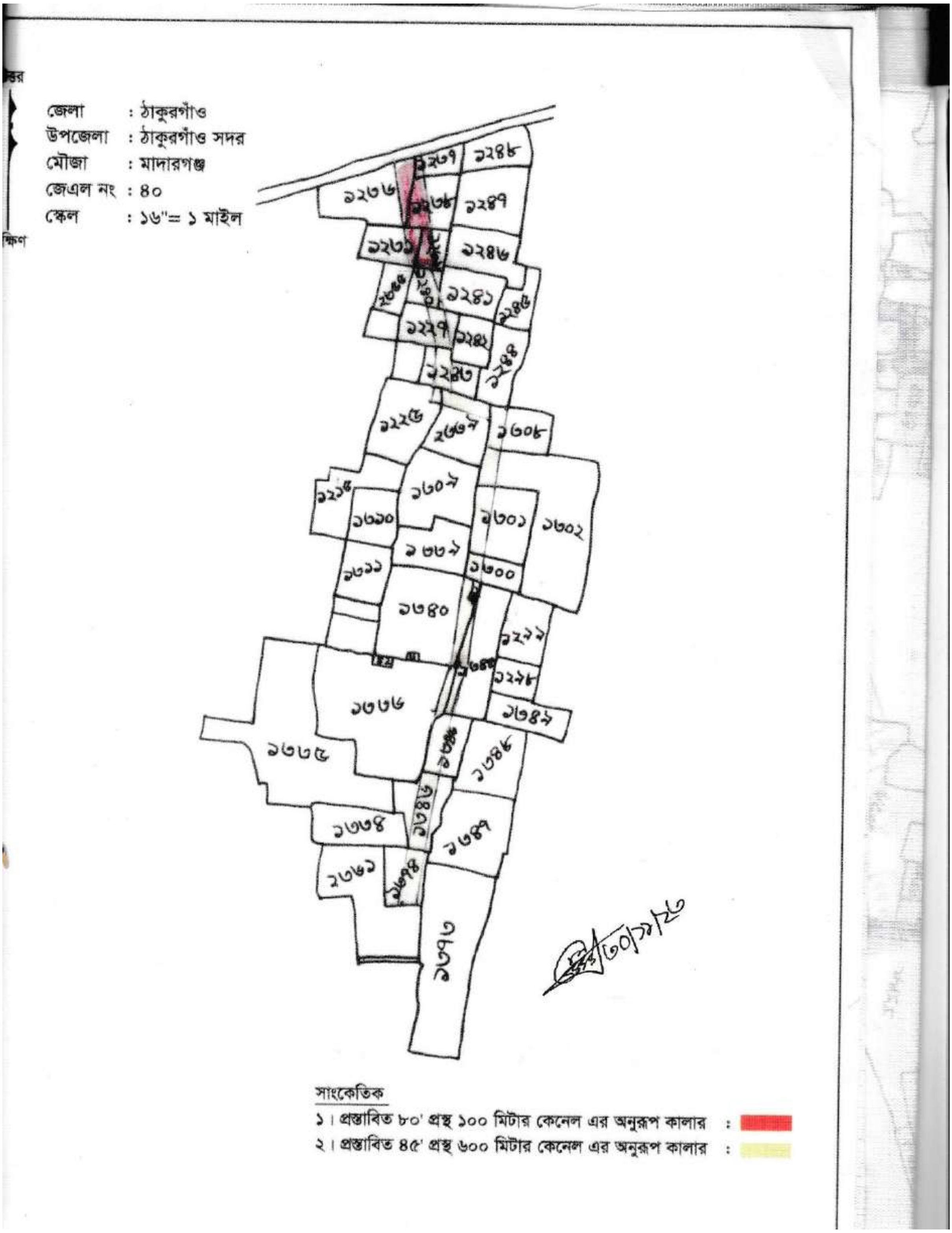
অধিগ্রহণকৃত জমির তফসিল

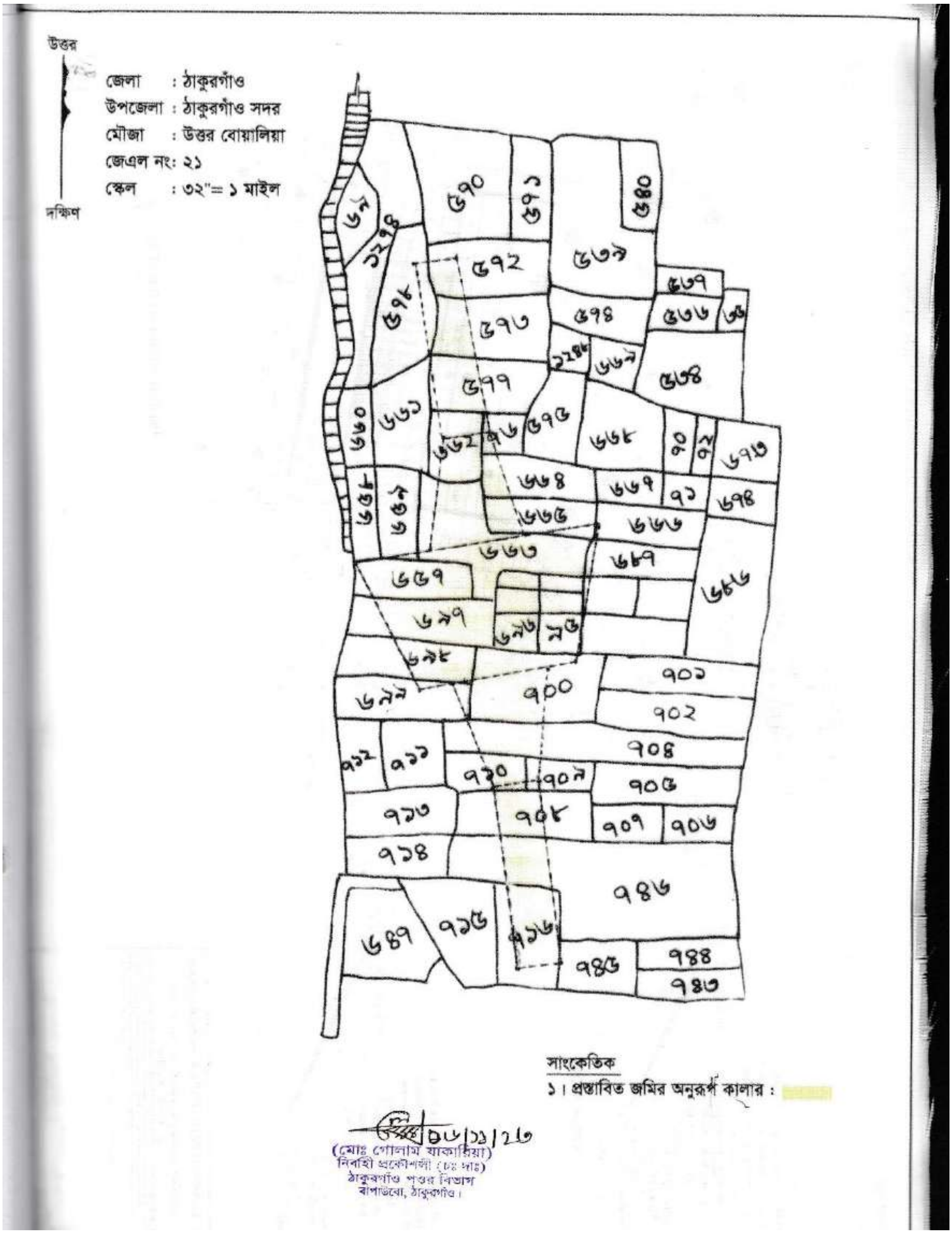
ক্রমিক নং	দাগ নং	খতিয়ান নং	প্রস্তাবিত জমির পরিমাণ
০১	২৭৮৪	সি এস- ১৯৯	০.৫৪
০২	২৭৮৭	সি এস- ৩৩৩	০.০৩
০৩	২৭৯৮	সি এস- ১৯৯	১.৬৫
০৪	২৮০৯	সি এস- ১৯৯	০.৫৯
০৫	২৮১০	সি এস- ১৯৯	০.০৭
০৬	২৮১১	সি এস-	০.০৩
০৭	২৮১২	সি এস-	০.০৮
০৮	২৮১৩	সি এস- ৩৩৩	০.০৬
মোট প্রস্তাবিত জমির পরিমাণ (একর) =			৩.০৫

আলামতঃ

১। প্রবাহমান নদীর অবস্থান

২। অধিগ্রহণের প্রস্তাবিত জমি


জেলা : ঠাকুরগাঁও
উপজেলা : ঠাকুরগাঁও সদর
মৌজা : মাদারগঞ্জ
জেএল নং : ৪০
স্কেল : ১৬"= ১ মাইল
সাংকেতিক
১। প্রস্তাবিত ৮০' প্রস্থ ১০০ মিটার কেনেল এর অনুরূপ কালার :
২। প্রস্তাবিত ৪৫' প্রস্থ ৬০০ মিটার কেনেল এর অনুরূপ কালার :


উত্তর
দক্ষিণ
জেলা : ঠাকুরগাঁও
উপজেলা : ঠাকুরগাঁও সদর
মৌজা : উত্তর বোয়ালিয়া
জেএল নং: ২১
স্কেল : ৩২"= ১ মাইল
সাংকেতিক
১। প্রস্তাবিত জমির অনুরূপ কালার :
(মোঃ গোলাম যাকারিয়া)
নির্বাহী প্রকৌশলী (চঃ দাঃ)
ঠাকুরগাঁও পওর বিভাগ
বাপাউবো, ঠাকুরগাঁও।

Appendix E: No Objection Certificate (NOC) from DOE

শেখ হাসিনার বাংলাদেশ
পরিচ্ছন্ন পরিবেশ

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিবেশ অধিদপ্তর
পরিবেশ ভবন
ই-১৬, আগারগাঁও, শেরে বাংলা নগর, ঢাকা-১২০৭
www.doe.gov.bd

স্মারক নং-২২.০২.০০০০.০১৮.৯৯.০০৭.২৪ - ১২

১৫/১১/১৪৩০ বঙ্গাব্দ
তারিখ: ---------------------- ।
২৮/০২/২০২৪ খ্রিস্টাব্দ

বিষয় ঃ "ঠাকুরগাঁও জেলার টাংগন ব্যারেজ, বুড়ি বাঁধ ও ভূল্লি বাঁধ সেচ প্রকল্পসমূহ পুনর্বাসন নদীতীর সংরক্ষণ ও সম্মিলিত পানি নিয়ন্ত্রণ অবকাঠামো নির্মাণ (১ম সংশোধনী)" শীর্ষক প্রকল্পের আওতায় ভূল্লি বাঁধ সেচ প্রকল্পের নতুন সেচখাল নির্মাণের জন্য ঠাকুরগাঁও জেলার রাণীশংকৈল ও সদর উপজেলার বিভিন্ন মৌজায় ২১.৬১ একর বা ৮.৭৫ হেক্টর ভূমি অধিগ্রহণের নিমিত্তে অনাপত্তি প্রদান।

সূত্র ঃ ১। নির্বাহী প্রকৌশলীর কার্যালয়, ঠাকুরগাঁও পওর বিভাগ, বাপাউবো, ঠাকুরগাঁও -এর স্মারক নং-৪২.০১.৯৪০০.১৮১.৩২.০০১.২১-১২৩, তারিখ ঃ ২৮/০১/২০২৪ খ্রিঃ;
২। পরিবেশ অধিদপ্তর, রংপুর বিভাগীয় কার্যালয়ের স্মারক নং-২২.০২.৮৫০০.৩৭৫.৭১.০১০.২৪.৯৯,তারিখ:১৪/০২/২০২৪খ্রিঃ।

উপর্যুক্ত বিষয় ও সূত্রের পরিপ্রেক্ষিতে জানানো যাচ্ছে যে, "ঠাকুরগাঁও জেলার টাংগন ব্যারেজ, বুড়ি বাঁধ ও ভূল্লি বাঁধ সেচ প্রকল্পসমূহ পুনর্বাসন নদীতীর সংরক্ষণ ও সম্মিলিত পানি নিয়ন্ত্রণ অবকাঠামো নির্মাণ (১ম সংশোধনী)" শীর্ষক প্রকল্পের আওতায় ভূল্লি বাঁধ সেচ প্রকল্পের নতুন সেচখাল নির্মাণের জন্য ঠাকুরগাঁও জেলার রাণীশংকৈল ও সদর উপজেলার বিভিন্ন মৌজায় ২১.৬১ একর বা ৮.৭৫ হেক্টর ভূমি অধিগ্রহণের জন্য নিম্নবর্ণিত বিষয়াদি প্রতিপালনের শর্তে অত্র দপ্তর হতে নির্দেশক্রমে অনাপত্তি প্রদান করা হলো ঃ

শর্তাবলী ঃ

(ক) বর্ণিত প্রকল্পের অনুকূলে পরিবেশ সংরক্ষণ বিধিমালা, ২০২৩ অনুযায়ী পরিবেশ অধিদপ্তর কর্তৃক অনুমোদিত কার্যপরিধি (TOR)-এর ভিত্তিতে পরিবেশগত প্রভাব নিরূপন (EIA) প্রতিবেদন অনুমোদনপূর্বক প্রথমে অবস্থানগত ছাড়পত্র গ্রহণ এবং পরবর্তীতে পরিবেশগত ছাড়পত্র গ্রহণ করতে হবে।

(খ) পরিবেশ অধিদপ্তর হতে ছাড়পত্র গ্রহণ ব্যতিরেকে আলোচ্য প্রকল্পের কার্যক্রম শুরু করা যাবে না।

(গ) আলোচ্য প্রকল্পের মাধ্যমে কোন পুকুর/ডোবা/খাল/বিল/জলাশয় ভরাট করা যাবে না।

২৮/০২/২৪
মাসুদ ইকবাল মোঃ শামীম
পরিচালক (পরিবেশগত ছাড়পত্র)
ফোন ঃ ০২-২২২২১৮৩৪২

নির্বাহী প্রকৌশলী
বাংলাদেশ পানি উন্নয়ন বোর্ড
ঠাকুরগাঁও পওর বিভাগ, ঠাকুরগাঁও।

অনুলিপি ঃ অবগতির জন্য।
১। পরিচালক, পরিবেশ অধিদপ্তর, রংপুর বিভাগীয় কার্যালয়, রংপুর।
২। সহকারী পরিচালক, মহাপরিচালক মহোদয়ের শাখা, পরিবেশ অধিদপ্তর, ঢাকা।

Appendix F: Land Document

Appendix G: ECC Processing Fee Challan Copy

গ্রাহকের কপি

অনলাইন ব্যাংকিং
অর্থ জমা গ্রহণ স্লিপ

ট্র্যাকিং নম্বর	:	২৩২৪-০০৩৮০৩৭০৫১
যে সরকারি প্রতিষ্ঠান বরাবর চালান জমা দেওয়া হচ্ছে	:	প্রধান কার্যালয়, পরিবেশ অধিদপ্তর
যে ব্যক্তি/প্রতিষ্ঠানের পক্ষে জমা দেওয়া হচ্ছে	:	BANGLADESH WATER DEVELOPMENT BOARD
সনাক্তকরণ নম্বর	:	
ঠিকানা	:	Bangladesh Water Development Board, Kalibari, Thakurgaon.
যার মাধ্যমে জমা দেওয়া হচ্ছে তার নাম	:	মোঃ গোলাম যাকারিয়া
জমাকারী মাধ্যমের সনাক্তকরণ নম্বর	:	৩২৫৬৬১৪৮১৩
জমাকারী মাধ্যমের ঠিকানা	:	বাসা/হোল্ডিং: জে -০২, গ্রাম/রাস্তা: আলমনগর, ডাকঘর: আলম নগর-৫৪০২, উপজেলা: রংপুর সদর, জেলা: রংপুর, বিভাগ: রংপুর
মোবাইল ফোন নম্বর	:	০১৭৩৮৪৩৪২৮২
চালান বাবদ অর্থ জমা প্রদানের উদ্দেশ্য	:	পরিবেশগত ছাড়পত্র ফি

অর্থ জমার খাত/কোডওয়ারী বিবরণ :

অর্থনৈতিক কোডের বিবরণ	টাকার পরিমাণ
১৪২২৩১৯-পরিবেশগত ছাড়পত্র ফি	১০,০০০.০০
মোট টাকার পরিমাণ	১০,০০০.০০

টাকার পরিমাণ (কথায়): দশ হাজার টাকা

অর্থ জমার খাত/কোডওয়ারী বিবরণ :

পরিশোধের ধরন	ব্যাংক ও শাখা	টাকার পরিমাণ
ব্যাংকে কাউন্টারে জমা	-	১০,০০০.০০

চালানের তারিখ ও সময় : ১৯/০৫/২০২৪

সোনালী ব্যাংক পিএলসি
নগদ গ্রহণ
20 MAY 2024
ঠাকুরগাঁও শাখা ঠাকুরগাঁও।

20/05/24

জমা প্রদানকারীর স্বাক্ষর

ব্যাংক সিল

জমা গ্রহণকারীর স্বাক্ষর

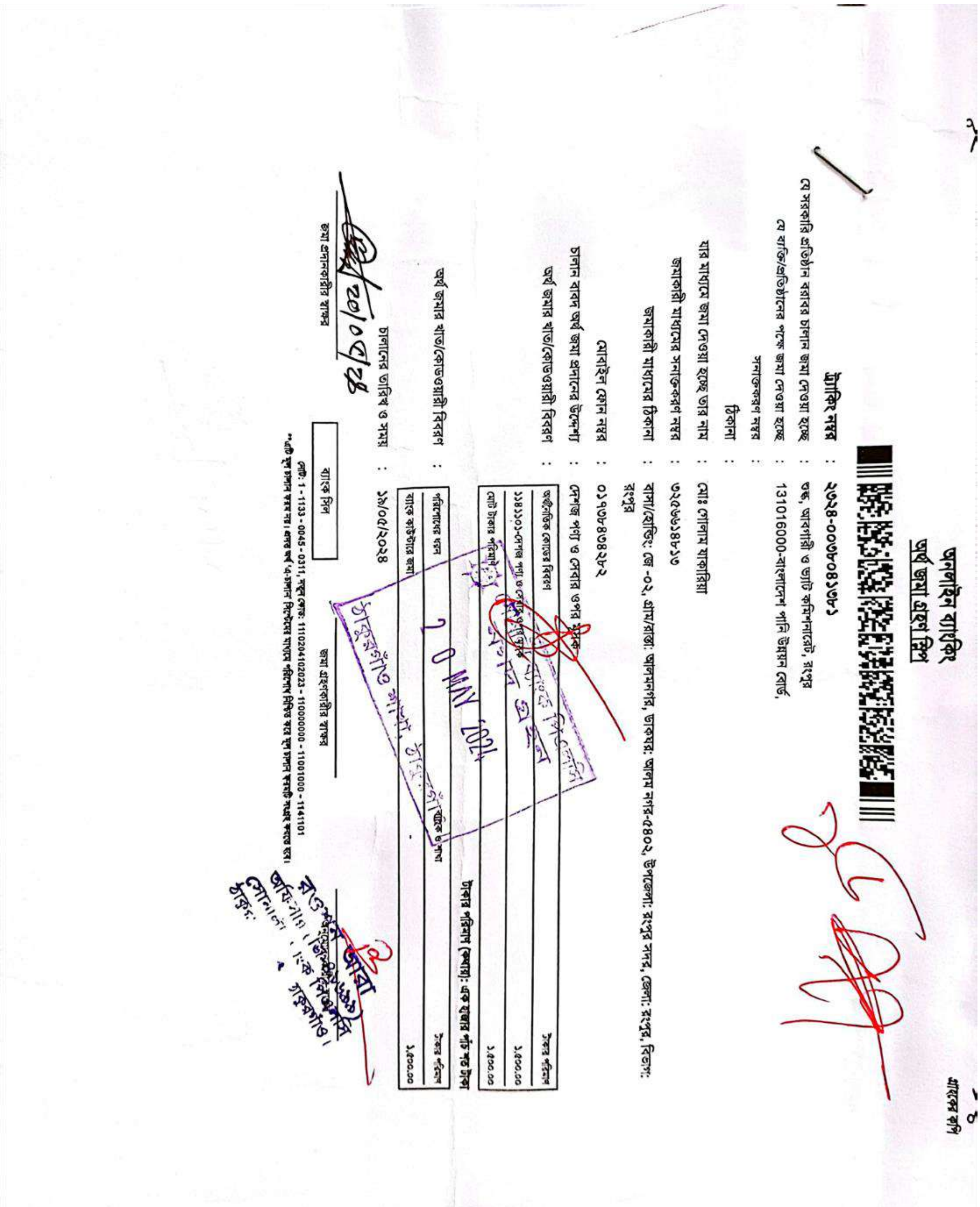
অনুমোদনকারীর স্বাক্ষর

রওশন আরা
অফিসার (জি-৪৯৬৯৯)
সোনালী ব্যাংক পিএলসি
ঠাকুরগাঁও শাখা, ঠাকুরগাঁও

নোট: 1 - - - , নতুন কোড: 1450301124572 - 110000000 - 11001000 - 1422319

**এটি মূল চালান ফরম নয়। প্রদত্ত অর্থ 'এ-চালান' সিস্টেমের মাধ্যমে পরিশোধ নিশ্চিত করে মূল চালান কপিটি সংগ্রহ করতে হবে।

Appendix H: VAT Challan Copy



গ্রাহকের কপি

অনলাইন ব্যাংকিং

অর্থ জমা গ্রহণ স্লিপ

ট্র্যাকিং নম্বর	:	২৩২৪-০০৩৮০৪১৩৮১
যে সরকারি প্রতিষ্ঠান বরাবর চালান জমা দেওয়া হচ্ছে	:	শুল্ক, আবগারী ও ভ্যাট কমিশনারেট, রংপুর
যে ব্যক্তি/প্রতিষ্ঠানের পক্ষে জমা দেওয়া হচ্ছে	:	131016000-বাংলাদেশ পানি উন্নয়ন বোর্ড,
সনাক্তকরণ নম্বর	:	
ঠিকানা	:	
যার মাধ্যমে জমা দেওয়া হচ্ছে তার নাম	:	মোঃ গোলাম যাকারিয়া
জমাকারী মাধ্যমের সনাক্তকরণ নম্বর	:	৩২৫৬৬১৪৮১৩
জমাকারী মাধ্যমের ঠিকানা	:	বাসা/হোল্ডিং: জে -০২, গ্রাম/রাস্তা: আলমনগর, ডাকঘর: আলম নগর-৫৪০২, উপজেলা: রংপুর সদর, জেলা: রংপুর, বিভাগ: রংপুর
মোবাইল ফোন নম্বর	:	০১৭৩৮৪৩৪২৮২
চালান বাবদ অর্থ জমা প্রদানের উদ্দেশ্য	:	দেশজ পণ্য ও সেবার ওপর মূসক
অর্থ জমার খাত/কোডওয়ারী বিবরণ	:	

অর্থনৈতিক কোডের বিবরণ	টাকার পরিমাণ
১১৪১১০১-দেশজ পণ্য ও সেবার ওপর মূসক	১,৫০০.০০
মোট টাকার পরিমাণ	১,৫০০.০০

টাকার পরিমাণ (কথায়): এক হাজার পাঁচ শত টাকা

অর্থ জমার খাত/কোডওয়ারী বিবরণ :

পরিশোধের ধরন	ব্যাংক ও শাখা	টাকার পরিমাণ
ব্যাংকে কাউন্টারে জমা	-	১,৫০০.০০

চালানের তারিখ ও সময় : ১৯/০৫/২০২৪

২০/০৫/২৪

জমা প্রদানকারীর স্বাক্ষর | ব্যাংক সিল | জমা গ্রহণকারীর স্বাক্ষর | অনুমোদনকারীর স্বাক্ষর

নোট: 1 - 1133 - 0045 - 0311, নতুন কোড: 1110204102023 - 110000000 - 11001000 - 1141101

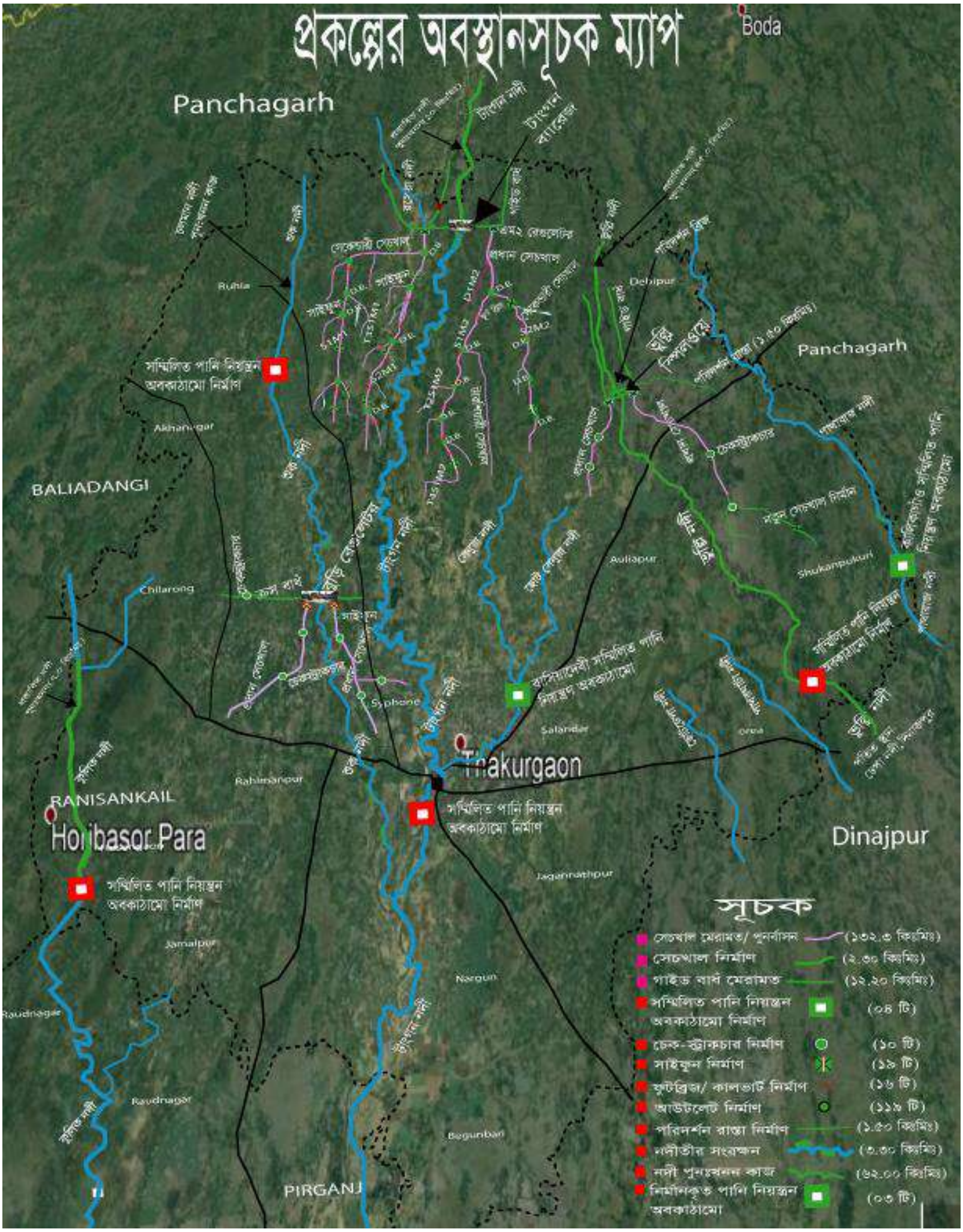
**এটি মূল চালান ফরম নয়। প্রদত্ত অর্থ 'এ-চালান' সিস্টেমের মাধ্যমে পরিশোধ নিশ্চিত করে মূল চালান ফরমটি সংগ্রহ করতে হবে।

ব্যাংক প্রিন্সিপাল ... গ্রহণ

2 0 MAY 2024

ঠাকুরগাঁও শাখা, ঠাকুরগাঁও

Appendix I: Project Layout for Location



Appendix J: Photographs and Attendance Sheet of PCM & FGD


Comments and suggestions from participants for Combined Water control structure in Bangroad


Comments and suggestions from participants for Combined Water Control Structure in Beltola


Comments and suggestions from participants for Combined Water Control Structure in Rautnaga

Appendix J-1: Attendance of the Public Consultation Meeting

Combined Water Control Structure in Beltola Over Shukh River

Date: 15/05/2024

Profile of FGD Participants

Place: বেলতলা,

SN	Name	Age	Occupation	Address/Mobile No
১	শ্রীমান্ত কুমার বর্মন	৫২	শিক্ষকতা	০১৭৪০৮৩২৮০৯
২	অনন্ত দাস	৬১	কৃষি	০১৭৮৮১৯৪৬৫৯
৩	জগেশ চন্দ্র বর্মন	৫০	কৃষি	০১৭২২৬২১০০৪
৪	মহেন চন্দ্র বর্মন	৪০	"	০১৭৮০৮৬৩১৯২
৫	বাসুদেব বর্মন	৫৫	"	০১৭৪০৯০৩৯৪০
৬	বিনোদ লাল বর্মন	৪৮	"	০১৭১৬৯০৪৭৭২
৭	আতাউর জামান	৬০	"	০১৭৬৭২২১৪৬
৮	পরেশ চন্দ্র রায়	৪০	"	০১৭৫০৭১৬৫৯০
৯	সুপেন চন্দ্র রায়	৪৮	"	০১৭৭৩৫৩৯৩৪০
১০	কালাম আলী	৫৬	মৎস্য	০১৭৬৭০৮৫৪৩০
১১	কেশব চন্দ্র রায়	৪৫	"	০১৭১৭৬৮৩৯০১
১২	মো: আমিরুল ইসলাম	৪৮	শিক্ষকতা	০১৭১৭২৮৯৭১৬
১৩	মো: আইয়ুব আলী	৫৫	কৃষি	০১৭৪০২২৯৪৪২
১৪	গৌরাঙ্গ চন্দ্র বর্মন	৫৩	কৃষি	০১৭২৩৩৯১৪৩
১৫	অশোক চন্দ্র বর্মন	৫৪	কৃষি	০১৭৭৪৩৭২২৫৯

Combined Water Control Structure in Bangroad over Bhulli River

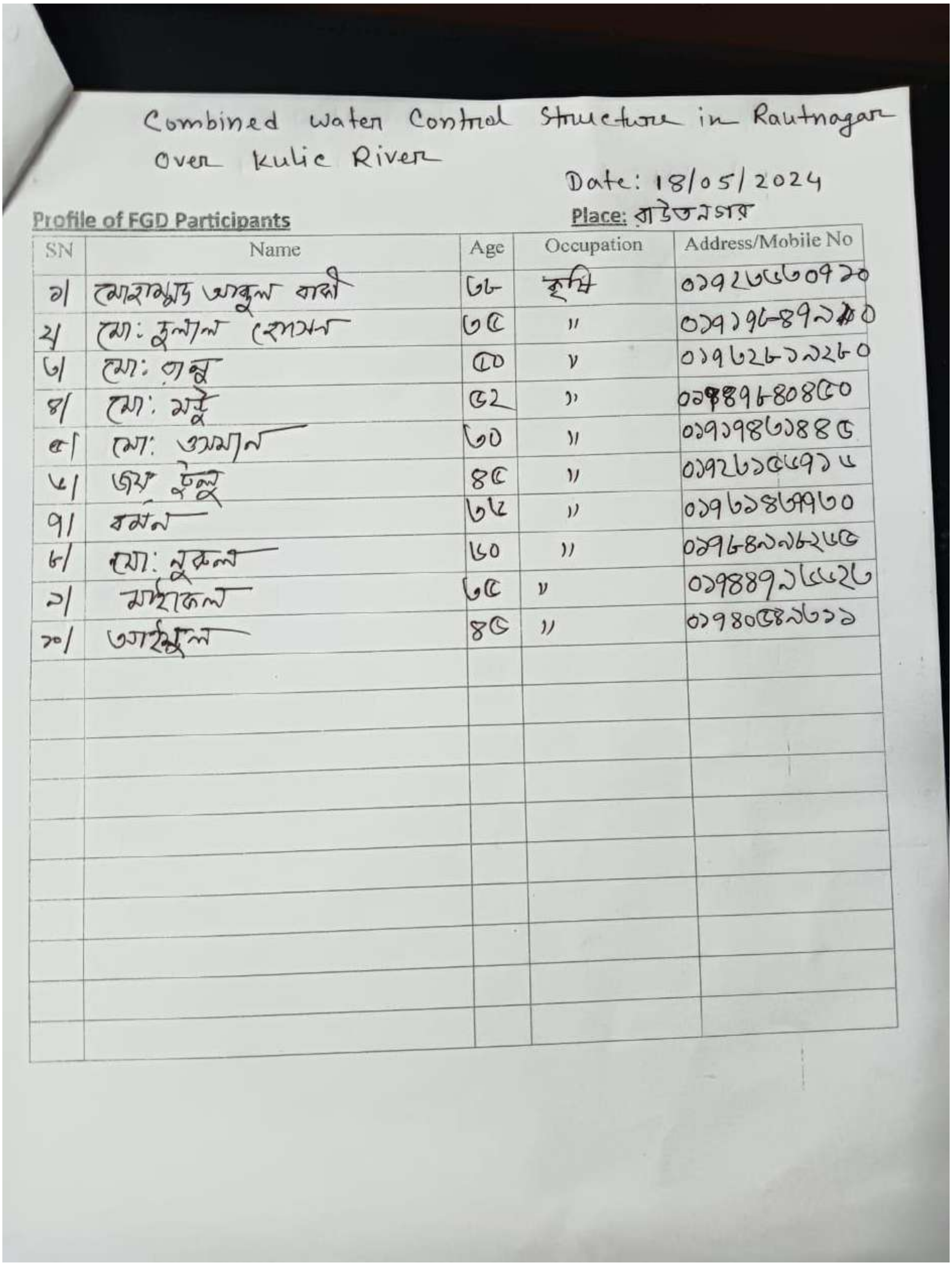
Date: 16/05/2024

Place: বাংরোট

Profile of FGD Participants

SN	Name	Age	Occupation	Address/Mobile No
১/	জীবন কুমার ঘোষ	৫৬	কৃষি	০১৭৫৭৮৭৮২৮৫৫
২/	গোপাল চন্দ্র ঘোষ	৪৫	কৃষি	০১৭২৬৫৭১৫৬৩
৩/	মো: আব্দুল মজিদ	৪৯	শিক্ষক	০১৭১৭২৪৫৯৪০
৪/	মো: শামসুল আলম	৩৮	মৎস্য	০১৭১৭৪৮৬৮৬৬
৫/	বিনত চন্দ্র রায়	৪৫	কৃষি	০১৭৬৬৪৪৫৪১৫
৬/	মো: সেলিম	২৮	"	০১৫৭৬৫৭৮৬৫৬
৭/	তপন কুমার ঘোষ	৬৫	"	০১৭৭৩১৮২৭০৭
৮/	মো: তরিকুল ইসলাম	৫৪	"	০১৭৬৮৮৮৬৬৬৪
৯/	মো: আনোয়ার	২৭	"	০১৭৮৮৩৬৮৮৭৫
১০/	তোফাজ্জুল	৪০	মৎস্য	০১৭৭৬২৯৯৮৮১
১১/	সুভাষ রায়	২৯	ব্যবসা	০১৭৬৭২৭৯৩৫৩
১২/	মো: সোহেল রানা	২৪	কৃষি	০১৮২৫৫২৪২৪৪
১৩/	মো: রফিকুল	৪২	"	০১৭৯২৮১৪৪৭৫
১৪/	রবীন্দ্রনাথ রায়	৪১	"	০১৭৬১৩৭৪৪৬৫
১৫/	হরিশংকর রায়	৪২	"	০১৭৪০৯৬৬৬৬৪
১৬/	মো: সোহরাব	২৮	"	০১৭৬৮৪৬৬৩১৮
১৭/	মো: জুবায়ের ইসলাম	২৭	"	০১৬১৫২০৬৯৬৫

Appendix J-2: Attendance of the Focus Group Discussion



Combined water Control Structure in Rautnagar Over Kulic River

Date: 18/05/2024

Place: রাউতনগর

Profile of FGD Participants

SN	Name	Age	Occupation	Address/Mobile No
১।	মোহাম্মদ আব্দুল বারী	৬৮	কৃষি	০১৭২৬৬৬০৭২০
২।	মো: দুলাল হোসেন	৬৫	"	০১৭১৭৮-৪৭৯[illegible]০
৩।	মো: বাবু	৫০	"	০১৭৬২৮১৯২৮০
৪।	মো: মন্টু	৫২	"	০১৪৮৯৮৪০৪৫০
৫।	মো: ওসমান	৬০	"	০১৭১৭৮৬১৮৮৫
৬।	জয় টুলু	৪৫	"	০১৭২৬১৫৬৭১৬
৭।	রমন	৬৬	"	০১৭৬৯১৪৬৭৬০
৮।	মো: নুরুল	৮০	"	০১৭৮৪৯৯৮২৬৫
৯।	মাইকেল	৬৫	"	০১৭৮৮৭৯১৫৫২৬
১০।	আইনুল	৪৫	"	০১৭৪০৫৪৯৬১১

Appendix K: Photographs of the Stakeholder Consultation and Focus Group Discussion


FGD participants for Combined Water Control Structure in Bangroad


FGD participants for Combined Water Control Structure in Beltola


FGD participants for Combined Water Control Structure in Nischintapur

	
FGD participants for Combined Water Control Structure in Rautnagar	
	
Discussions with upazila fisheries officer, Thakurgaon Sadar	

Appendix L: Applicable Standards of DOE

Appendix L-1: Air Quality Standards/Guidelines

Air Pollutant	Unit	Average Time	Bangladesh Standards	WHO Guidelines
Carbon Monoxide (CO)	mg/m^3	24-hour	-	4
	mg/m^3	8-hour	5	10
	mg/m^3	1-hour	20	35
Lead (Pb)	$\mu g/m^3$	Annual	0.25	-
	$\mu g/m^3$	24-hour	0.50	-
Nitrogen Dioxide (NO_2)	$\mu g/m^3$	Annual	40	10
	$\mu g/m^3$	24-hour	80	25
Coarse Particulates (PM_{10})	$\mu g/m^3$	Annual	50	15
	$\mu g/m^3$	24-hour	150	45
Fine Particulates ($PM_{2.5}$)	$\mu g/m^3$	Annual	35	5
	$\mu g/m^3$	24-hour	65	15
Ozone (O_3)	$\mu g/m^3$	8-hour	100	100
	$\mu g/m^3$	1-hour	180	-
Sulfur Dioxide (SO_2)	$\mu g/m^3$	24-hour	80	40
	$\mu g/m^3$	1-hour	250	-
Ammonia (NH_3)	$\mu g/m^3$	Annual	100	-
	$\mu g/m^3$	24-hour	400	-

Source: Air Pollution (Control) Rules, 2022 and WHO global air quality guidelines, 2021

Appendix L-2: Standards for Odor in Bangladesh

S/N	Parameter	Unit	Standard Limit
1	Acetaldehyde (C_2H_4O)	ppm	0.5 - 5.0
2	Ammonia (NH_3)	ppm	1 - 5
3	Hydrogen Sulfide (H_2S)	ppm	0.02 - 0.20
4	Methyl Disulfide ($C_2H_6S_2$)	ppm	0.009 - 0.10
5	Methyl Mercaptan (CH_4S)	ppm	0.02 - 0.20
6	Methyl Sulfide (C_2H_6S)	ppm	0.01 - 0.20
7	Styrene (C_8H_8)	ppm	0.4 - 2.0
8	Trimethylamine (C_3H_9N)	ppm	0.005 - 0.07

Source: Air Pollution (Control) Rules, 2022

Appendix L-3: Noise Level Standards/Guidelines

11.2.1.1.1.1.L.3.1 WHO Ambient Noise Level Standards

Category of Area/Receptor	IFC-WHO[11]	
	Day dB(A)	Night dB(A)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Source: Guidelines for Community Noise, World Health Organization, 1999

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

11.2.1.1.1.1.L.3.2 Standards for Sound in Bangladesh

S/N	Category of Area/Zone	Limit in dB(A) Leq*	
		Day-time	Night-time
1	Silent zone	50	40
2	Residential area	55	45
3	Mixed area	60	50
4	Commercial area	70	60
5	Industrial area	75	70

Notes:

1. The time from 6 am to 9 pm is counted as day-time.
2. The time from 9 pm to 6 am is counted as night-time.

* The time-weighted average of sounds related to the human ear for a certain period is expressed by dB(A) Leq which is indicated in dB(A) scale.

Source: Noise Pollution (Control) Rules, 2006

[11] Guidelines values are for noise levels measured out of doors.

Appendix L-4: Standards for Water Quality

11.2.1.1.1.1.L.4.1 Standards for Inland Surface Water in Bangladesh

S/N	Best Practice-Based Classification	Parameters											
		pH	DO	BOD	NO_3-N	NH_4-N	PO_4-P	Total Cr	Pb	Hg	Total Coliform	TDS	COD
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	mg/L	mg/L
1	Source of drinking water for supply only after disinfecting	6.5 - 8.5	≥ 6	≤ 2	7.0	0.1	0.1	0.02	0.03	0.001	≤ 100	1000	10
2	Water usable for recreational activity	6.5 - 8.5	≥ 5	≤ 3	7.0	0.3	0.5	0.2	0.05	0.001	≤ 50	1000	10
3	Source of drinking water for supply after conventional treatment	6.0 - 9.0	≥ 5	≤ 3	7.0	0.3	0.5	0.02	0.03	0.001	≤ 5000	1000	25
4	Water usable by fisheries	6.0 - 9.0	≥ 5	≤ 6	7.0	0.3	0.5	0.05	0.1	0.004	≤ 5000	1000	50
5	Water usable by various process and cooling industries	6.5 - 8.5	≥ 1	12	-	2.7	-	0.1	0.1	0.05	-	1000	100
6	Water usable for irrigation	6.5 - 8.5	-	≤ 12	5.0	1.5	2.0	0.1	0.1	0.002	≤ 50000	1000	100

Notes:

1. In water used for irrigation water, electrical conductivity is 2250 µS/cm (at a temperature of 25°C); Sodium is less than 26%; boron is less than 0.2%.

Source: The Environment Conservation Rules, 2023 (Schedule-2)

11.2.1.1.1.1.L.4.2 Standards for Coastal Water

Category		Conservation		Recreation		Fisheries	Industry
Class		Coral Community	Natural Area[1]	Direct Contact[2]	Indirect Contact[3]	Aquaculture and shellfish Culture	Industries and Others
Parameters	Unit						
pH	-	7.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0

Category		Conservation		Recreation		Fisheries	Industry
Class		Coral Community	Natural Area[1]	Direct Contact[2]	Indirect Contact[3]	Aquaculture and shellfish Culture	Industries and Others
Parameters	Unit						
Suspended Solids	mg/L	2	25	5	10	50	100
Dissolved Oxygen (DO)	mg/L	≥ 5	≥ 5	-	-	≥ 5	≥ 4
COD	mg/L	2	8	-	-	5	5
Total Coliform	CFU/100 mL	1000	1000	1000	5000	1000	-
Fecal Coliform	CFU/100 mL	200	200	200	1000	200	-
Nitrate-Nitrogen (NO_3^--N)	mg/L	0.2	0.3	0.8	0.8	0.8	1.0
Phosphate (PO_4^{3-})	mg/L	0.04	0.05	0.08	0.08	0.08	0.1
Oil and Grease	mg/L	0.01		-	-	0.14	5.0
Phenols	mg/L	0.05		-	-	0.05	0.05
Arsenic (As)	mg/L	0.001		-	-	0.003	0.003
Cadmium (Cd)	mg/L	0.005		-	-	0.005	0.005
Cyanide (Cn)	mg/L	0.002		-	-	0.007	0.0014
Chromium (Hexavalent Cr)	mg/L	0.05		-	-	0.05	0.1
Lead (Pb)	mg/L	0.05		-	-	0.05	-
Mercury (Hg)	mg/L	0.0001		-	-	0.0001	0.0001

Note:

1. Conservation of natural area i.e., mangrove, sea grass, wildlife habitat and marine spawning, nursing and feeding ground.
2. Water sports i.e., swimming, diving, surfing where there is direct contact with water.
3. Water sports i.e., sailing, fishing, and other activities where the possibility of contact with water is minimal.

Source: The Environment Conservation Rules, 2023 (Schedule-2)

11.2.1.1.1.1.L.4.3 Standards for Drinking Water

S/N	Parameters	Unit	Bangladesh Standards	WHO Guideline
1	Aldrin/Dieldrin	µg/L	0.03	
2	Aluminum (Al)	mg/L	0.20	
3	Ammonia (NH_3)	mg/L	1.50	
4	Anionic Detergent	mg/L	0.20	
5	Arsenic (As)	mg/L	0.05	0.01
6	Barium (Ba)	mg/L	0.70	
7	Benzene (C_6H_6)	mg/L	0.01	
8	Boron (B)	mg/L	1.0	
9	Cadmium (Cd)	mg/L	0.003	
10	Calcium (Ca)	mg/L	75	
11	Chloride	mg/L	250[a]	
	Chlorinated Alkanes			
12	Carbon Tetrachloride (CCl_4)	mg/L	0.005	
13	1,1 Dichloroethane (1,1 $C_2H_4Cl_2$)	mg/L	0.03	
14	1,2 Dichloroethane (1,1 $C_2H_4Cl_2$)	mg/L	0.03	
15	Tetrachloroethane ($C_2H_2Cl_2$)	mg/L	0.04	
16	Trichloroethane ($C_2H_3Cl_3$)	mg/L	0.02	
	Chlorinated Phenols			
17	Pentachlorophenol	mg/L	0.009	
18	2,4,6 Trichlorophenol	mg/L	0.20	
19	Chlorine (Free Residual)	mg/L	0.20	
20	Chloroform ($CHCl_3$)	mg/L	0.09	
21	Chromium (Total Cr)	mg/L	0.05	
22	Coliform (Fecal)	CFU/100 mL	0	
23	Coliform (Total)	CFU/100 mL	0	
24	Color	Hazen unit	15	
25	Copper (Cu)	mg/L	1.5	
26	Cyanide (CN)	mg/L	0.05	
27	Fluoride	mg/L	1.0	
28	Hardness (as $CaCO_3$)	mg/L	500	
29	Iron (Fe)	mg/L	0.3–1.0	
30	Kjeldhl Nitrogen (Total)	mg/L	1.0	
31	Lead (Pb)	mg/L	0.01	
32	Magnesium (Mg)	mg/L	30–35	

S/N	Parameters	Unit	Bangladesh Standards	WHO Guideline
33	Manganese (Mn)	mg/L	0.40	
34	Mercury (Hg)	mg/L	0.001	
35	Nickel (Ni)	mg/L	0.05	
36	Nitrate (NO_3^-)	mg/L	45	
37	Nitrite (NO_2^-)	mg/L	1.0	
38	Odor	-	Odorless	
39	Oil and Grease	mg/L	0.01	
40	pH	-	6.5 - 8.5	6.5 - 8.5
41	Phenolic Compounds (Phenols)	mg/L	0.002	
42	Potassium (K)	mg/L	12	
43	Radioactive Materials (Gross Alpha Activity)	Bq/L	0.1	
44	Radioactive Materials (Gross Beta Activity)	Bq/L	1.0	
45	Selenium (Se)	mg/L	0.01	
46	Silver (Ag)	mg/L	0.02	
47	Sodium (Na)	mg/L	200	
48	Suspended Particulate Matters	mg/L	10	
49	Sulfide as Hydrogen Sulfide (Sulfide as H_2S)	mg/L	0.05	
50	Sulfate (SO_4^{-2})	mg/L	250	
51	Total Dissolved Solids (TDS)	mg/L	1,000	
52	Temperature	°C	20 - 30	
53	Tin (Sn)	mg/L	2.0	
54	Turbidity	NTU	5.0	
55	Zinc (Zn)	mg/L	5.0	

Note:

a. In the coastal area, the standard for chlorine is 1000 mg/L.

Source: The Environment Conservation Rules, 2023 (Schedule-2)

Appendix L-5: Standards for Sewage Discharge in Bangladesh

S/N	Parameter	Unit	Standard Limit
1	Temperature	°C	30
2	pH	-	6.0 - 9.0
3	BOD_5 at 20°C	mg/L	30
4	COD	mg/L	125
5	Suspended Solids (SS)	mg/L	100
6	Oil and Grease	mg/L	10

S/N	Parameter	Unit	Standard Limit
7	Nitrate (NO_3)	mg/L	50
8	Phosphate	mg/L	15
9	Total Coliform	CFU/100 mg/L	1000

Source: The Environment Conservation Rules, 2023 (Schedule-3)

Appendix L-6: Standards for Waste from Industrial Units or Projects

S/N	Parameter	Unit	Guideline Values			
			National Standards			GIIP
			Place 1[12]	Place 2[13]	Place 3[14]	
1	Ammoniacal Nitrogen (as elementary N)	mg/L	50	50	50	5
2	Ammonia (as free ammonia)	mg/L	5	5	5	-
3	Arsenic (as As)	mg/L	0.2	0.2	0.2	-
4	BOD_5 at 20°C	mg/L	30	250	100	-
5	Boron (B)	mg/L	2.0	2.0	4.0	-
6	Cadmium (as Cd)	mg/L	2.0	1.0	2.0	0.1
7	Chloride (Cl^-)	mg/L	600	600	-	-
8	Chromium (as total Cr)	mg/L	0.5	1.0	1.0	0.5
9	COD	mg/L	200	400	250	250
10	Chromium (as hexavalent Cr)	mg/L	0.1	2.0	1.0	0.1
11	Copper (as Cu)	mg/L	3.0	3.0	3.0	0.5
14	Fluoride (as F)	mg/L	2	15	10	5
15	Sulfide (as S)	mg/L	1	-	5	0.1
16	Iron (as Fe)	mg/L	3	3	3	-
17	Iron	mg/L	-	-	-	5
18	Total Kjeldahl Nitrogen (as N)	mg/L	100	-	100	-
19	Total Nitrogen	mg/L	-	-	-	30
20	Lead (as Pb)	mg/L	0.1	1.0	2.0	0.2
21	Manganese (as Mn)	mg/L	2.0	2.0	2.0	-
22	Mercury (as Hg)	mg/L	0.01	0.01	0.01	0.1
23	Nickel (as Ni)	mg/L	1.0	2.0	5.0	0.5
24	Nitrate (as elementary N)	mg/L	10.0	-	20.0	
25	Oil and Grease	mg/L	10	20	20	10

[12] Inland surface water.

[13] Public sewerage system connected to treatment at second stage.

[14] Coastal areas.

S/N	Parameter	Unit	Guideline Values			
			National Standards			GIIP
			Place 1[12]	Place 2[13]	Place 3[14]	
26	Phenolic Compounds (as C_6H_5OH)	mg/L	1.0	5.0	5.0	0.5
27	Dissolved Phosphorus (as P)	mg/L	5.0	-	-	-
28	Total Phosphorus	mg/L	-	-	-	2
29	Radioactive substance a. Alpha particle radiation b. Beta particle adiation	µCi/L	To be specified by Bangladesh Atomic Energy Commission			-
30	pH	-	6-9	6-9	6-9	6-9
31	Selenium (as Se)	mg/L	0.05	0.05	0.05	-
32	Zinc (as Zn)	mg/L	5	15	15	2
34	Temperature	°C	Not more than 5°C of waterbody temperature	-	Not more than 5°C of waterbody temperature	-
36	Suspended Solids (SS)	mg/L	100	500	100	35
37	Cyanide (as Cn)	mg/L	0.1	2.0	0.2	-
38	Cyanide (free)	mg/L	-	-	-	0.1
39	Cyanide (total)	mg/L	-	-	-	0.5
40	Total Residual Chlorine	mg/L	1.0	-	1.2	-
41	Bioassay test[15]	-	90% of fisheries can survive in treated wastewater even after 96 hours			-

Source: The Environment Conservation Rules, 2023 (Schedule-4) and Bangladesh Bank Guidelines on Environmental and Social Risk Management (ESRM) for Banks and Financial Institutions in Bangladesh, June 2022.

[15] Only applicable for pesticide and pharmaceutical industries.

Appendix M: Laboratory Test Report

EcoTechnology
13 (Ground Floor), Road # 6, Janata Housing, Agaragaon Taltala, Dhaka-1207

Ref: Ecotech/Noise Level/2071

Analysis Results of Noise Level Measurement

Project Name	:	Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District
Description of Activity	:	Noise Level Measurement
Monitoring Personnel	:	Monitored by EcoTechnology Personnel
Monitoring Date	:	16.05.2024
Date of Analysis	:	25.05.2024

Description of Analysis

Code	Noise Level in dB(A)				Location Setting	Zone	Bangladesh Standard[1]	
	Leq_{day}	Leq_{night}	L_{max}	L_{min}			Day	Night
NL-1	54.4	49.8	64.2	37.4	26° 7'34.00"N 88°24'38.00"E	Residential	55	45
NL-2	48.8	38.1	59.5	35.2	26° 7'38.00"N 88°32'4.00"E	Mixed	60	50
NL-3	61.2	47.3	71.7	55.4	26° 7'22.00"N 88°31'60.00"E	Commercial	70	60
NL-4	54.2	39.7	70.6	30.8	26° 7'24.00"N 88°32'58.00"E	Mixed	60	50
NL-5	60.2	46.4	72.8	56.3	26° 3'0.00"N 88°36'59.58"E	Mixed	60	50
NL-6	46.1	35.2	56.3	30.8	26° 1'35.00"N 88°27'23.00"E	Silent	50	40
NL-7	47.4	39.5	57.3	33.21	25°50'35.00"N 88°13'29.00"E	Mixed	60	50

[1] Noise Pollution (Control) Rules, 2006.

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EcoTechnology
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Standard (ECR' 1997) & Noise Pollution (Control) Rules 2006	**Day**	**Night**
Silent Area	50	40
Residential Area	55	45
Mixed Area	60	50
Commercial Area	70	60
Industrial Area	75	70
World Bank/ IFC Standard		
Residential, Institute, Education	55	
Industrial	70	

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EcoTechnology
13 (Ground Floor), Road # 6, Janata Housing, Agaragaon Taltala, Dhaka-1207

Ref: Ecotech/water/2056

Analysis Results of Surface Water Quality

Project Name	:	Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District
Description of Activity	:	Surface Water Quality
Monitoring Personnel	:	Analyzed by Eco Technology Personnel
Sample Collection Date	:	16.05.2024 and 17.05.2024
Date of Analysis	:	21.05.2024 to 26.05.2024

Description of Analysis

Parameter	Unit	Analysis Method	SW-1	SW-2	SW-3	Bangladesh Standards*
DO	mg/L	*Ion electrode method*	8.1	7.4	9.2	6 or more
TDS	mg/L	*Ion electrode method*	30	41	29	--
pH	--	*Ion electrode method*	6.29	6.56	6.67	6.5-8.5
Turbidity	NTU	*Turbidimetric Photoelectric Method*	0.2	0.27	0.25	--
Temperature	°C	*Ion electrode method*	26.0	28.1	27.2	--
Electric Conductivity (EC)	µS/cm	*Ion electrode method*	60	71	56	2250
Salinity	ppt	*Ion electrode method*	0.02	0.05	0.04	--
Phosphate	mg/L	*Photometric method*	0.23	0.27	0.34	--
Nitrate	mg/L	*Photometric method*	0.5	0.4	0.4	--
Iron	mg/L	*Photometric method*	0.032	0.039	0.033	--
BOD5 (at 20°C)	mg/L	*Ion electrode method*	1.8	1.5	1.6	2 or less

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COD	mg/L	*Photometric method*	23.2	21.1	23.5	--
Total Suspended Solid	mg/L	*Standard Methods (2005), 2540D and EPA (1983) Method 160.2*	26.2	21.1	29.3	--

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EcoTechnology
13 (Ground Floor), Road # 6, Janata Housing, Agaragaon Taltala, Dhaka-1207

Ref: Ecotech/air/1086

Analysis Results of Ambient Air Quality

Project Name	:	Rehabilitation of Tangoan Barage, Buri Bundh and Bhully Bundh Irrigation Projects, River Bank Protection and Construction of Combined Water Control Structure at Thakurgaon District
Description of Activity	:	Ambient Air Quality
Monitoring Personnel	:	Eco Technology Personnel
Monitoring Date	:	16.05.2024 and 17.05.2024
Date of Analysis	:	21.05.2024 to 23.05.2024

Description of Analysis

Sl#	Code	GPS Location	Ambient Air pollution concentration in μg/m^3					
			SPM	$PM_{2.5}$	PM_{10}	SO_2	NOx	CO
1	AAQ-1	26° 7'37.00"N 88°24'39.00"E	65.45	12.98	23.85	14.52	31.32	<1
2	AAQ-2	26° 3'4.32"N 88°37'23.00"E	59.75	9.12	29.43	11.34	27.23	<1
3	AAQ-3	26° 1'35.00"N 88°27'19.00"E	66.34	15.34	22.13	11.12	32.11	<1
4	AAQ-4	26° 7'14.00"N 88°31'26.00"E	55.36	14.56	25.21	9.89	27.23	<1
5	AAQ-5	25°50'35.00"N 88°13'30.00"E	54.38	12.13	26.26	15.34	26.34	<1
Duration (hours)			8	24	24	24	24	8
Weather Condition			Sunny					

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Sl#	Code	GPS Location	Ambient Air pollution concentration in µg/m^3					
			SPM	$PM_{2.5}$	PM_{10}	SO_2	NOx	CO
Air Pollution (Control) Rules, 2022			200	65	150	80	80	5

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