ENVIRONMENTAL IMPACT ASSESSMENT
FOR
THE HAOR AREA RESILIENCE AND DEVELOPMENT (HARD) PROJECT [LGED Part]



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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT (HARD) PROJECT [LGED Part]

Prepared by	**JICA Survey Team** Concord Baksh Tower, Unit 5-A & B (5th Floor), Plot #11-A, Road #48, Block #CWN (A), Gulshan-2, Dhaka-1212, Bangladesh Supported by **EQMS Consulting Limited** House #53, Road #4, Block-C, Banani, Dhaka-1213, Bangladesh
Prepared for	**Local Government Engineering Department (LGED)** LGED Bhaban, Level 11, Main Building, Agargaon, Sher-E-Bangla Nagar, Dhaka-1207
Authorized Signature of the Study Team	 **Tauhidul Hasan** Team Leader (Natural Environmental Expert) and Executive Director, EQMS Consulting Limited

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TABLE OF CONTENTS

TABLE OF CONTENTS i
LIST OF FIGURES vi
LIST OF TABLES viii
ACRONYMS AND ABBREVIATIONS x
EXECUTIVE SUMMARY xvii
GENERAL INFORMATION xxvii
1 INTRODUCTION 1-1
1.1 Background 1-1
1.2 Statement of Need 1-2
1.2.1 Context 1-2
1.2.2 Key Problems Identified 1-2
1.2.3 Justification for the Project 1-2
1.2.4 Alignment with National and Regional Priorities 1-3
1.2.5 Urgency of Intervention 1-3
1.2.6 Proposed Focus Areas 1-4
1.3 Objectives of the Project 1-4
1.4 Scope of the Study 1-4
1.4.1 Applicable Reference Framework 1-5
1.5 Approach and Methodology 1-5
1.5.1 Approach for the Study 1-6
1.5.2 Methodology for the Study 1-7
1.6 Structure of the Report 1-13
2 ADMINISTRATIVE AND LEGAL FRAMEWORK 2-1
2.1 Environment Related Policies in Bangladesh 2-1
2.1.1 National Environment Policy, 2018 2-1
2.1.2 National Environment Management Action Plan, 1995 2-2
2.1.3 National Biodiversity Strategy and Action Plan, 2004 2-2
2.1.4 Other Policies Relevant to Environment 2-3
2.2 Environment and Social Related Legislations in Bangladesh 2-9
2.2.1 Bangladesh Environment Conservation Act, 1995 and Subsequent Amendments 2-9
2.2.2 Environment Conservation Rules, 2023 2-9
2.2.3 Air Pollution (Control) Rules, 2022 2-10
2.2.4 Noise Pollution (Control) Rules, 2025 2-10
2.2.5 EIA Guidelines for Industry, 2021 2-11
2.2.6 Bangladesh Haor and Wetland Conservation Act, 2026 2-11
2.2.7 Other Legislations Relevant to Environment 2-12
2.3 Environmental Standards 2-25
2.4 Administrative Setup Related to Environment in Bangladesh 2-25
2.4.1 Department of Environment (DOE), Bangladesh 2-25
2.5 International Treaties 2-25

2.5.1 Rio Declaration 2-25
2.5.2 Convention on Biological Diversity, 1992 2-26
2.5.3 Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, 1971 2-26
2.5.4 United Nations Convention on the Law of the Sea, Montego Bay, 1982 2-26
2.5.5 UNESCO World Heritage Convention 2-26
2.5.6 Other Relevant International Treaties and Conventions 2-26
2.6 International Safeguard Requirements 2-29
2.6.1 JICA Guidelines for Environmental and Social Considerations, 2022 2-29
3 PROJECT DESCRIPTION 3-1
3.1 The Project and Its Location 3-1
3.1.1 Scope of the Project 3-1
3.1.2 Geographic Coverage 3-1
3.2 Project Components 3-2
3.2.1 Rural Infrastructure Development 3-2
3.2.2 Fisheries Promotion 3-5
3.3 Project Activities 3-5
3.3.1 Main Project Activities to be Undertaken 3-5
3.4 Project Plan, Design, Standard, and Specification 3-7
3.4.1 Project Plan 3-7
3.4.2 Design 3-7
3.4.3 Standard 3-8
3.4.4 Specification 3-8
3.5 Project Schedule 3-9
3.5.1 Seasonal Execution Plan 3-9
3.5.2 Resources and Utilities Requirement 3-9
3.5.3 Operational Resources 3-10
3.6 Survey Information 3-11
3.6.1 Road Infrastructure 3-11
3.6.2 Infrastructure for Trade and Access 3-11
3.6.3 Protective and Supporting Structures 3-11
3.6.4 Fisheries and Livelihood Interventions 3-12
4 ENVIRONMENTAL AND SOCIAL BASELINE 4-1
4.1 Study Area and Methodology 4-1
4.1.1 Study Area 4-1
4.1.2 Methodology 4-2
4.2 Physical Environment 4-3
4.2.1 Land Environment 4-3
4.2.2 Air Environment 4-12
4.2.3 Water Environment 4-19
4.3 Biological Environment 4-24
4.3.1 Bio-ecological Zones of the Study Area 4-25
4.3.2 Ecological Sensitive Areas 4-26
4.4 Socio-economic Environment 4-30

4.4.1 Administrative Area and Location 4-30
4.4.2 Demography 4-31
4.4.3 Religion 4-33
4.4.4 Ethnic Composition 4-33
4.4.5 Literacy 4-35
4.4.6 Settlement and Housing 4-36
4.4.7 Public Utilities 4-39
4.4.8 Economy and Employment 4-44
4.4.9 Traffic and Transport 4-47
5 ANALYSIS OF ALTERNATIVES 5-1
5.1 Alternatives Considered 5-1
5.1.1 Alternative 1: No-Project Scenario 5-1
5.1.2 Alternative 2: Limited Infrastructure Development Only 5-1
5.1.3 Alternative 3: All Weather Road 5-1
5.1.4 Alternative 4: Integrated Approach (Rural Infrastructure + Fisheries Promotion + Livelihood Support) 5-2
5.2 Justification for Selected Option 5-2
6 SCREENING AND SCOPING 6-1
6.1 Screening 6-1
6.1.1 Categorization of the Project 6-1
6.2 Scoping 6-2
7 PRIMARY BASELINE SURVEY 7-1
7.1 Physical Environment 7-1
7.1.1 Ambient Air Quality 7-1
7.1.2 Ambient Noise Level 7-10
7.1.3 Surface Water Quality 7-14
7.1.4 Groundwater Quality 7-20
7.1.5 Soil Quality 7-23
7.1.6 River Bottom Sediment Quality 7-25
7.2 Biological Environment 7-30
7.2.1 Terrestrial Ecosystem 7-30
7.2.2 Aquatic Ecosystem 7-33
7.2.3 Haor Specific Wildlife Diversity 7-37
8 IMPACT ASSESSMENT AND EVALUATION 8-1
8.1 Impact Identification 8-1
8.1.1 Impacts on Physical Environment 8-1
8.1.2 Impacts on Natural Resources 8-17
8.1.3 Impacts on Social Environment 8-24
8.1.4 Others 8-39
8.2 Summary of Identified Impacts 8-40
8.3 Evaluation of Impacts 8-52
9 PUBLIC CONSULTATION AND DISCLOSURE 9-1
9.1 Introduction 9-1

9.2 Scope and Specific Objectives 9-1
9.3 Identification of Stakeholders 9-2
9.4 Stakeholder Mapping 9-4
9.5 Approach and Methodology for Stakeholder Mapping and Analysis 9-4
9.6 Information Disclosure, Consultation, and Participation 9-11
9.6.1 Key informant Interviews 9-11
9.6.2 Focused Group Discussion (FGDs) 9-11
9.6.3 Public Consultation Meeting 9-14
10 ENVIRONMENTAL MANAGEMENT PLAN 10-1
10.1 Introduction 10-1
10.2 Objectives of the Environmental Management Plan 10-1
10.3 Environmental Mitigation Plan 10-1
10.4 Greenbelt Development 10-16
10.5 Environmental Monitoring Plan 10-16
10.5.1 Environmental Monitoring Plan during Construction Phase 10-16
10.5.2 Environmental Monitoring Plan during Operation Phase 10-19
10.6 Budget Plan for Environmental Management 10-23
10.7 Institutional Setting and Implementation Arrangement 10-24
10.7.1 Overall Institutional Framework 10-24
10.7.2 Project Level Institutional Framework 10-24
10.7.3 Capacity Strengthening 10-27
11 GRIEVANCE REDRESS MECHANISM 11-1
11.1 Objectives 11-1
11.2 Proposed Institutional Mechanism 11-1
11.3 GRM Implementation Approach 11-2
11.4 Grievance Redress Committees (GRCs) 11-3
11.5 Public Disclosure of the GRM 11-3
11.6 Training/Workshops/Meetings on Grievance Redress Mechanisms 11-3
11.7 Recording of Grievances 11-3
11.8 Grievance Resolution and Follow-Up 11-4
11.9 Monitoring and Reporting 11-4
12 EMERGENCY RESPONSE PLAN AND DISASTER MANAGEMENT PLAN 12-1
12.1 Introduction 12-1
12.2 Objective of Emergency Response Plan 12-1
12.3 Elements of an Emergency Response Plan 12-1
12.4 Hazards Associated with the Proposed Project 12-2
12.5 Hazard Identification and Risk Assessment 12-2
12.5.1 Floods and Flash Floods 12-3
12.5.2 Earthquake 12-3
12.5.3 Landslide 12-4
12.6 On-Site Emergency Response and Preparedness Plan for Construction Contractor 12-4
12.7 Emergency Response Procedure 12-4
12.7.1 Emergency Identification 12-4

12.7.2 Emergency Action Plan at the Project Site 12-4
12.8 Hazard Control Measures 12-7
12.8.1 Fire 12-7
12.8.2 Natural Disasters 12-8
12.8.3 Electrical Accidents 12-8
12.8.4 Personal Protective Equipment (PPE) 12-8
12.8.5 First Aid 12-9
13 CONCLUSION 13-1

APPENDICES

Appendix A – References
Appendix B – Record of Meetings and Consultations
Appendix C – Photographs of Monitoring and Sampling
Appendix D – List of Recorded Flora and Fauna Species in the Study Area
Appendix E – Photographs of Recorded Floral and Faunal Species
Appendix F – Applicable Environmental Standards
Appendix G – Laboratory Analysis Reports
Appendix H – Haor Flood Management Planning Maps

LIST OF FIGURES

Figure 1-1: Approach to the EIA 1-7
Figure 1-2: Impact assessment process 1-12
Figure 4-1: Study area map 4-2
Figure 4-2: Geology of the study area 4-5
Figure 4-3: Physiography of the study area 4-7
Figure 4-4: Geomorphology of the study area 4-8
Figure 4-5: Agro-ecological zone of the study area 4-10
Figure 4-6: Soil map of the study area 4-12
Figure 4-7: Climatic sub-regions of the study area 4-13
Figure 4-8: Monthly maximum, minimum, and average temperatures at Sylhet Meteorological Station 4-14
Figure 4-9: Monthly maximum, minimum, and average temperatures at Sreemangal Meteorological Station 4-15
Figure 4-10: Monthly maximum, minimum, and average temperatures at Mymensingh Meteorological Station 4-15
Figure 4-11: Monthly maximum, minimum, and average rainfall at Sylhet Meteorological Station ... 4-16
Figure 4-12: Monthly maximum, minimum, and average rainfall at Sreemangal Meteorological Station 4-16
Figure 4-13: Monthly maximum, minimum, and average rainfall at Mymensingh Meteorological Station 4-17
Figure 4-14: Monthly maximum, minimum, and average relative humidity at Sylhet Meteorological Station 4-18
Figure 4-15: Monthly maximum, minimum, and average relative humidity at Sreemangal Meteorological Station 4-18
Figure 4-16: Monthly maximum, minimum, and average relative humidity at Mymensingh Meteorological Station 4-19
Figure 4-17: River system of the study area 4-21
Figure 4-18: Map of the Bio-ecological zone of the study area 4-25
Figure 4-19: Map of nearest Protected Areas of the Study Area 4-26
Figure 4-20: Location Map of Nearest ECA from Project Study Area 4-27
Figure 4-21: Location Map of Nearest Ramsar Sites from Project Study Area 4-28
Figure 4-22. Important Bird and Biodiversity Area (IBA) near the Project Site 4-29
Figure 4-23: Study area 4-31
Figure 4-24: Religious profile of the study area 4-33
Figure 7-1: Monitoring location map 7-2
Figure 7-2: Concentrations of PM_{10} in the study area 7-6
Figure 7-3: Concentrations of $PM_{2.5}$ in the study area 7-7
Figure 7-4: Concentrations of SPM in the study area 7-7
Figure 7-5: Concentrations of NO_x in the study area 7-8
Figure 7-6: Concentrations of SO_2 in the study area 7-9
Figure 7-7: Concentrations of CO in the study area 7-9

Figure 7-8: Concentrations of O_3 in the study area.....7-10
Figure 7-9: Monitoring location map 7-12
Figure 7-10: Monitoring location map 7-15
Figure 7-11: Monitoring location map 7-21
Figure 7-12: Monitoring location map 7-24
Figure 7-13: Monitoring location map 7-26
Figure 7-14: Map Showing Plankton and Macrobenthos Sampling Locations 7-36
Figure 10-1: Institutional arrangement for implementation of HARD Project.....10-26
Figure 11-1: Proposed Grievance mechanism 11-2

LIST OF TABLES

Table 1-1: Tasks to be undertaken for the EIA 1-7
Table 1-2: Primary baseline data for the EIA 1-10
Table 2-1: Policies relevant to environment 2-4
Table 2-2: Legislations relevant to environment 2-13
Table 2-3: Other relevant international treaties and conventions signed by Bangladesh 2-27
Table 2-4: Major gaps analysis between environmental regulations of Bangladesh and the JICA Guidelines 2-31
Table 3-1: Study area 3-1
Table 3-2: LGED Rural Infrastructure (Tentative) 3-4
Table 3-3: HARD Project indicative quantities of rural road network 3-11
Table 3-4: Improvements required for rural markets, growth centers, and ghats 3-11
Table 3-5: Protective works and community resilience structures 3-12
Table 3-6: Fisheries and beel development requirements 3-12
Table 4-1: Seasonal variation of hydrological parameters in the Surma River at Kanaighat (Station ID: 266) 4-19
Table 4-2: Seasonal variations of hydrological parameters in the Kushiyara River at Sheola (Station ID: 173) 4-20
Table 4-3: Administrative area of the project area 4-30
Table 4-4: Demography of the study area 4-32
Table 4-5: Ethnic composition in the study area 4-34
Table 4-6: Literacy rate of the study area 4-35
Table 4-7: Type of structures in the study area 4-36
Table 4-8: Housing tenancy in the study area 4-38
Table 4-9: Source of drinking water (%) 4-40
Table 4-10: Electricity connection of the study area 4-41
Table 4-11: Toilet facility in the study area 4-43
Table 4-12: Healthcare facilities 4-44
Table 4-13: Employment status in the project area 4-46
Table 4-14: Length of metaled, semi metaled and unmetalled roads in the study area 4-47
Table 4-15: Number of railway stations, steamer/launch station and bus stand in the study area 4-48
Table 6-1: Scoping matrix for the proposed project 6-2
Table 7-1: Ambient air quality monitoring locations 7-2
Table 7-2: Air Quality Parameters Monitoring Method 7-3
Table 7-3: Summary of ambient air quality monitoring results 7-4
Table 7-4: IFC Noise Level Guidelines 7-10
Table 7-5: Bangladesh Noise Level Standards 7-11
Table 7-6: Ambient noise monitoring locations 7-11
Table 7-7: Ambient noise level in the study area 7-13
Table 7-8: Surface water sampling locations 7-14
Table 7-9: Surface water analysis result 7-16

Table 7-10: Groundwater sampling locations 7-20
Table 7-11: Groundwater analysis results 7-22
Table 7-12: Soil sampling locations 7-23
Table 7-13: Analysis result of soil sample 7-24
Table 7-14: River Bottom Sediment Sampling Locations 7-25
Table 7-15: Analysis result of river bottom sediment samples 7-27
Table 7-16: Sampling points for plankton and benthos survey 7-35
Table 8-1: Typical development and construction equipment/vehicle and associated noise specifications 8-12
Table 8-2: Guidance on effects of vibration levels 8-14
Table 8-3: Summary of the identified impacts 8-42
Table 8-4: Evaluation matrix of environmental and social impact 8-52
Table 9-1: Identification of stakeholders 9-2
Table 9-2: List of identified key project stakeholders 9-6
Table 9-3: Summary of stakeholder consultation 9-12
Table 9-4: Summary of the PCM locations 9-14
Table 9-5: Brief overview of the public consultation meeting 9-17
Table 9-6: Brief overview of the public consultation meeting 9-23
Table 9-7: Brief overview of the public consultation meeting 9-29
Table 9-8: Brief overview of the public consultation meeting 9-35
Table 10-1: Environmental mitigation plan during the construction phase 10-2
Table 10-2: Environmental mitigation plan during the operation phase 10-13
Table 10-3: Summary of the proposed monitoring plan during the construction phase 10-17
Table 10-4: Summary of the proposed monitoring plan during operation phase 10-21
Table 10-5: Summary of costs for environmental management during construction phase 10-23
Table 10-6: Summary of costs for environmental management during operation phase 10-24
Table 11-1: Proposed GRC Committees under this Project 11-3
Table 11-2: Sample record form of grievance received 11-4
Table 12-1: Description of Seismic Zones of Bangladesh 12-3

ACRONYMS AND ABBREVIATIONS

AAQ	Ambient Air Quality
AAS	Atomic Absorption Spectroscopy
AC	Alternating Current
ADB	Asian Development Bank
ADG	Additional Directors General
AIDS	Acquired Immunodeficiency Syndrome
ANL	Ambient Noise Level
ARIPA	Acquisition and Requisition of Immovable Property Act
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BDT	Bangladeshi Taka
BECA	Bangladesh Environmental Conservation Act
BFD	Bangladesh Forest Department
BFIDC	Bangladesh Forest Industries Development Corporation
BFRI	Bangladesh Forest Research Institute
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BNH	Bangladesh National Herbarium
BOD	Biochemical Oxygen Demand
BSc	Bachelor of Science
BSS	Bachelor of Social Science
BUCA	Beel User Co-operative Association
BWDB	Bangladesh Water Development Board
CAIGA	Compensatory Alternative Income-Generating Activities
CAP	Corrective Action Plan
CBD	Convention on Biological Diversity
CbFRM	Community-based Flood Risk Management
CEAP	Construction Environmental Action Plan
CEM	Construction Environmental Management Plan
CEMP	Construction Environmental Management Plan
CFU	Colony-forming Unit
CITES	Convention on International Trade in Endangered Species

CMS	Conservation of Migratory Species
CNC	Computer Numerical Control
CNG	Compressed Natural Gas
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CP	Construction Phase
CPUE	Catch Per Unit Effort
CR	Critically Endangered
DAE	Department of Agricultural Extension
DC	Deputy Commissioner
DD	Data Deficient
DG	Diesel Generator
DG	Director General
DIFE	Department of Inspection for Factories and Establishments
DO	Dissolved Oxygen
DOE	Department of Environment
DPD	Deputy Project Manager
DPHE	Department of Public Health Engineering
DSMC	Design–Supervision–Monitoring Consultant
EC	Electrical Conductivity
ECA	Ecologically Critical Areas
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
EHS	Environment, Health, and Safety
EIA	Environmental Impact Assessment
EL	Elevation Level
EMP	Environmental Management Plan
EMS	Environmental Management System
EN	Endangered
EPC	Engineering, Procurement, and Construction
EPR	Extended Producer Responsibility
EQS	Environmental Quality Standards
ESAP	Environmental and Social Action Plan
ESDD	Environmental and Social Due Diligence
ESIA	Environmental and Social Impact Assessment

ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESS	Environmental and Social Standard
FAO	Food and Agriculture Organization
FC	Fecal Coliform
FCPS	Fellow of the College of Physicians and Surgeons
FD	Forest Department
FGD	Focus Group Discussions
FI	Financial Intermediary
FPIC	Free, Prior, and Informed Consent
GBV	Grievance Committee
GC	Governing Council
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GIS	Geographic Information System
GL	Guidelines
GOB	Government of Bangladesh
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GSB	Geological Survey of Bangladesh
GW	Groundwater
HARD	Haor Area Resilience and Development
HC	Hydrocarbons
HFMLIP	Haor Flood Management and Livelihood Improvement Project
HH	Household
HILIP	Haor Infrastructure and Livelihood Improvement Project
HIV	Human Immunodeficiency Virus
HSE	Health, Safety, and Environment
HSMP	Health and Safety Management Plan
IBA	Important Bird and Biodiversity Areas
IEC	Important Environmental Component
IEE	Initial Environmental Examination
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
ILRP	Indigenous and Local Resettlement Plan

IMG	Independent Monitoring Group
IPM	Integrated Pest Management
IPP	Indigenous Peoples Plan
IRR	Internal Rate of Return
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
IWM	Institute of Water Modelling
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
JICAGL	Japan International Cooperation Agency Guidelines
JMC	Joint Management Committee
KII	Key Informant Interview
LC	Least Concern
LCB	Local Competitive Bidding
LCS	Local Community Contracts
LGED	Local Government Engineering Department
LGI	Local Government Institute
LRP	Livelihood Restoration Plan
LS	Lump Sum
MBA	Master of Business Administration
MBBS	Bachelor of Medicine, Bachelor of Surgery
MEA	Multilateral Environmental Agreement
MOEFCC	Ministry of Environment, Forest, and Climate Change
MOLE	Ministry of Labor and Employment
MOWR	Ministry of Water Resources
MS	Master of Science
MSL	Mean Sea Level
MSS	Master of Social Science
NBSAP	National Biodiversity Strategy and Action Plan
NCS	National Conservation Strategy
ND	Not Detected
NE	Not Evaluated
NEMAP	National Environment Management Action Plan
NEP	National Environmental Policy
NGO	Non-government Organization

NK	Nippon Koei
NO	Nitric Oxide
NOC	No Objection Certificate
NO_X	Oxides of Nitrogen
NT	Near Threatened
NTU	Nephelometric Turbidity Unit
NWMP	National Water Management Plan
ODS	Ozone-depleting Substances
OHS	Occupational Health and Safety
OP	Operation Phase
OTM	Open Tender Method
PA	Protected Area
PAH	Polynuclear Aromatic Hydrocarbons
PAP	Project Affected Person
PCM	Public Consultation Meeting
PCP	Pre-Construction Phase
PD	Project Director
PGD	Postgraduate Diploma
PIU	Project Implementation Unit
PM	Particulate Matter
PMO	Project Management Office
PPE	Personal Protective Equipment
PRSP	Poverty Reduction Strategy Paper
PSC	Project Steering Committee
PTFE	Polytetrafluoroethylene
PUO	Project Upazila Office
PWD	Public Works Department
RAP	Resettlement Action Plan
RCC	Reinforced Cement Concrete
SDE	Sub-Divisional Engineers
SDG	Sustainable Development Goal
SLCP	Short-Lived Climate Pollutants
SMO	Subproject Management Office
SO_2	Sulfur Dioxide
SPARRSO	Space Research and Remote Sensing Organization

SPM	Suspended Particulate Matters
SRDI	Soil Resource Development Institute
SS	Suspended Solids
SW	Surface Water
TC	Total Coliform
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TOR	Terms of Reference
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
UAV	Unmanned Aerial Vehicle
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNO	Upazila Nirbahi Officer
UNR	Union Road
UP	Union Parishad
USEPA	United States Environmental Protection Agency
UZR	Upazila Road
VES	Visual Encounter Surveys
VR	Village Road
VU	Vulnerable
WARPO	Water Resources Planning Organization
WHO	World Health Organization
WMO	Water Management Organization

Executive Summary

EXECUTIVE SUMMARY

E-1 Introduction

The Haor region in northeastern Bangladesh is a seasonally submerged wetland supporting 20 million people through Boro rice cultivation and wet-season fisheries. Climate change, flash floods, poor connectivity, declining fisheries, and limited infrastructure have heightened vulnerability and constrained development. Building on lessons from the Haor Flood Management and Livelihood Improvement Project, the HARD Project targets 15 haors across five districts to rehabilitate flood control structures, improve rural roads, enhance fisheries, and promote sustainable livelihoods. Aligned with national plans like the Haor Master Plan and Bangladesh Delta Plan 2100, the project emphasizes integrated planning, stakeholder engagement, and environmental and social safeguards. By strengthening climate resilience, improving access to markets, education, and health, and supporting agriculture and fisheries productivity, HARD aims to deliver inclusive, sustainable and long-term benefits for livelihoods, food security, and ecosystem conservation.

E-2 Project Description

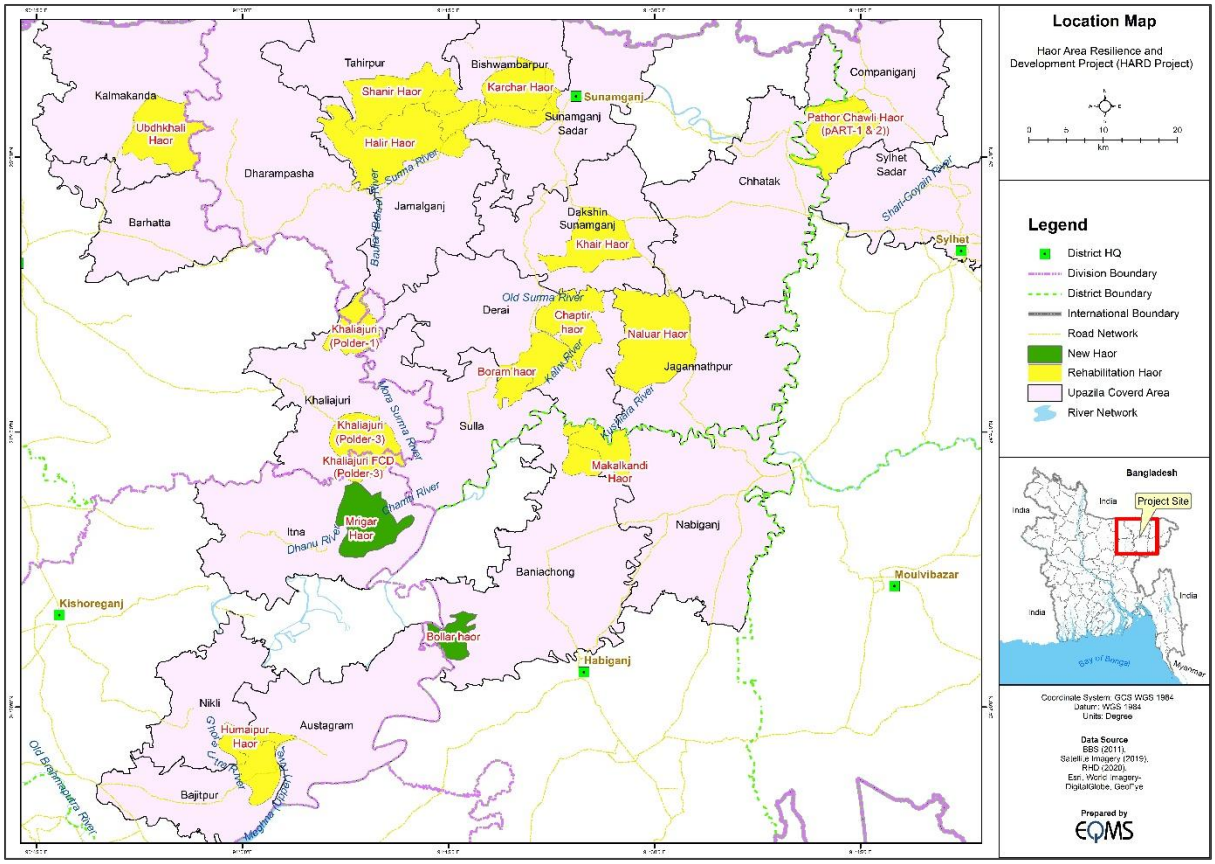
The Haor Area Resilience and Development (HARD) Project aims to strengthen rural connectivity, fisheries, and climate resilience across 15 priority haors in five north-eastern districts, benefiting around 4.1 million people. Building on the Haor Flood Management and Livelihood Improvement Project, HARD is implemented by LGED in coordination with BWDB, DoF, and MoL, focusing on Rural Infrastructure Development and Fisheries Promotion, alongside livelihood support and community capacity building.

Key interventions include upgrading 355.46 km of roads, constructing bridges, culverts, protection works, village walls, rural markets, and boat landings, alongside sustainable management and restoration of 194 beels, re-excavation of 582 km of khals, expansion of culture fisheries, and establishment of a Haor Natural Resource Museum. Complementary livelihood activities and seasonal planning ensure local engagement and sustainability. The HARD Project is designed to deliver lasting improvements in connectivity, livelihoods, climate resilience, and socio-economic development in the haor region.

E-2.1 Location of the Project

The HARD Project focuses on 15 priority haors across five north-eastern districts i.e., Sunamganj, Habiganj, Sylhet, Netrokona, and Kishoreganj, covering 84,711 hectares of deep floodplain basins prone to seasonal flooding, isolation, and wave action. These haors were selected from 373 candidates totaling 858,460 hectares based on pre-feasibility studies and potential for integrated rural development. The project aims to benefit about 4.1 million people, enhancing access to education, healthcare, markets, and fisheries, while reducing vulnerability to floods and other hazards. Spanning 18 upazilas, HARD ensures targeted interventions reach communities across these high priority haor ecosystems. The general location map of the proposed project is shown in Figure E-1.

Figure E-1: Location of the proposed project



Source: Study Team, 2025

E-3 Administrative and Legal Framework

The HARD Project in Bangladesh is guided by national policies, laws, and rules for environmental protection, including the National Environmental Policy 2018, the National Environmental Management Action Plan 1995, the Environment Conservation Act 1995, and the Environmental Conservation Rules 2023 (ECR 2023). These frameworks require an Environmental Clearance Certificate (ECC) and an Environmental Impact Assessment (EIA) for designated projects, set pollutant reference values, and categorize projects by potential environmental impact.

Internationally, the project aligns with the JICA Guidelines for Environmental and Social Considerations (2022) and is classified as Category B, indicating moderate environmental and social impacts. The project does not involve large-scale river control, sensitive ecological areas, or other high-risk features, so significant adverse environmental impacts are not anticipated.

A gap analysis was conducted to reconcile Bangladesh regulations with JICA standards, and mitigation measures have been proposed. All necessary permits and approvals will be obtained before, during, and after construction to ensure compliance and sustainable implementation.

E-4 Description of Environment

The baseline study has been conducted to capture the environmental conditions in and around the project area. Data was collected through primary surveys conducted in both the dry and wet seasons to account for seasonal variations. Secondary sources have also been reviewed and referenced to support and validate the findings.

E-4.1 Land Use Studies

The haor districts span about 2 million hectares, with 55 percent under cultivation and the remainder consisting of rivers, canals, wetlands, forests, homesteads, ponds, and infrastructure. They support around 1.68 million farm households, mainly smallholders, and 1.37 million non-farm households. Land use is highly seasonal: dry-season water recession enables intensive Boro rice cultivation in central haors, while elevated areas host homesteads, gardens, and small plots. Monsoon flooding transforms agricultural lands into fisheries and grazing areas, sustaining local livelihoods. Settlements sit on natural or raised levees, linked by basic rural infrastructure, with reed beds, aquatic plants, and homestead trees providing biodiversity and essential resources. The haor landscape follows a seasonal rhythm, alternating between agriculture in dry months and water-based livelihoods during the monsoon.

E-4.2 Meteorological Data

The project area falls within Bangladesh's tropical monsoon climate, with hot temperatures, heavy rainfall, high humidity, and four distinct seasons. Pre-monsoon from March to May is hot, reaching 36°C with occasional storms. Monsoon from June to September brings 60 to 67 percent of annual rainfall, high humidity, and cloudy conditions. Post-monsoon in October and November is generally hot and sunny, while the dry season from December to February is cooler and mostly rain-free.

In haor districts like Sylhet, Sreemangal, and Mymensingh, 30-year data show maximum temperatures of 32 to 36°C and minimums of 7 to 12°C. Annual rainfall is substantial, over 4,000 mm in Sylhet, around 2,370 mm in Sreemangal, and 2,100 mm in Mymensingh, largely concentrated in the monsoon, causing seasonal flooding that shapes agriculture, fisheries, and infrastructure planning.

Humidity is high year-round, 60 to 74 percent in dry months and over 80 percent during the monsoon, affecting soil moisture, evapotranspiration, human comfort, and construction scheduling. This climate context is important for designing resilient infrastructure and planning project activities.

E-4.3 Ambient Air Quality

Baseline air quality in the Haor region is generally good. Monitoring at nine locations during the dry season showed PM10 (60–69 µg/m³) and PM2.5 (30–36 µg/m³) within Bangladesh standards but above WHO guidelines, mainly due to dust from roads, agriculture, and domestic cooking. Other pollutants viz. NOx, SO2, CO, and O3 were well below national and WHO limits. Overall, the air quality poses no immediate health risks, providing a reference for the HARD project's environmental monitoring.

E-4.4 Water Quality

Surface and groundwater in the Haor Region were monitored at nine locations across dry and wet seasons. Surface water temperatures rose from 20.2–22.8°C in the dry season to 25.3–25.6°C in the wet season. Turbidity (1.28–27.40 NTU dry, 1.2–23.0 NTU wet) reflected local sediment inputs, while pH remained near neutral. Dissolved oxygen improved in the wet season, and BOD, COD, TDS, ammonia, and nitrate decreased, showing minimal pollution. Total coliforms were low, and all parameters met Bangladesh standards, indicating clean, ecologically healthy water suitable for fisheries and irrigation.

Groundwater was generally within Bangladesh and WHO standards for key parameters, but localized exceedances of arsenic (GW-8, GW-9), iron (GW-7, GW-9), manganese (GW-2), fluoride (GW-3), phosphate (GW-4–GW-6), and turbidity (GW-7–GW-9) were observed. Microbiological quality was excellent.

Overall, surface water is clean and fit for ecological and irrigation purposes, while groundwater is mostly safe for drinking, with site-specific interventions needed to address contamination and ensure long-term water safety.

E-4.5 Ambient Noise Quality

Baseline noise monitoring was conducted at nine representative locations across the Haor Region to capture both daytime and nighttime levels. The results show daytime Leq values between 42.1 and 45.3 dB(A) and nighttime Leq values between 39.8 and 42.5 dB(A), all well below the permissible limits of Bangladesh standards (55 dB(A) daytime, 45 dB(A) nighttime) and IFC guidelines for residential areas.

The ambient noise environment is low, reflecting the rural wetland character of the Haor landscape. Sources of noise are mainly boat engines, motorized three-wheelers, tractors, and occasional local road traffic. Overall, the Haor Region maintains a quiet baseline environment suitable for residential and community activities.

E-4.7 Topography

The study area is a low-lying haor basin, with 25% of land below EL. 5 m and 50% below EL. 8 m, making it highly prone to seasonal flooding. Part of Bangladesh's floodplain system, it receives runoff from the Meghalaya foothills. Flat terrain and shallow elevations dominate, with areas submerged in the monsoon and used for cultivation and settlements in the dry season. This topography strongly influences land use, agriculture, fisheries, and local livelihoods.

E-4.8 Ecologically Sensitive Area

There is no ecologically sensitive area or protected area in the study area. The nearest ecologically sensitive area is at an aerial distance of more than 12 km away from the site.

E-4.9 Flora and Fauna

The haor region comprises diverse terrestrial and aquatic ecosystems influenced by natural and human factors. Terrestrial habitats such as homesteads, agricultural lands, and roadside plantations support fruit and timber trees, 11 herpetofaunal species, 61 birds including migratory species, and nine mammals, mostly Least Concern with some Near Threatened species.

Aquatic habitats including beels, rivers, seasonal wetlands, swamp forests, and marshes contain 37 plant species and 60 fish and shrimp species, including Endangered, Near Threatened, and Vulnerable species. Plankton and benthos communities with 23 phytoplankton, 30 zooplankton, and 23 benthic macroinvertebrates indicate a productive ecosystem.

These habitats collectively sustain biodiversity, ecological functions, and local livelihoods, highlighting the importance of integrated conservation and management of the haor wetlands.

E-5 Public Consultation and Disclosure

Stakeholder engagement for the HARD Project followed JICA's 2022 Guidelines and involved continuous consultation with communities, farmers, fishermen, women, local authorities, NGOs, and financing institutions. Consultations showed strong support for embankment rehabilitation and road development due to anticipated benefits for agriculture, flood protection, and connectivity.

Key concerns focused on land acquisition, fair and timely compensation, livelihood impacts, and protection of vulnerable groups. Stakeholders recommended local employment opportunities, capacity building for farmers and fishermen, and active participation of women.

Additional issues included sustainable water use, fisheries management, ecological protection, and timely construction to minimize agricultural disruption. Government agencies emphasized adherence to environmental standards, while communities requested construction safety measures.

Overall, the consultations demonstrated broad project acceptance and provided actionable recommendations. Successful implementation will require fair compensation, livelihood restoration, gender inclusion, and robust environmental management.

E-6 Anticipated Environmental Impacts

The potential impacts of the proposed project on different components of the environment are systematically identified for evaluation of significance.

Impact on Air Quality

The HARD Project may affect air quality during construction and operation, primarily from dust and vehicle emissions. Construction activities like earthworks, excavation, and material handling generate PM10 and PM2.5, causing respiratory irritation, while vehicle exhaust adds CO, NO2, and particulates. These moderate impacts can be minimized through dust suppression, covering stockpiles, phased earthworks, machinery maintenance, speed control, soil stabilization, and regular air quality monitoring. During operation, dust from unpaved shoulders and increased traffic may pose low to moderate risks, mitigated by road paving, dust control, speed limits, roadside vegetation, traffic management, and emissions monitoring, protecting workers and community health.

Impact on Water Quality

The HARD Project may affect surface and groundwater quality mainly during construction. Runoff from earthworks, dredging, stockpiles, accidental spills, and untreated wastewater can increase turbidity, nutrients, and pollutants in rivers, canals, wetlands, and ponds, posing moderate, localized risks to aquatic life. Groundwater may be impacted by infiltration of fuels, chemicals, or wastewater, affecting shallow aquifers. Mitigation includes bunded hazardous material storage, spill response training, erosion and sediment control, wastewater treatment, careful stockpile management, timing works away from sensitive areas, and regular monitoring. During operation, impacts are negligible, with drainage systems maintaining water quality and protecting ecosystems and communities.

Impact on Soil Quality

The HARD Project may affect soil quality mainly during construction through spills of fuels and chemicals, improper disposal of dredged spoils and liquid waste, and soil compaction from heavy machinery, with moderate impacts on agricultural lands, vegetation, and sensitive areas. Mitigation measures include bunded storage of hazardous materials, spill response training, proper waste disposal, limiting machinery to designated areas, soil rehabilitation and re-vegetation, and monitoring soil quality. During operation, no significant impacts are expected, as contaminants will be removed and routine maintenance and drainage will preserve soil stability. With these measures, soil quality impacts can be effectively managed throughout the project.

Wastes

The HARD Project will generate waste mainly during construction, including debris from excavations, dredging, concrete, timber, metal, packaging, and domestic waste from labor camps, along with hazardous materials like fuels, oils, chemicals, solvents, and batteries. If unmanaged, waste could contaminate soil, obstruct drainage, affect nearby water bodies, and pose health risks to local communities. Impacts are considered moderate. Mitigation measures

include implementing a solid waste management plan, segregating waste, securely storing hazardous materials, regular collection and disposal at approved facilities, recycling debris where feasible, worker training, and site restoration. During operation, waste generation is minimal, limited to routine maintenance, with no significant impacts expected.

Impact on Ambient Noise Levels

During construction, noise from heavy machinery, vehicles, and material handling may affect workers, nearby residents, schools, healthcare centers, mosques, and local fauna, causing annoyance, communication interference, and temporary hearing discomfort. Impacts are moderate and temporary. Mitigation includes limiting noisy activities to daytime, using quieter equipment, regular maintenance, providing ear protection, erecting acoustic barriers, minimizing idle engines, and monitoring noise levels. During operation, traffic noise, especially from heavy vehicles, may affect receptors within 200 meters, but road surfacing, speed limits, green belts, and night-time restrictions will keep impacts moderate. Overall, noise impacts are manageable and within acceptable standards.

Impact on Vibration

During construction, vibration from heavy machinery, earthworks, and vehicle movement may affect on-site workers and nearby structures within about 110 meters, causing minor annoyance, temporary discomfort, or concerns for building stability. These impacts are considered low to moderate due to their localized and temporary nature. Mitigation measures include proper maintenance and operation of machinery, restricting heavy equipment near sensitive structures, careful scheduling of high-vibration activities, and periodic monitoring of vibration levels. During operation, routine activities are not expected to generate significant vibrations, and impacts are negligible.

Impact on Bottom Sediment

During construction, excavation, dredging, filling, and machinery movement in or near water bodies may disturb bottom sediments, increasing turbidity, reducing light penetration, smothering habitats, and releasing adsorbed pollutants. Aquatic organisms such as fish, benthic fauna, and plants, along with local water users relying on these bodies for irrigation, fishing, or domestic use, are the primary receptors. Impacts are considered moderate due to their localized but direct nature. Mitigation includes limiting in-water works to essential areas, using silt curtains or cofferdams, scheduling activities during low-flow periods, covering exposed soils, rehabilitating disturbed habitats, and monitoring turbidity and sedimentation. During operation, no major dredging or sediment disturbance is expected, and impacts are negligible.

Impact on Protected Areas and Eco-sensitive Zones

The immediate HARD Project study area does not include any designated PA under national regulations. The nearest PA is Rema-Kalenga Wildlife Sanctuary, located approximately 53 km from Mrigar Haor. In addition, the study area does not contain any Ecologically Critical Area (ECA), Ramsar Site, or Important Bird and Biodiversity Area (IBA). The nearest ECA is Tanguar Haor, which is about 2 km from the study area (Shantir Haor). Some local fish sanctuaries within haors serve as seasonal refuges for brood fish and juveniles. During construction, activities such as embankment building, excavation, and bridge works may temporarily increase turbidity, sedimentation, and noise near these sanctuaries, potentially affecting aquatic life. Mitigation measures including siting avoidance, sediment control, secure material storage, spill prevention, and restricted construction near sanctuaries can reduce impacts to insignificant levels. During operation, routine maintenance and fisheries use pose minor risks of habitat disturbance or spills, which can be managed through seasonal work scheduling,

fishing restrictions, proper material handling, and community monitoring. Overall, the project is not expected to cause measurable adverse effects on protected areas or fish sanctuaries, with localized impacts effectively mitigated.

Impacts on Terrestrial Ecosystems and Biota

The HARD Project area hosts a simplified terrestrial ecosystem with scattered homestead vegetation, roadside plantations, and wetland-edge habitats, supporting trees like Hijol, Koroch, Jarul, Mango, Jackfruit, and Coconut, as well as common birds, reptiles, amphibians, and small mammals. Construction activities, i.e., land clearing, tree felling, earthworks, and infrastructure development, can cause vegetation loss, habitat fragmentation, soil compaction, and disturbance or mortality of less mobile species. These impacts can be reduced to insignificant through tree-minimization, compensatory planting, dust and noise control, topsoil conservation, and worker awareness. During operation, routine maintenance, vehicle movement, and community activities may disturb wildlife, but vegetative buffers, seasonal scheduling, restricted off-road access, and community education will keep impacts minimal. Overall, with proper mitigation and monitoring, no long-term ecological damage is expected.

Impacts on Fisheries and Aquatic Resources

The HARD Project area supports rich aquatic biodiversity, including 55 fish and shrimp species, endangered species, plankton, benthic invertebrates, and waterbirds, with communities reliant on fisheries. Construction activities, i.e., excavation, embankments, canal re-excavation, and spoil disposal, can increase turbidity, siltation, and vegetation loss, disturbing aquatic life and degrading water quality. These significant impacts can be minimized through seasonal scheduling, silt curtains, responsible spoil and noise management, and spill prevention. During operation, minor risks from water connectivity changes, regulator management, and agricultural runoff can be mitigated via fish-friendly water management, wetland restoration, organic farming, and controlled navigation. With mitigation and monitoring, long-term impacts on aquatic biodiversity and haor ecology are minimal.

Impact on Hydrology

The haor area's hydrology, shaped by seasonal flooding, natural drainage, and interconnected wetlands, may be influenced by project activities such as road construction, embankments, and excavation. Construction during the dry season limits disruption, with only minor, short-term effects like localized runoff changes or temporary waterlogging, which can be managed through proper timing, material storage, and site rehabilitation. During operation, infrastructure may alter flow, cause sedimentation, or restrict fish movement if cross-drainage is inadequate. Aligning roads along natural ridges, preserving drainage patterns, and providing sufficient culverts, bridges, and regulators ensures impact remains minor and manageable with ongoing monitoring.

Impact on Topography/geology

The haor's flat, low-lying terrain may experience minor, localized changes from submerged road and embankment construction. Temporary elevation from earthworks can alter the surface, but limiting fill and conserving topsoil keeps impacts minor. During operation, roads allow seasonal flooding, preserving natural flow, so long-term geomorphological changes are negligible. Overall, topographic and geological impacts are minimal, reversible, and manageable with proper construction and post-construction measures.

Impact on Social Environment

During construction, noise from heavy machinery, vehicles, and material handling may affect workers, nearby residents, schools, healthcare centers, mosques, and local fauna, causing

annoyance, communication interference, and temporary hearing discomfort. Impacts are moderate and temporary. Mitigation includes limiting noisy activities to daytime, using quieter equipment, regular maintenance, providing ear protection, erecting acoustic barriers, minimizing idle engines, and monitoring noise levels. During operation, traffic noise, especially from heavy vehicles, may affect receptors within 200 meters, but road surfacing, speed limits, green belts, and night-time restrictions will keep impacts moderate. Overall, noise impacts are manageable and within acceptable standards.

Impact on Climate Change

The HARD Project has a low climate footprint, with minor greenhouse gas emissions from construction machinery and vehicles. Operational emissions are negligible, though traffic may slightly increase. Its climate-resilient design preserves flood flows and reduces extreme weather vulnerability. Mitigation measures such as equipment maintenance, low-emission fuels, efficient operation, traffic management, and GHG monitoring further limit impacts, ensuring minimal contribution to climate change while protecting natural hydrological systems.

Accidents

The project carries accident risks during both construction and operation, mainly from heavy machinery, vehicle movement, and increased traffic near settlements and schools. Implementing the Health and Safety Plan, traffic management, signage, safety infrastructure, worker training, emergency preparedness, speed controls, public awareness, and monitoring will significantly reduce these risks, ensuring safer conditions for workers and local communities throughout the project.

E-7 Environmental Management Plan

A number of mitigation measures to manage adverse impacts and recommendations to enhance benefits are captured in the Environmental Management Plan (EMP). The EMP also includes the following.

- Environmental Mitigation Plan
- Environmental Monitoring Plan

The EMP and other management plans have been developed in accordance with the requirements of regulations in Bangladesh. The EMP and other plans will be implemented during the construction and operation of the project. The EMP takes each of the impacts identified in the impact assessment of the EIA and sets out the management/mitigation measures needed to deal with the impacts as well as describes the responsibility for implementing these.

E-8 Environmental Monitoring Program

Environmental monitoring will help:

- Assessing the changes in environmental conditions.
- Monitoring the effective implementation of mitigation measures.
- Measuring deterioration of environmental quality for further preventive action(s).

The following monitoring programs are to be carried out at the project in order to meet the above objectives:

- Ambient air and noise, water, and soil quality
- Health, Safety, and Environment (HSE) audits
- Terrestrial and Aquatic Ecosystem
- Inspection of prevention and control measures.

E-9 Conclusion

The HARD Project is designed to deliver significant socio-economic and environmental benefits to the Haor region while minimizing adverse impacts. With careful implementation of mitigation measures and adherence to the Environmental Management Plan, the project will enhance flood resilience, secure agricultural productivity, improve fisheries, and strengthen local infrastructure and livelihoods. By integrating community participation, climate-adapted engineering, and ecosystem management, the project supports sustainable development, long-term climate resilience, and improved well-being for vulnerable populations, ensuring that both people and the environment can thrive.

General Information

GENERAL INFORMATION

G-1 Project Entrepreneur

The Local Government Engineering Department (LGED) is one of the largest public sector organizations in Bangladesh, operating under the Ministry of Local Government, Rural Development and Cooperatives. It is primarily responsible for planning, designing, and implementing rural, urban, and small-scale infrastructure to foster socio-economic development at the grassroots level. LGED's major activities include the construction and maintenance of rural roads, bridges, culverts, growth centers, and markets, as well as small-scale irrigation, drainage, and flood control projects. The department plays a vital role in improving rural connectivity, boosting agricultural production, and supporting poverty reduction by linking remote communities with markets and essential services. With extensive coverage across the country and collaboration with development partners like the World Bank, ADB, and JICA, LGED significantly contributes to rural and urban infrastructure development, decentralization, and local government capacity building.

Contact details of the project proponent is presented in Table G-1.

Table G-1: Contact details of the project proponent

Items	Detailed Description
Project Name	Haor Area Resilience and Development (HARD) Project [LGED Part]
Project Proponent	Local Government Engineering Department (LGED)
Address	LGED Bhaban (Level 11), Main Building, Agargaon, Sher-E-Bangla Nagar, Dhaka-1207
Contact Person	Md Rayhan Shiddique
Designation	Interim Project Director, HARD Project (LGED Part)
Contract Number	+880 1712582525
Email	rayhan_lged@yahoo.com

G-2 Environmental Consultant

Japan International Cooperation Agency has assigned JICA Survey Team (Comprises of Nippon Koei Co., Ltd; IC Net Limited and Shin-Ohashi Service & Research, Inc) for conducting "Preparatory survey for Haor Area Resilience and Development (HARD) Project". As part of this survey, an EIA study will be carried out. The persons in charge of the EIA study from the JICA Survey Team are-

1. Dr. A.K.M. Nurul Islam, Environmental and Social Considerations (International)
2. Tatsuya Nagino, Environmental and Social Considerations (International)
3. Md. Rezaul Karim, Environmental and Social Expert (National).

JICA Survey Team has entrusted EQMS Consulting Limited to carry out the EIA study. The contact details are as follows.

EQMS Consulting Limited

House #53, Road #4, Block-C, Banani, Dhaka-1213, Bangladesh
info@eqmscl.com | www.eqmscl.com

Contact Person : Tauhidul Hasan, Team Leader and Natural Environmental Expert

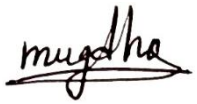
Telephone : +880 248810789-90
+880 1721346853

The EQMS team has utilized a multi-disciplinary team comprising of environmental and social experts. The team members have extensive professional experience working in the fields of environmental and social impact assessment specifically in Bangladesh and abroad. The team members involved in the EIA study are listed in Table G-2.

Table G-2: Team composition of the EIA study

S/N	Name	Qualification	Area/Field	Area of Study	Signature
1	Tauhidul Hasan	MS (Environmental Science) B.Sc. (Environmental Science)	• Environmental and Social Impact Assessment • Air Dispersion Modeling • Noise Modeling • Environmental and Social Due Diligence (ESDD) • Environment, Health and Safety Audit • Environmental and Social Action Plan (ESAP) Implementation Audit • Construction Environmental Action Plan (CEAP) • Hazard and Risk Assessment • GIS Mapping	Natural Environmental Expert	
2	Abu Mohammad Nasiruddin	MSS (Sociology) BSS (Sociology)	• Social Impact Assessment • Resettlement Action Plan • Livelihood Restoration Plan • Stakeholder Engagement Plan	Social Safeguard Specialist	
3	Mohammad Zahirul Haque	PhD (Environmental Science) MS (Environmental Science) PGD (Wildlife Management) B.Sc. (Forestry)	• Baseline Biodiversity Survey and Biodiversity Inclusive Impact Assessment • Critical Habitat Assessment and Analysis • Ecological Investigation of Terrestrial and Aquatic Habitat and Habitat Mapping • Wildlife Biodiversity and Composition Analysis • Wildlife Monitoring, Status Survey, and Population Estimation Preparation of Biodiversity Conservation, Management and Monitoring Plan	Ecology and Biodiversity Expert	

S/N	Name	Qualification	Area/Field	Area of Study	Signature
			• Human Wildlife Conflict Mitigation • Community-based Conservation Education		
4	Habibur Rahman	MS (Agriculture - Plant Pathology) B.Sc. (Agriculture) MBA (Marketing) MBA (Human Resource Management)	• Assess baseline agriculture (cropping, soil, land use, inputs, traditional practices). • Evaluate project impacts on agriculture, livelihoods, and food security. • Evaluate linkages between agriculture, fisheries, and water management. • Propose mitigation and enhancement measures (climate-smart practices, crop diversification, livelihood restoration). • Engage stakeholders (farmers, women groups, extension officers) and integrate feedback.	Agriculture Specialist	
5	Sadman Khaled Monsur	MS (Resources and Environmental Management) MS (Development Studies) B.Sc. (Environmental Management)	• Assess potential climate change impacts on the project and its vulnerability to extreme weather events. • Calculate the project's carbon footprint, including direct and indirect greenhouse gas (GHG) emissions. • Evaluate emissions from construction, operation, and maintenance phases. • Identify opportunities for GHG reduction and energy efficiency improvement. • Recommend climate change mitigation measures aligned with national and international targets.	Climate Change Specialist	

S/N	Name	Qualification	Area/Field	Area of Study	Signature
			• Propose adaptation strategies to enhance project resilience to climate risks. • Ensure compliance with relevant climate policies, standards, and reporting frameworks.		
6	Ferdows Alam Quaraishi	MS (Soil, Water and Environment) BS (Soil, Water and Environment)	• Environmental and Social Impact Assessment • Environmental and Social Management Plan • Environmental and Social Management Framework • Environmental and Social Safeguard Monitoring • Air Dispersion Modeling • Noise Modeling • Quantitative Risk Assessment and Modeling • Soil Pollution	Environment Expert	
7	Redoan Rakib	MSc (Environmental Science) BSc (Environmental Science) MBA (Finance)	• Initial Environmental Examination (IEE) • Environmental Impact Assessment (EIA) • Environmental & Social Impact Assessment (ESIA) • Environmental and Social Management System (ESMS) • Environmental Management Plan (EMP) • Construction Environmental Management Plan (CEMP) • Environmental Mitigation Corrective Action Plan (CAP)	Environmental Monitoring Expert	

S/N	Name	Qualification	Area/Field	Area of Study	Signature
			• Environmental Health and Safety (EHS) • Environmental Monitoring • Environmental Monitoring and Mitigation report writing • Environmental Inspection and Testing		
8	Balai Chandra Bhowmik	M.Sc. (Aquaculture) B.Sc. (Fisheries)	• Biodiversity/Ecological Baseline Data Collection • Habitat Classification and Phytosociological Analysis • Biodiversity Inclusive Impact Assessment • Management Plans for Biodiversity, Invasive Species, and Greenbelt Plantation • Biodiversity/Ecological Monitoring • Biodiversity Conservation and Wildlife Management	Fisheries Expert	
9	Farah Shamima Sultana	MS (Development Studies) B.Sc. (Urban & Regional Planning)	• Geographic Information System • Urban Planning • Remote Sensing • Satellite and UAV Image Analysis, Processing • Mapping and Cartography including web GIS mapping • Land Survey • Topographic Survey • Cadastral Survey and Mapping • Hydrological Analysis	GIS Expert	

CHAPTER 1

Introduction

1 INTRODUCTION

1.1 Background

The Haor region in northeastern Bangladesh is a unique wetland ecosystem that remains submerged for nearly half the year, forming a vast inland sea during the monsoon and exposing fertile plains in the dry season. This cycle sustains the livelihoods of nearly 20 million people who depend mainly on dry-season Boro rice cultivation and wet-season fisheries. However, the region is becoming increasingly vulnerable to climate change. Rising temperatures, erratic rainfall, and more frequent extreme weather events are undermining agriculture and fisheries, threatening both food security and socio-ecological stability.

Recognizing these challenges, national strategies such as the Bangladesh Delta Plan 2100, the Perspective Plan of Bangladesh 2021-2041, and the Eighth Five-Year Plan identify the Haor as a priority hotspot for flood management, poverty reduction, and climate resilience. These policies emphasize protecting agriculture and vulnerable communities from flash floods, diversifying livelihoods, and integrating climate adaptation into infrastructure and resource management.

The successfully completed “Haor Flood Management and Livelihood Improvement Project (HFMLIP)” (2014-2024) implemented embankments, slope protection works, and livelihood support programs that contributed to reducing certain risks. Despite these achievements, flash floods, erosion, and damage to infrastructure remain persistent challenges. These lessons underscore the importance of advancing climate-resilient flood management, strengthening rural infrastructure, and promoting sustainable agricultural and fisheries practices. This project was implemented by Bangladesh Water Development Board (BWDB) and Local Government Engineering Department (LGED) with JICA as a development partner. An Environmental Impact Assessment (EIA) for HFMLIP was prepared and duly approved by the Department of Environment (Ref. No. DOE/Clearance/5491/2015/339, dated 11 August 2016), and the Environmental Clearance Certificate (ECC) has subsequently been renewed over the past eight years.

The Haor Area Resilience and Development (HARD) Project aims to rehabilitate and construct flood control facilities, improve rural infrastructure, and promote agriculture and fisheries, aligning with both national priorities and community needs. The proposed HARD Project is a follow up of the HFMLIP. The project is expected to enhance food security, strengthen climate resilience, and improve the well-being of Haor communities while safeguarding this fragile ecosystem.

The HARD Project is designed in line with the Haor Master Plan (2012), Haor Master Plan for 2025 (Draft), and national priorities on food security, poverty reduction, disaster risk reduction, and climate adaptation. It also advances integrated basin-wide planning by aligning BWDB’s water management investments with LGED’s rural infrastructures and livelihood enhancement programs such as agricultural promotion activities coordinating with the Department of Agricultural Extension (DAE) and fisheries promotion programs coordinating with the Department of Fisheries (DoF) and the Ministry of Land (MoL) on beel tenure and community co-management.

To ensure effective implementation, a preparatory survey has been initiated by the JICA Survey Team in collaboration with local experts. The survey will assess environmental and social impacts and develop an Environmental Management Plan (EMP) with mitigation measures to minimize risks and maximize positive outcome.

1.2 Statement of Need

1.2.1 Context

The Haor Basin, located in the north-eastern region of Bangladesh, covering approximately 859,000 hectares and consisting of 373[1] haors and over 4,500 beels spread across districts like Sunamganj, Sylhet, Kishoreganj, Netrokona, Habiganj, Moulvibazar, and parts of Brahmanbaria. This region experiences prolonged flooding for six to seven months a year due to flash floods from the Meghalaya hills, resulting in extensive damage to standing boro crops, rural infrastructure, and fisheries resources.

Despite its ecological significance and contribution to national food security through rice and fisheries, the Haor Basin remains one of the poorest regions in Bangladesh. Poverty rates in several upazilas exceed 50%, and the lack of reliable infrastructure restricts access to markets, health care, and education, further deepening vulnerability.

1.2.2 Key Problems Identified

The haor region faces a complex web of challenges that keep its people trapped in cycles of poverty and vulnerability. Decades of underinvestment, coupled with a fragile ecosystem and increasingly unpredictable floods, have slowed its progress compared to the rest of the country. The following key constraints illustrate why targeted intervention is essential.

a. Frequent Flooding and Crop Losses

Early and intense flash floods often destroy the boro harvest, the main food and income source, causing economic shocks for farming households.

b. Poor Rural Connectivity

Submergible roads are limited, and during monsoon, boat transport is the only mode of movement. This isolation raises transport costs; delays trade and reduces market incentives.

c. Degradation of Fisheries Resources

Siltation of rivers and khals, overfishing, lack of proper beel management, and inadequate conservation measures have led to a steady decline in fish stocks and biodiversity over the past two decades.

d. Loss of Land and Livelihoods Due to Erosion

Strong wave action erodes homestead lands and threatens entire villages, forcing repeated displacement.

e. Low Employment Opportunities

With most land under single-crop farming and limited off-farm employment, rural households face prolonged periods of income scarcity.

f. Insufficient Social Infrastructure

Health facilities, education services, and rural markets remain sparse or poorly connected, limiting socio-economic progress.

1.2.3 Justification for the Project

Haor Flood Management and Livelihood Improvement Project (HFMLIP), implemented from 2014 to 2024, demonstrated the effectiveness of a coordinated and integrated approach in addressing the persistent challenges of the haor region. Through a combination of improved rural roads, development

[1] Master Plan of Haor Area, 2012.

of markets and boat landing stations, re-excavation of beels, establishment of community-based fisheries management systems and targeted livelihood support, the project contributed to improved food security, higher household incomes and stronger resilience among haor communities. These interventions not only facilitated the movement of people and goods but also enhanced access to education, health care and markets, while creating opportunities for more sustainable fisheries and diversified income sources.

Despite these achievements, the reach of Haor Flood Management and Livelihood Improvement Project (HFMLIP) was limited compared to the scale of need. Out of an estimated 373 haors in the northeastern region, only 27 were included in HFMLIP, leaving a large proportion of the population without the benefits of improved infrastructure and resource management.

The proposed Haor Area Resilience and Development (HARD) Project is designed to build on the successes of Haor Flood Management and Livelihood Improvement Project (HFMLIP) while expanding its reach to a larger portion of the haor region. The project will cover around 15 haors spanning in five districts (Sunamganj, Habiganj, Sylhet, Netrokona, and Kishoreganj) with approximately 83,247 hectares of area and is expected to benefit millions of residents by improving connectivity, enhancing market access, and creating stronger economic opportunities. The HARD Project will prioritize closing the remaining gaps in rural infrastructure, strengthening community-based fisheries management, and introducing new measures to help communities adapt to the increasing risks of flash floods and climate variability. Drawing on the lessons and institutional capacity developed under HFMLIP, the HARD Project aims to deliver more inclusive, sustainable, and resilient improvements in the livelihoods of haor communities.

1.2.4 Alignment with National and Regional Priorities

The design and objectives of the proposed project are not developed in isolation. They are rooted in and guided by existing national and regional frameworks that define the long-term vision for the haor region. These frameworks ensure that the project complements other government and development partner initiatives, avoids duplication of efforts, and maximizes the impact of investments. The alignment is most clearly reflected in the following priorities.

- Haor Master Plan (2012), which emphasizes integrated development and multi-agency participation.
- Haor Master Plan (2025) (Draft), ensures sustainable management of the haor ecosystem, protect livelihoods, improve flood resilience, and promote socio-economic development in the haor regions of Bangladesh.
- Bangladesh Delta Plan (2100), calls for long-term water resource management to address climate impacts.
- Government of Bangladesh's poverty reduction and rural development strategies, particularly for lagging regions.
- JICA’s development agenda, including food security, climate adaptation, and livelihood improvement.

1.2.5 Urgency of Intervention

The conditions in the haor region are deteriorating in ways that, if left unaddressed, will become increasingly difficult and costly to reverse. Existing vulnerabilities are compounded by frequent flash floods, declining natural resources, and limited livelihood options. Timely intervention is therefore essential to prevent further decline and to protect the gains made in previous phases. The risks of inaction include the following.

- Continued loss of agricultural output and fisheries potential.
- Increased outmigration due to recurring shocks and limited opportunities.

- Irreversible ecological degradation in one of Bangladesh's most sensitive wetland ecosystems.

1.2.6 Proposed Focus Areas

To achieve meaningful and lasting improvements in livelihoods and resilience across the haor region, the project will focus on a set of core interventions that address both immediate needs and long-term challenges. These interventions have been identified through lessons learned from the Haor Flood Management and Livelihood Improvement Project (HFMLIP), field assessments, and consultations with local stakeholders. The main areas of focus are as follows.

- Improvement and rehabilitation of rural roads, bridges, culverts, and protective works.
- Development of rural markets, growth centers, and ghats for trade facilitation.
- Beel and khal restoration, fish sanctuary creation, and promotion of aquaculture.
- Construction of village protection walls to prevent homestead erosion.
- Alternative income generation (CAIGA) and targeted support for women and marginalized groups.

1.3 Objectives of the Project

The overall objective of the HARD Project (LGED Part) is to improve climate-resilient rural connectivity and reduce seasonal isolation in haor areas, thereby enhancing economic growth, fisheries production improvement, social development, and resilience.

The specific objectives are given below.

- To construct and rehabilitate submersible roads, improving connectivity and transportation during the dry season.
- To build bridges, culverts, and drainage structures that ensure safe and reliable transport while preserving natural water flow.
- To develop growth centers, ghats, and local markets (hats) to stimulate rural trade and economic activities.
- To improve road access to growth centers, ghats, and local markets (hats), enhancing agricultural and fisheries value chains.
- To strengthen rural livelihoods by reducing transport costs and travel times.
- To promote beel development with community-based management for sustainable resource use.
- To promote culture fisheries for increased production and income generation.
- To enhance fisheries development through the establishment of fisheries extension facilities, supporting sustainable production and community livelihoods.
- To improve access to education, health, and social services for isolated and underserved communities.
- To contribute to disaster risk reduction and climate adaptation by incorporating climate-resilient design in infrastructure.

These objectives directly contribute to the Haor Master Plan (2012) and align with GoB and JICA's investment priorities for the haor region.".

1.4 Scope of the Study

The project focuses on improving rural connectivity and fisheries productivity in the north-eastern haor belt while ensuring close alignment with ongoing flood management initiatives.

- Expansion of rural access infrastructure to enhance mobility and year-round connectivity.
- Enhancement of fisheries productivity through community-based interventions.
- Coordination with BWDB's flood management works for integrated and sustainable outcomes.

- Implementation of rural infrastructure and fisheries components under LGED leadership.
- Collaboration with the Department of Fisheries (DoF) and Ministry of Land (MoL) through formal MoUs, building on the HFMLIP framework.
- Resettlement and compensation: If the project involves the resettlement of communities, the EIA will include an assessment of the social impacts and the development of a resettlement plan. This would include measures to compensate those who are affected by the project.
- Public consultation: The EIA would involve consultation with stakeholders, including nearby communities, NGOs, and government agencies. The consultation process would help to identify potential concerns and ensure that the views of stakeholders are taken into account in the development of the project.
- Monitoring and reporting: The EIA would include a plan for monitoring the implementation of the project and assessing its impact. This would involve regular monitoring and reporting to ensure that the project is being implemented in accordance with the approved plans and that any potential impacts are being managed appropriately.

The scope of the study is designed to ensure that the project is implemented in a sustainable manner and that the potential impacts are minimized.

1.4.1 Applicable Reference Framework

The key national legislation and international standards and guidelines of relevance to the EIA include:

- National policies, laws, regulations, and standards belongings to environmental quality, health and safety, wildlife conservation, protected areas, land use control, land acquisition, involuntary resettlement, water resources management, etc., and socio-economic and cultural issues at the national and local levels.
- JICA Guidelines for Environmental and Social Considerations, 2022.

Legislation that is in draft form and not yet promulgated has also been reviewed during the EIA process such that the EIA and associated plans (i.e., Environmental and Social Management Plan) are responsive and meet the anticipated relevant standards and guidelines. A more detailed overview of the relevant national legislation and international standards and guidelines is contained in Chapter 2 of this report.

1.5 Approach and Methodology

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

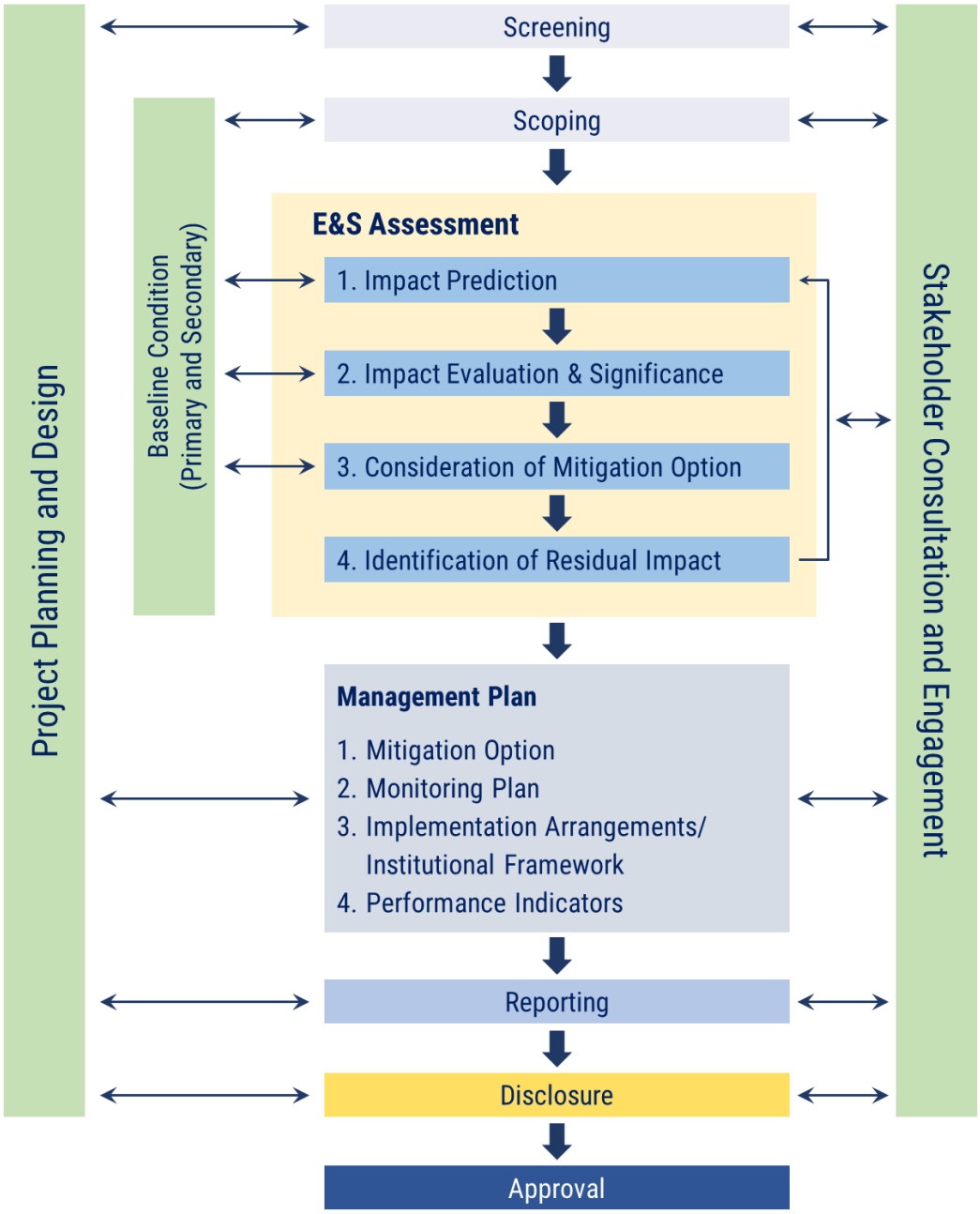
- **Scoping** includes a review of the project-related information, an assessment of regulatory requirements for the project, and a reconnaissance survey of the project site and surrounding area. The reconnaissance survey will help the consultant to identify the site and surrounding features including the presence of forests and other sensitive receptors, if any, located within the project influence area through primary and secondary data collection. The consultant will also consider the use of the existing data as readily available and provided by the client.
- Delineate any specific **baseline information** required to be collected for the study area with reference to the physical, biological, and social components of the environment.
- **Consult with stakeholders** and integrate their views into the project design and mitigation.
- Systematically **predict and evaluate the positive and negative changes** in these baseline conditions.

- All **impacts and benefits of the project** will be documented and fully explained within the EIA report.
- **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.
- Assess the **potential hazards and risks** associated with the project for the formulation of erosion, flood, lightning, and earthquake risk assessment and address them in the EIA.
- Develop an **Environmental Management Plan** which will delineate the following.
    - Mitigation measures for potential adverse environmental impacts.
    - Management tools and techniques for the implementation of mitigation measures.
    - Monitoring and reporting of requirements and mechanisms for the effective implementation of the mitigation measures and the EMP.

1.5.1 Approach for the Study

The approach proposed for the Environmental Impact Assessment (EIA) study has been presented in Figure 1-1.

Figure 1-1: Approach to the EIA



Source: Study Team, 2025

1.5.2 Methodology for the Study

In order to attain the earlier mentioned scope of work, the EIA would be based on the collection of primary and secondary baseline environmental information, impact assessment, and delineation of EMP. The methodology proposed to complete the EIA is divided into Tasks as presented in Table 1-1 and elaborated in subsequent sections.

Table 1-1: Tasks to be undertaken for the EIA

Task Number	Task Details
Task-1	Kick-off meeting

Task Number	Task Details
Task-2	Scoping
Task-3	Project description
Task-4	Review of policy, legislative, regulatory, and administrative consideration
Task-5	Analysis of alternatives
Task-6	Description of the environmental and socio-economic conditions
Task-7	Stakeholder consultation and information disclosure
Task-8	Identification and assessment of environmental and socio-economic impacts
Task-9	Hazard/risk assessment
Task-10	Development of environmental and social management plan
Task-11	Draft Final EIA Report
Task-12	Final EIA Report

1.5.2.1 Kick-off Meeting

Immediately following the completion of the contract negotiation and contract signing, the proponent, together with the project manager, completed all logistical arrangements. In accordance with the EQMS quality requirements, the project manager formalizes team briefing notes outlining the scope of work and output required from each of the team members. A kick-off meeting was held with the officials of the client for understanding and major objectives of the project, project details, activities, current status, project milestones, legal requirements, scope, etc.

1.5.2.2 Scoping

A scoping has been done at the beginning of the study to anticipate the potential impacts of the project on the physical and social environment. Scoping is a process to identify key environmental and social issues prior to in-depth investigation and analysis. This scoping has been prepared in accordance with the JICA guidelines.

The scoping results have been presented in the Terms of Reference (TOR) of EIA. The TOR has been prepared according to Schedule 10 of the Environment Conservation Rules (ECR), 2023 and submitted to the Department of Environment (DOE) on September 14, 2025.

1.5.2.3 Project Description

A section on the project description was prepared based on the available documents shared by the client with the consultant team. 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, discharge information inventories and maps using appropriate scales, etc. Also identify components of key environmental indicators on physical, biological, and social environments.

1.5.2.4 Review of Policy, Legislative, Regulatory, and Administrative Consideration

A literature review of national and international legislation, policies, and guidelines relevant to the proposed project, land acquisition and requisition, health and safety, emergency/disaster response and management, etc. was done by the study team during the scoping stage and EIA stage.

1.5.2.5 Analysis of Alternatives

A comparative analysis has been done to define the merits and demerits of realistic alternatives. The consultant systematically compared feasible alternatives to the proposed project site, technology, design, and operation, including the "without project" situation in terms of their potential environmental and social impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional training, and monitoring requirements.

1.5.2.6 Description of the Environmental and Socio-economic Condition

Based on the key issues identified in the scoping phase, available information on the existing environmental and social conditions (also referred to as baseline conditions) was gathered. This was supplemented by field studies and surveys where necessary. Baseline studies of physical, biological, and socioeconomic (including social, economic, and health) resources provide a reference point against which any future changes associated with a project can be assessed and offer information for subsequent monitoring of environmental performance.

Overall, the baseline information is based on gathering secondary data and site visit interactions with stakeholders. Secondary information for the baseline was sourced from publicly available information including current scientific literature, non-technical literature (environmental reports, articles, and other EIA documents, if available), online databases, and other secondary data sources.

For the proposed project, the following environmental and social aspects were studied within the scope of the EIA related to the project area, but not limited to:

- 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.
- Land use/cover.
- Road network and traffic factors.
- Prevailing land use.
- Socioeconomic aspects, health, and aesthetics.
- Demographic factors.
- Waste generation.

1.5.2.6.1 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), Department of Fisheries (DoF) 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, Salinity Intrusion, and Erosion.
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. - Sites of Cultural/Archaeological Importance.
C. Ecology and Biodiversity	• IUCN Red List Status 2015 • Flora and Fauna • Biodiversity Condition • Existing Terrestrial Ecosystem • Aquatic Fauna and Vegetation.

1.5.2.6.2 Primary Baseline Data Collection

The primary data which has been collected for the EIA is given in Table 1-2.

Table 1-2: Primary baseline data for the EIA

N°	Environmental Attribute	Number of Sampling Points	Frequency
1	Ambient Air Quality	9 locations	24 hours × 1 time (Dry season)
2	Noise Level	9 locations	Once during the baseline survey for 24 hours (Dry season)
3	Surface Water Quality	9 locations	2 times (Dry season and wet season)
4	Groundwater Quality	9 locations	1 time (Dry season)
5	Soil Quality	9 locations	Once during the baseline survey (Dry season)
6	River bottom sediment	9 points Survey area: River/ tributaries bottom around the project site (interventions)	2 times (Dry season and wet season)
7	Macro benthos (1) (Floodplain and river bottom)	9 points *Same as “River bottom sediment”	2 times (Dry season and wet season)

N°	Environmental Attribute	Number of Sampling Points	Frequency
8	Phytoplankton	9 points *Same as “River bottom sediment”	2 times (Dry season and wet season)
9	Zooplankton	9 points *Same as “River bottom sediment” Sampling :1 to 2 layers, depending on the depth) - 0 ~ - 2 m - 2 ~ - 10m	2 times (Dry season and wet season)
10	Fish and Other Nektons	9 areas - Fish market - Local fisheries office - Documents and hearing from experts/scientists Survey area: same as above - Important places (e.g., catching, spawning breeding, and other important zones for river aquatic ecosystem) of inland fishery activity in and around the Haor area - Fish migration patterns in and around the Haor area and nearby rivers	2 times (Dry season and wet season)

1.5.2.7 Stakeholder Consultation and Information Disclosure

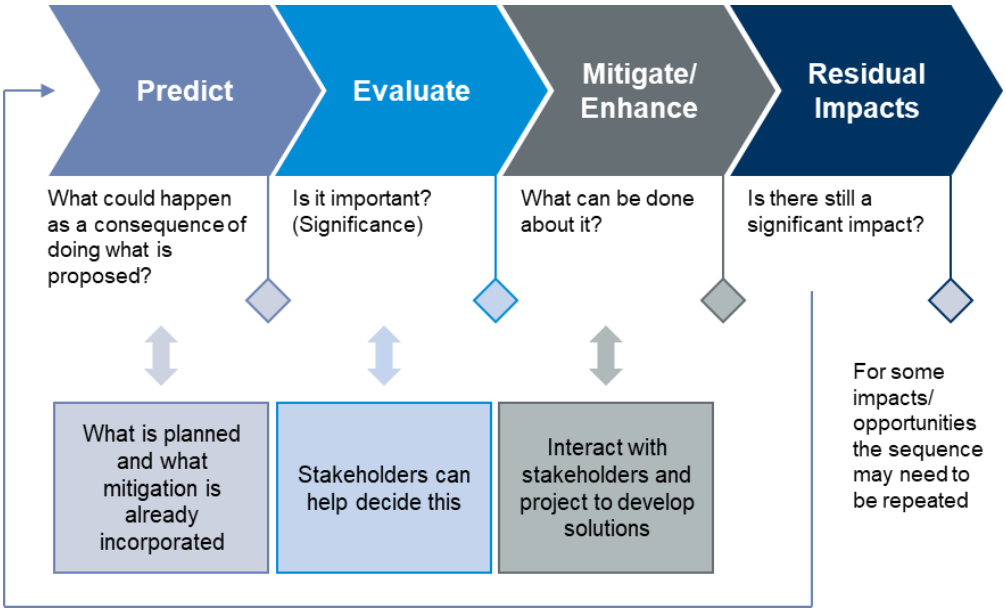
Extensive consultations were conducted with key stakeholders, including the local community, and government departments/agencies during the impact assessment phase. Stakeholder consultations were completed with the intent of collecting baseline information on the environmental and social conditions and sensitivities, developing a better understanding of the potential impacts, informing the public about the proposed project, and to gain an understanding of the perspectives/concerns of the stakeholders.

1.5.2.8 Identification and Assessment of Environmental and Socio-economic Impacts

The EIA 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 guidelines and standards and with reference to the JICA guidelines. Social impacts were assessed through the analysis of collected baseline data and available data found from the project proponent and secondary sources.

The impact assessment covered the full project lifecycle, including pre-construction, construction, operation/maintenance, and decommissioning. The impact assessment involves prediction, evaluation, and mitigation of impacts, and reporting on impacts including residual impacts (impacts remaining after all possible mitigation has been incorporated) 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 were proposed where necessary or appropriate.

Figure 1-2: Impact assessment process



Source: EQMS, 2025

Aspects which will be considered in the impact assessment, for the whole lifecycle of the project, include land use, water quality, air, noise, ecology (terrestrial and aquatic), critical habitat, endemic and threatened species, waste (solid, liquid, and hazardous), landscape and visual, land acquisition and resettlement, traffic, flood, erosion, and other natural disaster risks, soil and groundwater, socio-economic, occupational and community health and safety, labor and working condition, GBV and HIV/AIDS, etc. The environmental, ecological, socio-economic, and project information are to be collected to assess the potential impacts of the proposed activities. The issues among others are to be studied including potential project impacts.

The key issues will be identified 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 identified mitigation is implemented, for direct, indirect, and cumulative impacts, in the short and long term.

1.5.2.9 Hazard/Risk Assessment

The potentially hazardous areas of the project site have been identified and risk analysis to be done by the study team. Both the primary and secondary data relevant to the natural disasters/hazards were collected during the site visit and from the desktop review. Protective measures required to prevent the occurrence of any disaster have also been suggested and an emergency response plan has been prepared.

1.5.2.10 Development of Environmental Management Plan

Requirements 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.
- 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 that will be required during project implementation to avoid or reduce the environmental and/or social impacts, including developing the action plan in accordance with the requirements. An environmental monitoring plan will be 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.) are identified and provided as initial documents which will be updated before the start of construction activities by the contractor.

1.5.2.11 Reporting - Draft and Final EIA Report

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

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

1.6 Structure of the Report

The EIA report has been prepared to meet the requirement of national regulations as well as international guidelines. The outline of the present EIA report is as under:

1. **Introduction:** The chapter describes the background of the study, brief description, scope of the study, reference frameworks, approach and methodology, EIA team combination, and structure of the report.
2. **Administrative and Legal Framework:** This chapter covers all the legal provisions, including environmental and social laws applicable to the project. The chapter also covers all the national and international legislation and standards applicable to the project.
3. **Project Description:** This chapter provides a short description of the proposed project comprising project location, layout, and project components.
4. **Environmental and Social Baseline:** This chapter covers the environmental baseline parameters on the physical environment (land use, topography, geology, physiography, geomorphology, agroecology, 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. **Analysis of Alternatives:** The chapter analyzes the possible alternatives for the proposed project.
6. **Screening and Scoping:** This chapter presents a screening and scoping matrix of expected environmental and social impacts.
7. **Primary Baseline Survey:** This chapter describes the baseline environment of the project area and its surroundings, including ambient air quality, ambient noise environment, water quality, soil quality, and ecological resources, including biodiversity.
8. **Impact Assessment and Evaluation:** This chapter covers the detailed impact of the proposed project on different environmental components during the construction and operation phases of the project.

9. **Public Consultation and Disclosure:** This chapter presents information disclosure, consultation, and participation, comprising public consultations and disclosures conducted in the study area.
10. **Environmental Management Plan:** 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, 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.
11. **Grievance Mechanism:** The chapter presents the grievance mechanism for the development and implementation of the project.
12. **Emergency Response Plan and Disaster Management Plan:** This chapter presents the emergency response plan and disaster management plan for the proposed project.
13. **Conclusion:** This chapter presents the conclusion of the report.

CHAPTER 2

Administrative and Legal Framework

2 ADMINISTRATIVE AND LEGAL FRAMEWORK

This chapter provides a legal and regulatory framework, covering national requirements as well as guidelines and standards to address the environmental and social risks of any proposed project and its associated components and to protect and conserve the environment from any adverse impacts. This chapter intends to discuss the regulatory context, which is directly related to environmental compliance, which must be adhered to by all parties involved in the project throughout the planning, development and construction, and operation.

2.1 Environment Related Policies in Bangladesh

The National Environment Policy and the associated legislation on environmental protection and conservation represent the most important documents that relate to environmental protection and management in Bangladesh. The requirement of EIA for projects is described in these documents.

2.1.1 National Environment Policy, 2018

In 1992, the Bangladesh Government developed the National Environmental Policy (NEP) which defines the overall environmental framework and assigns responsibility for regulatory development, administration, and enforcement. This responsibility has been given to the Department of Environment (DOE) which is under the Ministry of Environment, Forest, and Climate Change. The National Environment Council, with the head of the government as chairperson, provides the overall policy direction.

In 26 years since the adoption of the Environment Policy, 1992, the nature and level of environmental and ecological degradation have changed. In order to address all those changes and with a view to protecting and conserving the environment and ecosystem in a rigorous, pragmatic, and sustainable manner as well as to bring climate change to the mainstream of the environment and development, the government has revised the National Environment Policy, 1992 and adopted the revised National Environment Policy, 2018.

The following are the key subject matters covered under the National Environment Policy, 2018.

- Ensuring sustainable development through reducing human pressure on nature and natural resources.
- Considering environment protection as an integral part of the development programs planned to meet the need of the present and future generations.
- Making natural resources extraction, use, environmental conservation, etc. to be based on science.
- Considering environmental impacts and risks in extracting and using natural resources.
- Evaluating the economic contribution of ecosystem services simultaneously to that of natural resources.
- Giving priority to poor and underprivileged groups of people in order to ensure their participation, equity, justice, accessibility to the use of natural resources, and getting ecosystem services on which they are dependent.
- Taking initiatives to prevent misuse and ensure the optimum of water, land, natural gas, and other natural resources in the production process as well as day-to-day purposes.
- Encouraging sustainable use of new and renewable resources.
- Enhancing long-term poverty alleviation and food security through conserving biological diversity.
- Realizing compensation from persons and institutes those who are liable for environmental pollution through applying the polluter pay principle.

- Including environmental conservation and preservation in all national policies and ensuring implementation of the environment policy at both government and non-government levels.
- Giving priority to preventive measures over curative measures in environmental conservation.
- Including adaptation and mitigation programs in all development projects in order to address adverse impacts of climate change.
- Ensure sustainable utilization of ecosystem goods and services.
- Implementation of 3R principle in utilization of resources.
- Strengthening institutional and legal capacity of institutions (government, local, private, and technical) relevant to the enforcement and implementation of rules and regulations relating to environment policy and environment conservation.
- Ensuring considerations of climate change and challenges of calamities in all kinds of infrastructure projects.
- Reducing all SLCP (Short-Lived climate pollutants) which are harmful to health and the environment.
- Taking development programs considering sustainable production and consumption as an integral part of environmental conservation to meet the need of present and future generations.
- Allocating necessary funds to all areas of environmental conservation, preservation, and control.
- Taking up programs in favor of a flourishing environment-friendly economy.

The policy has provided sector-wise policy coverage for 24 different sectors along with their plan of implementation, identification of respective implementing agencies, legal and institutional framework, and directives on compliance.

2.1.2 National Environment Management Action Plan, 1995

The NEMAP is a wide-ranging and multi-faceted plan, which builds on and extends the statements, set out in the NEP. NEMAP was developed to address issues and management requirements related to the environment during the period 1995 to 2005; it also sets out the framework within which the recommendations of the NCS are to be implemented. NEMAP was developed to achieve the following broad objectives.

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

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

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

2.1.3 National Biodiversity Strategy and Action Plan, 2004

The National Biodiversity Strategy and Action Plan (NBSAP) of Bangladesh provides a framework for conservation, sustainable use, and sharing of the benefits of biodiversity in the country. A major focus

of the NBSAP is the need for cross-sectoral linkages, reflecting the fact that in Bangladesh, more so than most other countries, biodiversity conservation is closely interwoven with social and economic development. Thus, NBSAP also provides a framework for securing the necessary environmental conditions to reduce poverty, ensure sustainable development, and respond to the implementation of elements of the country's Poverty Reduction Strategy Paper (PRSP). The major objectives of the NBSAP are to:

- Conserve and restore the biodiversity of the country for the well-being of the present and future generations.
- Ensure that the long-term food, water, health, and nutritional security of the people are met through the conservation of biological diversity.
- Maintain and improve the environmental stability of ecosystems.
- Ensure the preservation of the unique biological heritage of the nation for the benefit of the present and future generations.
- Guarantee the safe passage and conservation of globally endangered migratory species, especially birds and mammals in the country.
- Stop the introduction of invasive alien species, genetically modified organisms, and living modified organisms.

2.1.4 Other Policies Relevant to Environment

Additional policies in Bangladesh, their key features and their applicability to the project are detailed in Table 2-1.

Table 2-1: Policies relevant to environment

Policy/Legislation	Enforcement Agency - Ministry/Authority	Key features	Applicability
The National Forestry Policy, 2016	Ministry of Environment, Forest, and Climate Change	• Manage all existing forests, wildlife, and other forestry resources, adhering to the principles of sustainable management and climate resilience. • Enrich degraded forest areas and enhance land areas under forest/tree cover. • Develop wildlife conservation and management in protected areas and other habitats. • Produce a wide array of goods and ecosystem services for the benefit of Bangladesh's present and future generations.	Not applicable – There is no forest land.
The National Water Policy, 1999	Ministry of Water Resources	• Protection, restoration, and enhancement of the natural environment for ensuring sustainable development. • Minimize disruption to the natural aquatic environment in streams and water channels. • Protection of water quality, including strengthening regulations concerning agrochemicals and industrial effluent. • 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.	Applicable – The project will be in the haor area.

Policy/Legislation	Enforcement Agency - Ministry/Authority	Key features	Applicability
		• Ensure adequate upland flow in water channels to preserve the coastal estuary ecosystem threatened by the intrusion of salinity from the sea.	
The National Fisheries Policy, 1999	Ministry of Fisheries and Livestock	• Provide provisions for the protection and conservation of fish in freshwater and brackish water bodies. • Preservation, management, and exploitation of fisheries resources in inland open water. • Fish cultivation and management in inland closed water. • Prawn and fish cultivation in coastal areas. • Preservation, management, and exploitation of sea fishery resources. • Conserve fish breeding grounds and habitats. • promote fisheries development and conservation in all water bodies.	Applicable – The Haor is a major freshwater fish habitat, and the project activities might affect fish resources.
The 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, and use of natural resources. • Increasing food availability, rights, and purchasing power by increasing crop productivity 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.	Applicable – The LGED component improves rural connectivity, market access, and sustainable resource management, contributing to agricultural productivity and food security.

Policy/Legislation	Enforcement Agency - Ministry/Authority	Key features	Applicability
The 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 a growing population for a variety of reasons. • Prevent arbitrary use of land. • Formulate guidelines for the maximum use of land according to the natural differences in various 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. • Ensure that the use of land is compatible with the natural environment. • Making the best use of land to alleviate poverty and increase employment. • Play a helpful role in preventing the increase in the number of landless.	Applicable – The project involves land use for development while aiming to minimize land acquisition, preserve agricultural land, and use land efficiently for community benefit.
The Dredging and Dredged Material Management Policy, 2013	Ministry of Water Resources	• With respect to dredged material management, the policy says no agricultural land is hampered/damaged, might be dumped plan-wise in shallow places in rivers upon technical considerations, connection khals (channels) are not disconnected, and the best way of management to fill up low land (following Conservation Act 2000) or pile in government-owned Khas (wasteland).	Applicable – The LGED component involves beel and khal re-excavation, which generates dredged materials requiring proper management to avoid environmental damage and ensure compliance with the policy's

Policy/Legislation	Enforcement Agency - Ministry/Authority	Key features	Applicability
		• Salient features of the policy with respect to dredging are projects that has to be formulated after identifying locations of dredging and location for projecting/dumping of dredged materials; in the dry season, in no way dredged material shall be projected into flowing water.	guidelines on safe disposal and protection of agricultural land and water channels.
The Inland Water Transport Policy, 2009	Ministry of Water Resources	• Overall improvement of the inland water transport sector including dredging navigation routes, provision of inland port facilities and navigation aids, conducting hydrographic surveys, vessel development, etc.	Not applicable – The project does not involve inland water transport development or related infrastructure.
The National Land Transport Policy, 2004	Ministry of Communications	• All new roads and major improvements will be subject to an EIA. • Funding will be provided for mitigation measures. • The GOB will publish environmental standards for new roads and contemporary design standards addressing environmental issues.	Applicable – The LGED component includes construction and improvement of rural roads, bridges, and culverts, which require environmental assessment and mitigation measures as outlined in the policy.
The Coastal Zone Policy, 2005	Ministry of Water Resources	• Reduction of poverty, development of sustainable livelihoods. • Poverty reduction through enhancing economic growth in the coastal zone. • Sustainable management of natural resources like inland fisheries and shrimp, marine fisheries, marine fisheries, mangroves, and other forests, land, livestock, salt, minerals, and sources of renewable energy like tide, wind, and solar energy. • Emphasis on conservation and enhancement of critical ecosystem-necessary measures will be taken to conserve and	Not applicable – The project area is in the Haor region, which is inland and not part of the coastal zone.

Policy/Legislation	Enforcement Agency - Ministry/Authority	Key features	Applicability
		develop aquatic and terrestrial including all the ecosystems of importance identified by the Bangladesh national conservation strategy (Mangrove, coral reef, tidal wetland, seagrass bed, Barrier Island, estuary, closed water body, etc.).	
The National Occupational Health and Safety Policy, 2013	Department for Inspection of Factories and Establishment/ Ministry of Labor and Employment	• Necessary measures to ensure workplace safety and health protection in light of international Conventions/Declarations/ Recommendations/Instruments. • Review and updating of all laws relating to Occupational Health and Safety (OHS). • Inclusion of OHS issues in the policies and programs of all related Ministries and agencies. • Establish labor courts in the industrial zone as the workers and trade unions can have easy access to the courts for implementing the mandatory provisions of OHS. • Impose mandatory terms and conditions upon construction agencies to follow the OHS policies during govt. run construction works. • To ensure maximum safety standards during construction and implement all standards and regulations on an internal safety environment.	Applicable – As the policy pertains to the occupational rights and safety of workers and has the provision of a comfortable work environment and reasonable working conditions for all employees.

2.2 Environment and Social Related Legislations in Bangladesh

The main acts and regulations guiding environmental protection and conservation in Bangladesh are outlined in the following subsections.

2.2.1 Bangladesh Environment Conservation Act, 1995 and Subsequent Amendments

The Bangladesh Environment Conservation Act (BECA), 1995 is the main legislation for the conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution.

The provisions of the act authorize the Director General of DOE to undertake any activity that is deemed fit and necessary to conserve and enhance the quality of the environment and to control, prevent and mitigate pollution. The main highlights of the act are:

- Declaration of Ecologically Critical Areas (ECAs).
- Obtaining an Environmental Clearance Certificate (ECC).
- Regulation with respect to 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 in different areas and for different purposes.
- Promulgation of acceptable limits for discharging and emitting waste.
- Formulation of environmental guidelines relating to the control and mitigation of environmental pollution, conservation, and improvement of the environment.

2.2.2 Environment Conservation Rules, 2023

The Environment Conservation Rules (ECR), 2023 is the main subsidiary legislation of the Environment Conservation Act, 1995 which outlines various procedures or measures that need to be taken for compliance with the related provisions of the Environment Conservation Act, 1995. The Environment Conservation Rules, 1997 was the first set of rules promulgated under the Environment Conservation Act, 1995 which was repealed by the Environment Conservation Rules (ECR), 2023, promulgated on 5 March 2023. These rules provide for, inter alia, the following.

- 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 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 a listing of environmental consultants and specialists.

Environment Conservation Rules (ECR), 2023 provides specific rules and procedures for various categories of projects in relation to their approval prior to construction and operation.

2.2.3 Air Pollution (Control) Rules, 2022

The Air Pollution (Control) Rules, 2022 has been published by the government of Bangladesh 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 for environmental conservation and sustainable development. They include emission standards for mobile and stationary sources, such as vehicles, industries, power plants, etc.

Some of the key features of this rule are:

- It creates the National Air Quality Control Plan and the Air Pollution Prevention Plan.
- It enables the declaration and management of degraded airsheds.
- It identifies air pollution activities such as burning of waste, construction work, brick kilns, etc., and prescribes measures to control them.
- It establishes standards for ambient air quality and odor.
- It sets the standard for construction dust control.
- It establishes standards for emissions from mobile sources (vehicles) based on their fuel type, engine capacity, and year of manufacture. In order to control air pollution from motor vehicles, the regulatory authority for motor vehicles (http://www.brta.gov.bd/) shall comply with the standards and control methods specified in the Rules and follow the work procedures recommended in the National Air Quality Management Plan.
- The Department of Environment (DOE) may inspect the emissions of motor vehicles and restrict the movement of old motor vehicles that give off emissions exceeding the standards. The DOE may also regulate and prohibit certain engines in order to enforce the standards and control methods specified in the rules.
- It also establishes standards for emissions from stationary sources (industries and power plants) based on their type, size, and location.
- The DOE will prepare and publish a list of industries, projects, and activities that are harmful to the environment and human health. For the industries and activities included in the list, the DOE will establish emission standards and conditions for management as appropriate.
- It requires owners or operators of mobile and stationary sources to obtain permits from the Department of Environment and comply with the emission standards.
- It requires permits for air pollution activities and imposes penalties for violations such as two years imprisonment and Tk 2 lakh fine for emitting harmful substances into the air.
- Local government organizations, construction management authorities, and other relevant organizations shall comply with the standards and control methods specified in the rules and follow the work procedures recommended in the National Air Quality Management Plan.

The rules also provide for the prevention of air pollution from hazardous waste, excessive emissions of air pollutants, air quality monitoring and warning, data management, establishment of a national executive committee for air pollution control, measures to prevent damage to ecosystems caused by air pollution, awards for contributions to air pollution control, and penalties for violations.

2.2.4 Noise Pollution (Control) Rules, 2025

The Noise Pollution (Control) Rules, 2025 are a set of rules adopted by the government of Bangladesh to regulate and control noise pollution in the country. This rule has been promulgated under the provision of clause 20 of the Environment Conservation Act, 1995.

Some of the key provisions of the Noise Pollution (Control) Rules, 2025:

- Limits on noise levels: The rules provide standard limits for noise levels of vehicles and designated areas. It prescribes different limits for noise levels depending on the time of day and areas such as residential, silent, mixed, commercial, and industrial areas. For example, in residential areas, the permissible noise level during the day is 55 dB(A) and at night, it is 45 dB(A).
- Prohibition of certain activities: The rules prohibit certain activities that are likely to cause noise pollution, such as using loudspeakers or amplifiers in public places, playing loud music in residential areas, and using noisy construction equipment during restricted hours.
- safety and precautionary measures: The rules stipulate safety and precautionary measures in workplaces and designated authorities for allowing noise-generating appliances.
- Enforcement: It empowers the Department of Environment to monitor noise pollution, enforce the provisions of the rules, and to take necessary actions against violators.
- Penalties: The rules prescribe penalties for violations, which include fines and imprisonment.

2.2.5 EIA Guidelines for Industry, 2021

The EIA Guidelines is a handbook for procedures for preparing the EIAs and for reviewing them for the benefit of the development partners, EIA consultants, reviewers, and academicians. While preparing these guidelines, the present environmental status, as well as the need for the rapid economic development of Bangladesh, has been kept in view. These considerations have essentially resulted in simpler procedures to be followed to prepare the EIAs and their review.

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.

2.2.6 Bangladesh Haor and Wetland Conservation Act, 2026

The Bangladesh Haor and Wetland Conservation Act, 2026 provides the principal legal and institutional framework for the protection, conservation, restoration, and sustainable management of haor and wetland ecosystems in Bangladesh. The Act emphasizes biodiversity conservation, ecological balance, and regulation of human activities affecting wetlands.

A designated authority “Department of Bangladesh Haor and Wetland Development” is established under the Act to perform regulatory, planning, monitoring, and enforcement functions. The Authority is responsible for ensuring compliance with the provisions of the Act and coordinating with relevant government agencies for integrated wetland management. The main highlights of the Act are:

- Declaration of protected haor and wetland areas for conservation.
- Preparation and implementation of integrated wetland management plans, policies, and conservation programs.
- Regulation of activities affecting wetlands, including land use, water abstraction, infrastructure development, and natural resource utilization in the wetland areas.
- Protection and conservation of biodiversity, aquatic ecosystems, and natural habitats.
- Prohibition of harmful activities such as:
  - Illegal encroachment, land filling, and unauthorized land conversion
  - Pollution of water, soil, and environment
  - Disruption/obstruction of natural water flow
  - Destructive fishing practices and habitat destruction.
- Requirement of consultation and approval from the authority for development projects affecting wetlands.
- Provision for restoration and sustainable management of degraded wetlands.

- Promotion of climate-resilient and adaptive management approaches, supported by research and monitoring.
- Provision for inter-agency coordination and stakeholder engagement in wetland management.
- Provision for inspection, monitoring, compliance enforcement, and legal action against violations. Imposition of penalties including fines and imprisonment for non-compliance.
- Empowerment of the Government to formulate rules, guidelines, and regulatory instruments for effective implementation.

2.2.7 Other Legislations Relevant to Environment

Additional acts and regulations guiding environmental protection and conservation in Bangladesh are outlined in Table 2-2.

Table 2-2: Legislations relevant to environment

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
The Environment Court Act, 2010	Ministry of Environment, Forest, and Climate Change Judiciary	• Establishment of one or more environment courts in each district and one or more special magistrate courts in each district. • Also provides the jurisdictions of the environment court, the penalty for violating courts orders, a trial procedure in special magistrate court, power of entry and search, a procedure for investigation, procedure and power of environment court, the authority of the environment court to inspect, appeal procedure and formation of the environment appeal court.	Applicable – The court has jurisdiction, under the act's provisions, over a trial for an offense or compensation under environmental law, imposing penalties for violation, etc.
The Ozone Depleting Substances (Control) Rules, 2004 and amendment in 2014	Ministry of Environment, Forest, and Climate Change	• Ban on the use of Ozone depleting substances. • Phasing out of Ozone depleting substances.	Not applicable – The project does not involve the use or handling of ozone-depleting substances.
The Ecologically Critical Areas (ECAs) Management Rules, 2016	Ministry of Environment, Forest, and Climate Change	• The ECA Management Rule, 2016 has enabled the government to form a "National Committee" headed by the Secretary, MOEFCC. • To implement the decision of the Directorate, District, and Upazila committee may be formed. For the conservation and development of the ecologically critical area, one or more teams may be formed. The responsibility of the team would be to implement the decision and planning of the Government to improve the Environment for Ecology. • The Rule also prohibited many activities and processes which are detrimental to the natural condition of habitat, tranquility, biodiversity, etc.	Applicable – The Tanguar Haor is close to the site and some IBA sites are there.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
The Bangladesh Biodiversity Act, 2017	Ministry of Environment, Forest, and Climate Change	• The Act has enabled the government to form a "National Committee on Biodiversity" headed by the respective Minister/State Minister. The functions of the committee are to conserve biodiversity, genetic biodiversity, identification of biodiversity-related key areas, heritage, etc. • The government is empowered to declare, in consultation with local communities and bodies and in coordination with concerned ministries or departments, 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 affects, or may have an effect on endangered species; (b) adversely affects or may affect the environmental characteristics of the endangered ecological community; or (c) In accordance with the Ramsar Convention, the wetland may adversely affect or affect the environment and environmental characteristics of the declared area.	Applicable – The project may affect the surrounding environment and biodiversity, so measures are needed to conserve species and habitats.
The Forests Act, 1927 and subsequent amendments	Ministry of Environment, Forest, and Climate Change	• Categorization of forests as a reserve, protected, and village forest. • Permission is required for the use of forest land for any non-forest purposes.	Not applicable – There is no forest area within the project sites.
The Private Forests Ordinance Act, 1959	Regional Forest Officer, Forest Department	• Conservation of private forests and for the afforestation on wastelands.	Not applicable – There is no forest area within the project sites.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
The 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) 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, kunjaban, etc.). • No person, institution, or company shall establish or operate any industrial factory or brickfield within 2 (two) kilometers from the boundary of a sanctuary.	Applicable – As the project study area supports many wildlife species and their habitats.
The Protected Area Management Rules, 2017	Ministry of Environment, Forest, and Climate Change	• The legal basis for the management and co-management of forest-protected areas. • Structures, functions, and obligations of management of some of the protected areas, but excluding safari-park, zoo, botanical garden, private park, and wildlife fertility center from their application. • The Rules have 33 sections and provide a model for participatory co-management, consisting of forest-dependent communities, forest department, civil administration, and civil society organizations. • The rules provide financial benefits and income incentives to shareholders through participatory social forestry programs to be planted in buffer and landscape areas, and eco-tourism.	Not applicable – As there are no protected areas (gazette) present in the study area.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
The National Water Management Plan, 2001 (approved in 2004)	Ministry of Water Resources	• The plan provides a framework within which all concerned with the development, management, and use of water resources and water services in Bangladesh can plan and implement their own activities in a coordinated and integrated manner. The planned activity programs have been presented in the eight sub-sectoral clusters: i. Institutional development ii. Enabling environment iii. Main river iv. Towns and rural areas v. Major cities vi. Disaster management vii. Agriculture and water management viii. Environment and aquatic resources. • Each cluster comprises a number of individual programs. WARPO was assigned to monitor the NWMP.	Applicable – The LGED component includes rural infrastructure and fisheries development in the haor region, which depend on effective water management and coordination with BWDB and other agencies, consistent with the objectives of the National Water Management Plan.
The Bangladesh Water Act, 2013	Ministry of Water Resources	• Any infrastructure or landfilling activities over any natural watercourses, stop the natural flow or create obstacles or divert or attempt to divert the direction is strictly prohibited. • According to the provision of section 43, all the costs may be incurred for the removal of infrastructure or landfilling materials from the person liable for making infrastructure or carrying on landfilling activities. • Any area or any part or any land connected with water resources can be declared as a Water Stress Area.	Applicable – As the project will use both surface water and groundwater.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
		• Ensuring safe abstraction of water from aquifers and executive authority may be 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 store, preserve, or divert the water of any water source in any natural or artificial reservoir.	
The Bangladesh Water Rules, 2018	Ministry of Water Resources	• Provision of No Objection Certificate for the establishment of projects related to flood control and management project; surface water extraction, supply and use related project and part of the project; irrigation project using surface water; construction of hydraulic structures; water conservation project; flood-affected plain land and wetland development project; groundwater for industrial use; riverbank protection and river control; river excavation and dredging project; canal excavation and re-excavation project; fisheries development in surface water project; groundwater extraction, supply, and use related project and 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.	Applicable – As the project will use both surface water and groundwater.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
The National River Protection Commission Act, 2013	Ministry of Water Resources	• An act to establish a Commission for preventing illegal occupation of rivers, pollution of water and environment, pollution of rivers caused by industrial factories, illegal constructions, and various irregularities and ensuring multidimensional use of rivers for socio-economic development including restoration of the normal flow of rivers, proper maintenance thereof and making them navigable.	Applicable – The project may affect rivers and water bodies in the Haor area, so measures are needed to prevent pollution, illegal encroachment, and to maintain proper flow.
The Embankment and Drainage Act, 1952	Ministry of Water Resources	• An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal, and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion, and other damage by water.	Applicable – The LGED component includes construction of protective works and village protection walls to prevent flooding and erosion, activities that fall under the provisions of the Embankment and Drainage Act, 1952.
The National 3R Strategy for Waste Management, 2010	Department of Environment	• The concept of this strategy is minimizing waste impacts in terms of quantity or ill effects, by reducing the quantity of waste products with simple treatments and recycling the 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 which still have usable aspects. • Recycling means the use of waste itself, as resources.	Applicable – The project will generate construction waste, so the strategy can guide waste reduction, reuse, and recycling measures.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
		• It suggests ISO 14001 or any other EMS structure which is significant for the development of strategies relevant to the industry and its social and environmental setting. ISO 14001 is increasingly important in international trade.	
The Protection and Conservation of Fish Act, 1950 and its amendments The Protection and Conservation of Fish Rules, 1985 and its amendments	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 make any attempt to destroy any fish by explosives, gun, bow, or arrow in inland waters or within coastal waters. During the project intervention, it should be noted that if waste effluent is not treated then it may cause significant damage to the local fishery and thus violate the provision of the law. • No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents, or otherwise in inland waters. • Protection and conservation of fish in government-owned water bodies.	Applicable – The project activities may affect fish in Haor waters, so measures are needed to prevent pollution and protect local fisheries.
The Inland Shipping (Amendment) Act, 2005	Ministry of Shipping	• No inland ship shall proceed on any voyage or be used for any service without written permission from the registrar to ply in coastal water. • No inland ship or a facility plying or operating in, or around inland waterways shall be used without registration and sanitation facilities as may be prescribed and no inland ship activity shall be conducted to cause pollution of inland water. • Discharge of oily mixture and sewage into inland water is prohibited.	Not applicable – The project does not involve inland shipping or related activities.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
The Vehicle Act, 1927 The Motor Vehicles Ordinance, 1983 The Bengal Motor Vehicle Rules, 1940	Bangladesh Road Transport Authority	• Exhaust emissions. • Vehicular air and noise pollution. • Road/traffic safety. • Vehicle Licensing and Registration. • Fitness of Motor Vehicles. • Parking by-laws.	Applicable – The project will involve the movement of vehicles and machinery, so these laws are relevant for traffic safety, vehicle fitness, and controlling air and noise pollution.
The Hazardous Wastes and Ship Breaking Waste Management Rules, 2011	Ministry of Environment, Forest, and Climate Change	• The main focus of this legislation describes, premised on Basel; barred imports if ships not certified by authorized agents of exporting countries as not containing hazardous wastes; provided regulations for safe disposal of hazardous waste; emergency response plan; Implementation rests with a National Technical Committee under MOEFCC.	Not applicable – The project does not involve hazardous waste or ship-breaking activities.
The Removal of Wrecks and Obstructions in Inland Navigable Water Ways Rules, 1973	Bangladesh Water Transport Authority	• Removal of wrecks and obstructions in inland navigable waterways.	Not applicable – The project does not involve removal of wrecks or obstructions in navigable waterways.
The 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 because of land acquisition.	Applicable – The project may require land acquisition, so this law ensures compensation for affected persons and their assets.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
The Import and Export Control Act, 1950	Ministry of Finance	• No goods of the specified description shall be imported or exported except in accordance with the conditions of a license to be issued by the Chief Controller or any other officer authorized on this behalf by the Government.	Not applicable – The project does not involve import or export of licensed goods.
The Antiquities Act, 1968 The Antiquities Preservation Rules, 1986	Ministry of Cultural Affairs	• Preservation of the national cultural heritages, protection, and control of ancient monuments, regulates antiquities as well as the maintenance, conservation and restoration of protected sites, conservation and restoration of monuments, controls planning, exploration, and excavation of archaeological sites.	Not applicable – There are no archaeological and cultural sites in the project site.
The Urban Open-fields, Garden, and Natural Water Bodies Protection Act, 2000	City Corporation	• Preserve an area of open space from encroachment or conservation for other uses. • Protect the open spaces and natural water bodies including floodplains of the urban areas from filling up for the shake of urbanization and development.	Not applicable – The project is in a rural Haor area, not in urban open spaces or city floodplains.
The Fatal Accidents Act, 1855	Ministry of Law, Justice, and Parliamentary Affairs	• Provide compensation to families for loss occasioned by the death of a person caused by actionable wrong. It is mentioned in s.1, whenever the death of a person shall be caused by wrongful act, neglect or default, and the act, neglect or default is such as would (if death had not ensued) have entitled the party injured to maintain an action and recover damages in respect thereof, the party who would have been liable if death had not ensued shall be liable to an action or suit for damages, notwithstanding the death of the person injured, and although the death shall have been caused under such circumstances as amount in law to a felony or other crime.	Applicable – The project must ensure safety measures to prevent accidents, as the law provides compensation for deaths caused by negligence or wrongful acts.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
The Explosives Act, 1884	Ministry of Law, Justice, and Parliamentary Affairs	• 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.	Not applicable – The project does not involve the use, manufacture, or transport of explosives.
The Penal Code, 1860	Ministry of Law, Justice, and Parliamentary Affairs	• Valid provisions related to pollution management, environment protection, and protection of health and safety. Chapter XIV of the Penal Code provides offenses effective public health, safety, convenience, decency, and morals: • Section 277: Falling Water or Public Spring or Reservoir. • Section 278: Making Atmosphere Noxious to Health. • Section 284: Negligent Conduct with Respect to Poisonous Substance. • Section 285: Negligent Conduct with Respect to Fire or Combustible Matter. • Section 286: Negligent Conduct with Respect to Explosive Substance, etc.	Applicable – The project must follow safety and environmental precautions to prevent pollution, health hazards, and negligent acts that could harm people or the environment. .
The Factories Act, 1965 and the Factories Rules, 1979 The Bangladesh Labor Act, 2006 and its amendments The Bangladesh Labor Rules, 2015 and its amendments	Ministry of Labor and Employment	• This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions.	Applicable – The project must ensure workers' safety, health, and reasonable working conditions during construction and operation.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
The Fire Prevention and Extinguish Act, 2003 The Fire Prevention and Extinguish Rules, 2014	Ministry of Home Affairs	• This Act sets out regulatory enactments regarding the prevention, the successful extinguishing of fire, and also reduction of damage and consequences of fire. • Requires the owner of a building to apply for an Occupancy Certificate to ensure compliance with the relevant provisions of the Building Code.	Applicable – The project must implement fire safety measures to prevent and control fire hazards during construction phase.
The 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. • Responsibilities of waste generators, consumers, and users: Dispose of waste in accordance with the regulations of authorities including local government; Dispose of waste separately; Do not dump, store, or burn waste outdoors. • Responsibilities of manufacturers (*not defined) and importers of products: collect non-biodegradable products such as glass, plastic, polyethylene, multi-layered packaging, bottles, and cans from consumers and recycle or dispose of them if appropriate; determine work plans and implementation procedures for recycling and disposal; ensure that Extended Producer Responsibility (EPR) is properly implemented; Submit an annual report to the Department of Environment (DOE) on the amount of plastic recycled; Raise public awareness of proper waste management. Any violation of the above provisions shall be subject to imprisonment for not more than two years or a fine not exceeding 200,000 Taka (BDT), or both. The Regulations also include provisions for the treatment of solid waste such as composting and energy recovery.	Applicable – This rule is applicable for the management of waste (i.e., solid wastes) to minimize/reduce environmental, social, and economic problems.

Legislations	Enforcement Agency - Ministry/Authority	Key features	Applicability
The Bangladesh Labor Act, 2006 and its amendments	Ministry of Labor and Employment (MoLE)	• Worker safety and comfortable work environment. • Precautions for fire, explosives, lifting, and eye protection. • First aid, safety records, medical care, housing, and insurance for workers.	Applicable – The project involves workers during construction, so it must ensure their safety, health, and proper working conditions.
The Inspection and Enforcement Manual 2008	Department of Environment (DOE)	This manual provides national standards and ensures uniform procedures for environmental sampling, inspections, and investigations conducted by the Department of Environment (DOE) in Bangladesh.	Applicable – The project must follow DOE's standard procedures for environmental monitoring, sampling, and inspections.
The Bangladesh Climate Change Strategy and Action Plan, 2009	Ministry of Environment, Forest and Climate Change	Establishment of six strategic pillars for action, including: (1) food security, social protection and health. (2) disaster management.	Applicable – Ensures LGED projects protect livelihoods, health, and agriculture, and design roads, bridges, and drainage for climate resilience in hazard-prone areas.

2.3 Environmental Standards

The appropriate national environmental standards will be applied under the ECR, 2023. The standards, commonly known as Environmental Quality Standards (EQS), are legally binding. There is a separate schedule for industry-specific standards, other than the general industrial emission and effluent standards. International standards will also be applied. For reference, the Bangladesh standards and international guidelines for ambient air, noise, odor, and water are given in Appendix F.

2.4 Administrative Setup Related to Environment in Bangladesh

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

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

2.4.1 Department of Environment (DOE), Bangladesh

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

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

2.5 International Treaties

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

2.5.1 Rio Declaration

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

2.5.2 Convention on Biological Diversity, 1992

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

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

An obligation has been placed on State parties to provide for environmental impact assessments of projects that are likely to have significant adverse effects on biological diversity.

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

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

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

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

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

To set up a comprehensive new legal regime for the sea and oceans, as far as Environmental provisions are concerned, to establish material rules concerning environmental standards as well as enforcement provisions dealing with pollution of the marine environment.

To establish basic environmental protection principles and rules on global and regional cooperation, technical assistance, monitoring, and environmental assessment, and adoption and enforcement of international rules and standards and national legislation with respect to all sources of marine pollution.

2.5.5 UNESCO World Heritage Convention

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

2.5.6 Other Relevant International Treaties and Conventions

An overview of other relevant international treaties and conventions signed by Bangladesh is shown in Table 2-3.

Table 2-3: Other relevant international treaties and conventions signed by Bangladesh

Treaty or Convention	Year	Brief Description	Responsible Agency
Convention On Protection of Birds, Paris	1950	Protection of birds in a wild state	Department of Environment/Forest Department, Ministry of Environment, Forest and Climate Change (MoEFCC)
Convention on Oil Pollution Damage, Brussels	1969	Civil liability on oil pollution damage from ships	Department of Environment/Ministry of Shipping
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	Forest Department, Ministry of Environment, Forest and Climate Change (MoEFCC)
Convention on the Conservation of Migratory Species of Wild Animals (CMS) (Known as the Bonn Convention)	1979	Conservation of migratory species of wild animals	Forest Department/ Department of Environment, Ministry of Environment, Forest and Climate Change (MoEFCC)
Convention Concerning the Prevention and Control of Occupational Hazards, Geneva	1974	Protect workers against occupational exposure to carcinogenic substances and agents	Department of Inspection for Factories and Establishments (DIFE), Ministry of Labor and Employment (MoLE)
Convention Concerning the Protection of Workers against Occupational Hazards in the Working Environment due to Air Pollution, Noise and Vibration, Geneva	1977	Protect workers against occupational hazards in the working environment	Department of Inspection for Factories and Establishments (DIFE), Ministry of Labor and Employment (MoLE)
Convention Concerning Occupational Safety and Health in the Working Environment, Geneva	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	Department of Inspection for Factories and Establishments (DIFE), Ministry of Labor and Employment (MoLE)

Treaty or Convention	Year	Brief Description	Responsible Agency
Convention Concerning Occupational Health Services, Geneva	1985	To promote a safe and healthy working environment	Department of Inspection for Factories and Establishments (DIFE), Ministry of Labor and Employment (MoLE)
Vienna Convention for the Protection of the Ozone Layer	1985	Protection of the ozone layer	Department of Environment, Ministry of Environment, Forest and Climate Change (MoEFCC)
Montreal Protocol on Substances that Deplete the Ozone Layer	1987	Phase out the production and consumption of ozone-depleting substances (ODS) and protect the ozone layer	Department of Environment, Ministry of Environment, Forest and Climate Change (MoEFCC)
Convention on Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels, Geneva	1989	Safe methods for the transport of dangerous goods by road, railway, and inland vessels	Ministry of Shipping
International Convention on Civil Liability for Oil Pollution Damage, London	1990	Legal framework and preparedness for control of oil pollution	Ministry of Shipping
London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	1990	Control of global emissions that deplete the ozone layer	Department of Environment, Ministry of Environment, Forest and Climate Change (MoEFCC)
Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC)	1997	An international treaty on climate change and emission of greenhouse gases.	Department of Environment, Ministry of Environment, Forest and Climate Change (MoEFCC)
Cartagena Protocol on Biosafety to the Convention on Biological Diversity (CBD)	2000	Biological safety in transport and use of genetically modified organisms.	Department of Environment, Ministry of Environment, Forest and Climate Change (MoEFCC)

Treaty or Convention	Year	Brief Description	Responsible Agency
Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC)	2016	Limit global temperature rise to well below 2°C above pre-industrial levels and pursue efforts to limit it to 1.5°C. Promoting climate-resilient development and low-carbon growth. Strengthening financial, technological, and capacity-building support to developing countries.	Department of Environment, Ministry of Environment, Forest and Climate Change (MoEFCC)

2.6 International Safeguard Requirements

In addition to the applicable national laws, this EIA Report has been prepared with reference to the following international policies and procedures regarding the assessment and management of environmental and social impacts of the project.

- JICA Guidelines for Environmental and Social Considerations, 2022.

2.6.1 JICA Guidelines for Environmental and Social Considerations, 2022

The Japan International Cooperation Agency (JICA) has revised its Guidelines for Environmental and Social Considerations and Objection Procedures based on the Guidelines for Environmental and Social Considerations dated January 4, 2022. The guidelines are applicable to projects whose applications are submitted by project proponents on or after April 1, 2022.

The Guidelines for Environmental and Social Considerations are a set of guidelines that aim to ensure that JICA's projects are environmentally and socially sustainable. The guidelines cover a range of topics, including environmental impact assessment, biodiversity conservation, and stakeholder engagement.

Here are some key points from JICA's Guidelines for Environmental and Social Considerations:

- Project screening: JICA conducts an initial screening of all proposed projects to identify potential environmental and social risks and impacts.
- Project categorization: JICA classifies projects into four categories i.e., Category A, Category B, Category C, and Category FI, based on the extent of environmental and social impacts, taking into account the project's characteristics, scale, site condition, etc.
- Environmental and social impact assessment: JICA requires a comprehensive environmental and social impact assessment for all projects that are likely to have significant environmental or social impacts. The impacts include impacts on human health and safety, as well as on the natural environment. These also include environmental and social impacts such as involuntary resettlement, migration of population, local economies such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as peoples in poverty and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritages, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.
- Stakeholder engagement: JICA encourages early and continuous engagement with stakeholders, including affected communities, to ensure that their concerns and perspectives are taken into account in project design and implementation.

- Consideration for social environment and human rights: JICA considers social and institutional conditions and actual conditions of each project location when supporting for and reviewing of the environmental and social considerations. JICA respects the principles of internationally established human rights standards such as the International Convention on Human Rights when implementing cooperation projects.
- Environmental and social management plan: JICA requires the development of an environmental and social management plan that identifies measures to avoid, mitigate, or compensate for adverse impacts.
- Monitoring and evaluation: JICA requires regular monitoring and evaluation of project performance to ensure that environmental and social impacts are effectively managed and that project objectives are achieved.
- Compliance with international standards: JICA's guidelines are aligned with international standards and best practices, including the Equator Principles and the International Finance Corporation's Performance Standards.

By incorporating these key points into its project design and implementation, JICA aims to ensure that its projects contribute to sustainable development and improve the lives of people in developing countries while minimizing adverse environmental and social impacts.

2.6.1.1 Gap Analysis and Harmonization of Bangladesh Regulations and JICA Guidelines

The JICA Guidelines for Environmental and Social Considerations (2022) and the Bangladesh Environment Conservation Rules (2023) are both important frameworks for environmental and social protection in Bangladesh. However, there are some gaps in between Bangladesh's regulations and JICA Guidelines for Environmental and Social Considerations 2022 in preparation for Environmental Impact Assessment (EIA). Gap analysis and gaps filling measures related to environmental and social regulations are presented in Table 2-4.

Table 2-4: Major gaps analysis between environmental regulations of Bangladesh and the JICA Guidelines

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
1	Basic Principle	1. Environmental and social impacts caused by projects must be assessed and examined at the earliest possible planning stage. Alternatives or mitigation measures must be examined, in order to avoid such impacts as much as possible, and to minimize, reduce or mitigate them when such avoidance is impossible. The result of the examinations must be reflected into the project plan. 2. Such examinations must be endeavored to include an analysis of environmental and social costs and benefits in the most quantitative terms possible, as well as a qualitative analysis, and to be in a close harmony with the economic, financial, institutional, social, and technical analyses of projects. 3. The findings of the examination of environmental and social considerations, including alternatives and mitigation measures, must be documented as an independent document or as a part of other	In Article 17 (3), the point to be considered in the evaluation of the EIA is stated as "possible alternatives of the concerned project and, if necessary, on-site inspection of the proposed site of the said project". Article 15 (1) states that "shall prepare an environmental impact assessment report by conducting an environmental impact assessment survey. Article 17 (1) states that "the concerned industrial establishment or project promoter shall be invited to the meeting of the Environmental Clearance Committee to provide clarification on the information and data of the environmental impact assessment report.	No gap.	-

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		documents. Environmental assessment reports must be prepared for projects with potential significant impacts. 4. For projects which may have significant impacts in particular, or for controversial projects, a committee of experts may be formed so that projects may seek their opinions, in order to increase accountability. (JICAGL Attachment 1)			
2	Examination of Measures	1. Multiple alternatives must be examined in order to avoid or minimize adverse impacts by the project and to choose better project options in terms of environmental and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts. When this is not possible, minimization, reduction, and then mitigation of the impacts must be considered, in accordance with the mitigation hierarchy. Compensation measures must be examined only when significant	Article 5 states that "Industries or projects in the red category have a severe impact on the environment, which needs to be avoided in order to preserve the environment to an appropriate extent. Significant mitigation measures are required to reduce the environmental impact of this class of industries or projects." In Article 18 (1), the point to be considered in the approval of the EIA is states as "whether the proposed environmental management plan and monitoring program are	No gap.	-

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		impacts are still remain even with the aforementioned measures. 2. Appropriate plans and systems for measures, such as monitoring plans and environmental management plans, must be prepared. The costs of implementing such plans and systems, and the financial methods to fund such costs, must be determined. For projects with particularly significant impacts, detailed environmental management plans must be prepared. (JICAGL Attachment 1)	accurate, effective, practical and adequate".		
3	Impacts to be assessed	1. The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water use, climate change, biodiversity, and ecosystem services, including transboundary or global scale impacts. These also include social considerations such as: Migration of population including involuntary resettlement, local economy such as employment and	In Article 18 (1), the point to be considered in the approval of the EIA is states as "whether the environmental or social impact has been adequately assessed" Necessity of assessment of derivative, secondary, and cumulative impacts of the project is not stated.	No major gaps.	The study will cover the items in the guidelines. Derivative, secondary, and cumulative impacts of the project will also be examined as necessary.

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor peoples and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety. 2. In addition to the direct and immediate impacts of projects, derivative, secondary, and cumulative impacts as well as impacts associated with indivisible projects are also to be examined and assessed to a reasonable extent. It is also desirable to consider the impacts through a project life cycle. (JICAGL Attachment 1)			
4	Compliance with Laws,	1. Projects must comply with the laws, ordinances, and standards related to environmental and social	In Article 18 (1), the point to be considered in the approval of the EIA is states as "Whether the	There is no provision regarding conservation areas of nature or cultural	Impacts to protected areas and cultural heritage sites as defined by relevant laws

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
	Standards, and Plans	considerations established by host country governments, including local governments. Projects must also conform to the environmental and social consideration policies and plans of the host country governments. 2. In principle, Projects must be undertaken outside of areas that are specifically designated for conservation of nature or cultural heritages by the host country governments, unless the main purpose of the Projects is to promote or restore the protection of such areas. Also, projects shall not cause significant adverse impacts on such designated conservation areas. (JICAGL Attachment 1)	concerned industrial establishment or project proposal is contrary to the Government policy and plan".	heritages in the Bangladesh EIA regulations.	and regulations will be avoided as much as possible.
5	Social Acceptability	1. Projects must be adequately coordinated so that they are accepted in a socially appropriate manner for the countries and areas where the projects are planned. For Projects with potentially significant environmental and social impacts, sufficient consultations with local stakeholders, such as local	Article 16 states regarding the Red Category projects as "in the presence of the stakeholders concerned with the project and the officials of the concerned office of the Directorate, measures shall be taken to verify the public opinion in the said industrial establishment or the	No major gaps.	The stakeholder meeting will be conducted in accordance with ECR, 2023 and due considerations to socially vulnerable groups will be given.

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans are examined. The outcome of such consultations must be incorporated into the project plans.	area concerned with the project.".		
6	Climate Change	1. For projects that are expected to generate more than a certain amount of greenhouse gas emissions, the total amount of greenhouse gas emissions will be estimated and disclosed before the project implementation. (JICAGL Attachment 1)	No provision.	There is no provision regarding Climate Change in the Bangladesh EIA regulations.	An increase of greenhouse gas emissions by the project is expected, however, this will be studied in advance.
7	Biodiversity	1. Projects must not involve significant conversion or significant degradation of critical habitats or critical forests. 2. Illegal logging of forests must be avoided. Project proponents need to obtain logging permits from regulatory agencies and are encouraged to obtain forest certifications for forestry projects, in order to ensure the prevention of illegal logging.	No provision.	There is no provision regarding Biodiversity in the Bangladesh EIA regulations.	The area categorized under protected areas will be avoided as much as possible. If tree cutting is required, necessary permission will be confirmed to the related organizations.

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		(JICAGL Attachment 1)			
8	Involuntary Resettlement and Loss of Livelihood	1. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. If avoidance is not possible even after such examination, effective measures to minimize impacts and to compensate for losses must be taken upon agreement with the affected people. 2. Project affected people, such as people to be resettled involuntarily and/or people who may lose their livelihoods by the project, must be provided sufficient compensations and supports by the project proponents in a timely manner. Compensations must be calculated at full replacement cost as much as possible and provided in advance. Project proponents must make efforts for the affected people to improve or at least restore their standards of living, income opportunities and production levels to the pre-project levels. Measures to achieve this may include Providing land or monetary compensations for losses of land or assets, supporting	No provision.	There is no provision regarding Involuntary Resettlement and Loss of Livelihood in the Bangladesh EIA regulations.	Required procedure of Bangladesh will be proceeded in accordance with ARIPA, 2017. If there is a gap, gap filling measures will be taken.

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		for alternative sustainable livelihood, supporting for expenses necessary for relocation, and supporting for re-establishment of communities at resettlement sites. 3. Compensation standards are disclosed and consistently applied. The project affected persons need to be aware of the compensation standards. In principle, the contents of the individual compensation to be agreed are explained to the project affected persons in writing, and the project affected persons can confirm the contents at any time. 4. Appropriate participation of the project affected people and their communities must be promoted in the planning, implementation and monitoring of measures against involuntary resettlement and loss of livelihood. 5. For projects that result in large-scale involuntary resettlement, a Resettlement Action Plans (RAP) must be prepared and made available to the public prior to the resettlement and provision of compensation and support. In			

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		preparing the RAP, consultations must be held with the project affected people and communities, based on sufficient information made available to them in advance. When consultations are held, explanations must be given in languages and forms that are understandable to the project affected people. It is desirable that the RAP includes elements laid out in the Environmental and Social Standard (ESS) 5 of the World Bank's environmental and social policies. (JICAGL Attachment 1)			
9	Indigenous Peoples	1. Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. If avoidance is not possible even after such examination, effective measures for indigenous peoples must be taken to minimize the impacts and to compensate for the losses. 2. When projects may have adverse impacts on indigenous peoples, all of their rights in relation to land and	No provision.	There is no provision regarding Indigenous Peoples in the Bangladesh EIA regulations.	Impact to indigenous people is not expected, however, the impact will be studied. If there is impact, mitigation measures covering JICA GL will be taken.

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		resources must be respected in accordance with the spirit of the relevant international declarations and treaties, including the United Nations Declaration on the Rights of Indigenous Peoples. Efforts must be made to obtain the Free, Prior, and Informed Consent (FPIC) of the affected indigenous peoples. 3. Measures for the affected indigenous peoples must be prepared as an Indigenous Peoples Plan (IPP), which may constitute as a part of other documents for environmental and social considerations and must be made public in compliance with the relevant laws and ordinances of the host country. In preparing the IPP, efforts must be made to obtain the FPIC of the affected indigenous peoples based on sufficient information made available to them in advance. When consultations are held, explanations are given in languages and forms that are understandable to the indigenous peoples concerned. It is desirable that the IPP includes the elements			

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		laid out in ESS 7 of the World Bank's environmental and social policies. (JICAGL Attachment 1)			
10	Monitoring	1. During the project implementation, project proponents monitor whether any unforeseeable situations occur, and the performance and effectiveness of the planned mitigation measures. Project proponents take appropriate measures based on the results of such monitoring. 2. In cases where sufficient monitoring is deemed essential for appropriate environmental and social considerations, such as projects for which mitigation measures should be implemented while monitoring their effectiveness, Project proponents must ensure that the project plans include feasible monitoring plans. 3. Project proponents should make efforts to make the monitoring results available to local stakeholders involved in the project. 4. When third parties point out specifically that environmental and social considerations are not being	In Article 18(1), the point to be considered in the approval of the Environmental Impact Statement is states as "whether the proposed environmental management plan and monitoring program are accurate, effective, practical and adequate" Article 19 states that "It is further provided that while the red category industrial establishment or project is in progress, the directorate will issue instructions to the entrepreneur to update the environmental impact assessment report taking into account the effectiveness of the monitoring report and environmental management plan and any relevant new environmental or social issues.".	No major gaps.	If complaints and problems are reported, monitoring results will be share and solutions will be discussed in stakeholder meeting.

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		fully undertaken, project proponents should make efforts to reach an agreement on the procedures to resolve the problems, through forums for discussions and examinations of the countermeasures with participation of stakeholders involved in the projects, based on sufficient information disclosure. (JICAGL Attachment 1)			
11	Grievance Redress Mechanism	1. A mechanism for handling concerns and grievances from people and communities affected by the project's environmental and social impacts must be in place. 2. The grievance redress mechanism needs to be easily accessible for the project affected people and communities. Project proponents disseminate the information about the grievance redress mechanism through consultations with local stakeholders. The project affected people and communities must not be disadvantaged by filing a grievance. 3. Project proponents should make efforts to respond promptly to the	No provision.	There is no provision regarding Grievance Redress Mechanism in the Bangladesh EIA regulations.	Grievance Redress Mechanism will be established and measure covering JICA GL will be taken.

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		grievances they receive, taking into account the concerns and needs of the project affected people and communities. (JICAGL Attachment 1)			
12	Information Disclosure	1. In principle, project proponents disclose information about environmental and social considerations of their projects. JICA assists the project proponents through implementing cooperation projects as needed. 2. JICA discloses important information about environmental and social considerations at the key stages of cooperation projects, in an appropriate manner in accordance with the JICA Guidelines. 3. JICA discusses and agrees with project proponents on the frameworks that ensure information disclosure at the early stage of cooperation projects. 4. The information to be disclosed has to include environmental and social considerations, as well as the project information.	Article 16 (1) states regarding Red Category projects as "in the presence of the stakeholders concerned with the project and the officials of the concerned office of the Directorate, measures shall be taken to verify the public opinion in the said industrial establishment or the area concerned with the project". Article 16 (2) states that "For verification of public opinion, the industrial organization or project promoter should apply to the concerned office along with 3 (three) sets of environmental impact assessment report and related Bengali summary and copy thereof should be sent to the head office.". Article 16 (3) states that "Within 7 (seven) working days of receiving the application under	No major gaps.	-

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		In addition to the information to be disclosed. 5. JICA provides information about environmental and social considerations to third parties to the extent possible in response to their requests. 6. JICA actively encourages project proponents to disclose and present information about environmental and social considerations of their projects to local stakeholders. 7. Project proponents disclose information well in advance when they have consultations with local stakeholders in cooperation with JICA. On such occasions, JICA supports project proponents in preparation of documents in an official or widely used language(s) and in a form understandable by local peoples. 8. JICA discloses information on its website in Japanese, English, official language(s) and/or language(s) widely used in the host countries. It also provides the relevant reports for	sub- rule (2), the concerned industrial establishment or project promoter shall fix the date, time and place of public opinion verification and publish a notice in a widely circulated local and national daily newspaper.". Article 16 (4) states that "Detailed information related to the verification of public opinion shall be published on the website of the Directorate and the website of the said industrial organization or project promoter, if any.".		

S/N	Items	JICA Guidelines	Bangladesh's Procedures	Major Gap	Countermeasures to Bridge Gaps
		public reading at the JICA library and at related overseas offices. 9. JICA pays due consideration to the confidentiality of the commercial and other matters of project proponents, taking into account their competitive relationships. JICA encourages project proponents to exclude confidential information from any documents on environmental considerations that they submit which may later be subject to public disclosure. JICA takes into account the management of information of project proponents and discloses their documents subject to their approval. Any information that is prohibited from public disclosure in the agreement documents between JICA and project proponents may be disclosed only upon obtaining the approval of the project proponents or in accordance with legal requirements.			

CHAPTER 3

Project Description

3 PROJECT DESCRIPTION

3.1 The Project and Its Location

3.1.1 Scope of the Project

The project focuses on improving rural connectivity and fisheries productivity in the north-eastern haor belt while ensuring close alignment with ongoing flood management initiatives.

- Expansion of rural access infrastructure to enhance mobility and year-round connectivity.
- Enhancement of fisheries productivity through community-based interventions.
- Coordination with BWDB's flood management works for integrated and sustainable outcomes.
- Implementation of rural infrastructure and fisheries components under LGED leadership.
- Collaboration with the Department of Fisheries (DoF), the Department of Agricultural Extension (DAE), and Ministry of Land (MoL) through formal MoUs, building on the HFMLIP framework.

3.1.2 Geographic Coverage

The HARD Project fieldwork spans 5 districts and 18 upazilas across around 15 priority haors identified in the study.

According to the pre-feasibility analysis, approximately 4.103 million people, around 21.18% of the haor population, are expected to benefit directly or indirectly from the HARD Project interventions. Benefits include improved access to education and healthcare, increased agricultural and fisheries incomes, and reduced vulnerability to seasonal floods and other hazards.

The 15 priority haors (83,247 ha) were selected from the pre-feasibility and are part of a larger pool of 373 haors covering 858,460 ha in north-eastern Bangladesh.

These haors are deep floodplain basins characterized by extensive wet season flooding, prolonged isolation, and significant wave action. The details of the study area are presented in Table 3-1.

Table 3-1: Study area

S/N	Name of Haor	New Haor/ Rehabilitation Haor	District	Upazila	Union	Gross Area (Ha)
1	Naluar Haor (Polder-1)	Rehabilitation Haor	Sunamganj	Jagannathpur	Kolkolia, Chiliura Holdipur, Raniganj, Jagannathpur Pourashava	8,940.00
2	Mrigar Haor	New Haor	Kishoreganj	Itna	Itna Sadar, Joysiddi, Mriga, Dhonpur	5,500.00
3	Makalkandi Haor	Rehabilitation Haor	Habiganj	Baniachang, Nabiganj	Kagapasa, Doulatpur, Korgoan, Boro Vakoir West	9,500.00
4	Chaptir Haor	Rehabilitation Haor	Sunamganj	Derai	Jagdal, Karimpur	4,622.00
5	Shanir Haor	Rehabilitation Haor	Sunamganj	Jamalganj, Tahirpur, Bishwamvarpur	Behili, Tahirpur Sadar, South Sreepur, Fatepur	8,298.00

S/N	Name of Haor	New Haor/ Rehabilitation Haor	District	Upazila	Union	Gross Area (Ha)
6	Pathor Chauli Haor	Rehabilitation Haor	Sylhet	Companiganj	3 no Telikhal union, 5 no Isacolos union	6,500.00
7	Karchar Haor	Rehabilitation Haor	Sunamganj	Sunamganj Sadar, Bishwamvarpur	Fotepur, Polas, Solukabad	6,017.00
8	Halir Haor	Rehabilitation Haor	Sunamganj	Jamalganj, Tahirpur, Bishwamvarpur	Behili, Jamalganj Uttar, Sacna Bazar, South Sreepur, Fatepur	9,429.00
9	Khai Haor	Rehabilitation Haor	Sunamganj	Shantiganj (South Sunamganj)	Patharia Purbo, Birgaon, Paschim Birgaon, Dargapasha	3,400.00
10	Humaipur Haor	Rehabilitation Haor	Kishoreganj	Bajitpur, Nikli, Austogram	Chatirchar, Maizchar, Dighirpar, Humaipur	5,395.00
11	Updakhali Haor	Rehabilitation Haor	Netrokona, Sunamganj	Kalmakanda, Moddhyanagar	Kalmakanda Sadar, Borokhapon, Pogla, Moddhyanagar Sadar	2,325.00
Total Gross Area						**69,926.00**
12	Khaliajuri Polder-1	Rehabilitation Haor	Netrokona, Sunamganj	Khaliajuri, Jamalganj	Chakua, Fenarbak	3,300.00
13	Khaliajuri Polder-3	Rehabilitation Haor	Netrokona, Kishoreganj	Khaliajuri, Itna	Khaliajuri Sadar, Nogor, Dhonpur	3,024.00
14	Baram Haor	Rehabilitation Haor	Sunamganj	Derai, Shulla	Karimpur, Tarol, Habibpur	4,497.00
15	Ballar Haor (Chegaiya Haor)	New Haor	Habiganj	Baniachang	Mondori, Poilarkandi	2,500.00
Total Gross Area						**13,321.00**
Grand Total Gross Area						**83,247.00**

3.2 Project Components

The LGED part of the HARD Project focuses on two core components: (i) rural infrastructure development and rehabilitation, and (ii) fisheries promotion activities, with complementary activities to strengthen livelihoods, resilience, and market access in the haor region.

3.2.1 Rural Infrastructure Development

This component aims to improve connectivity, protect homesteads, and support rural trade through the following interventions.

- **Improvement of Roads**
  - Upazila Roads (submergible and non-submergible) – 27.70 km.
  - Union Roads (submergible and non-submergible) – 46.49 km.
  - Village Roads (submergible and non-submergible) – 281.90 km.
- **Bridges and Culverts**
  - Bridge construction – 230 m.
  - Culvert construction – 1,692 m.
- **Protective Works**
  - Protective structures along 15.607 km of vulnerable stretches.
- **Growth Centers, Rural Markets, and Ghats**
  - 14 growth centers and rural markets.
  - 37 boat landing stations (ghats).
- **Village Protection Walls**
  - 44,200 m of protective walls around vulnerable homesteads.
- **Rehabilitation and Maintenance of Roads**
  - 158.577 km of existing rural roads (Upazila, Union, and Village).

The haor-wise rural infrastructure development is presented in Table 3-2.

Table 3-2: LGED Rural Infrastructure (Tentative)

S/N	Haor Name	Road Infrastructure											Rural Infrastructures		
		New Road Construction						Road Rehabilitation	Protective Works		Structure		Market	Ghat	Village Protection Wall
		Upazila Road		Union Road		Village Road									
		Sub	Non-Sub	Sub	Non-Sub	Sub	Non-Sub		Sub	Non-Sub	Bridge	Culvert			
		km	km	km	km	km	km	m	km	km	m	m	nos.	nos.	m
1	Noluar Haor (Polder-1)	0	0	0	0	13.9	1.2	18,960	0	0.36	0	10	1	1	2,600
2	Mrigar Haor	7.04	0	14.1	0	17.11	0		0	0	0	152	0	0	2,600
3	Makalkandi Haor	0	0	0	6	23.55	0		0	1.8	0	81	0	0	5,200
4	Chaptir Haor	5	2.55	4.8	0	9.4	0	28,872	0	0.765	20	18	0	0	2,600
5	Sonir Haor	0	0	4	0	6.29	0	1,320	0	0	0	37	0	0	5,200
6	Pathor Chawli Haor	0	0	5.35	0	13.42	0		0	0	0	65	1	1	2,600
7	Korchar Haor	4	0	1	0	24.6	11.03	34,245	0	3.309	0	159	1	13	2,600
8	Halir Haor	0	0	0	1.8	19.5	0	1,000	0	0.54	30	120	0	3	2,600
9	Khai Haor	0	0	0	1.29	0.4	23.15	32,500	0	7.333	150	294	2	3	2,600
10	Humaipur Haor	0.27	0	0	0	7.6	0		0	0	0	29	0	4	5,200
11	Updakhali Haor	0	0	2.15	0	45.1	5	250	0	1.5	30	388	3	3	5,200
12	Khaliajuri Haor (Polder-1)	8.21	0	0	0	35.7	0	34630	0	0	0	201	4	6	2,600
13	Khaliajuri Haor (Polder-3)	0	0	5	0	10.5	0	3,000	0	0	0	90	1	1	0
14	Ballar Haor	0	0	0	0	11.5	0	3,800	0	0	0	43	0	1	0
15	Boram Haor	0	0	1	0	2.95	0	0	0	0	0	5	1	1	2,600
	Total	24.52	2.55	37.40	9.09	241.52	40.38	158,577	0	15.607	230	1692	14	37	44,200

Source: Feasibility Study Report

3.2.2 Fisheries Promotion

This component builds on the success of the Haor Flood Management and Livelihood Improvement Project (HFMLIP) and expands fisheries-based livelihood opportunities:

- **Beel Development and Community Management**
  - 194 beels to be developed (re-excavation, fish sanctuaries, swamp tree plantations, and CAIGA initiatives).
- **Beel Connecting Khal Development**
  - 582 km of khal re-excavation with swamp tree plantation.
- **Beel Connecting Roads**
  - 7.76 km of access roads to improve management and transport.
- **Culture Fisheries Promotion**
  - Activities including backyard pond aquaculture, fry rearing, rice-fish culture, and biofloc farming (to be finalized during implementation).
- **Natural Resource Museum**
  - Establishment of one eco-tourism and knowledge center for haor biodiversity and resources.

Haor flood management planning maps are given in Appendix H.

3.3 Project Activities

The HARD Project – LGED Part focuses on scaling up rural infrastructure and fisheries-based livelihood interventions around 15 haors across five districts. The activities planned are:

3.3.1 Main Project Activities to be Undertaken

3.3.1.1 Rural Infrastructure Development Activities

The rural infrastructure development activities are:

1. **Upgrade and construct rural roads**
   - Build and improve upazila, union, and village roads (about 355.48 km total).
   - Include drainage and flood-resilient features for submergible roads.
2. **Construct bridges and culverts**
   - Install approximately 230 m of bridges and 1,692 m of culverts to restore connectivity across water channels.
3. **Protect home steads and critical road stretches**
   - Install 15.607 km of protective works and 13,000 m of village protection walls to prevent erosion and wave damage.
4. **Developing rural markets and growth centers**
   - Upgrade 14 rural markets and growth centers to improve trade conditions, storage, and hygiene.
5. **Improve boat landing stations (ghats)**
   - Rehabilitate or construct 37 ghats to facilitate water–land transport transfer.

6. **Rehabilitate and maintain existing rural roads**
    - Repair and maintain 158.577 km of damaged roads, prioritizing high-access routes.

3.3.1.2 Fisheries Promotion Activities

HFMLIP experience showed that backyard ponds and fish drying/fermentation were successful, while cage culture, net-pen, and floodplain aquaculture faced failures due to floods and group conflicts. The HARD Project will prioritize successful models while piloting innovative approaches like fry rearing, rice-fish culture, and biofloc farming with careful risk management.

1. **Beel development and restoration**
    - Excavate and rehabilitate 194 beels, including fish sanctuaries, nurseries, and swamp tree plantations.
2. **Re-excavate connecting khals**
    - Restore 582 km of canals to improve water flow and fish migration.
3. **Construct beel connecting roads**
    - Build 7.76 km of simple access roads using excavated soil to connect fisheries resources with villages.
4. **Expand culture fisheries**
    - Promote backyard pond aquaculture, fry rearing, rice–fish culture, and biofloc farming based on local suitability.
    - Revive fish drying and fermentation units, with priority for women beneficiaries.
5. **Establish a haor natural resource museum**
    - Create one museum to enhance local awareness and attract eco-tourism.

3.3.1.3 Livelihood Support and Capacity Building

The activities for livelihood support and capacity building are as follows.

1. **Compensatory Alternative Income-Generating Activities (CAIGA)**
    - Provide tools, capital support, and training to fishers during annual fishing ban periods.
2. **Training and technical support**
    - Conduct workshops, exchange visits, and on-the-job training for:
        - Beel User Co-operative Association (BUCA)
        - Road maintenance groups
        - Women-led fisheries groups.
3. **Community awareness programs**
    - Campaigns on fish conservation, flood preparedness, and sustainable resource management.

3.3.1.4 Monitoring, Governance and Implementation

The activities for monitoring, governance and implementation are as follows.

1. Strengthening Monitoring and Evaluation (M&E) systems.
2. Establish an Interim Project Management Unit (from July 2024) before full-fledged the HARD Project roll-out.
3. Coordinate closely with LGED, MoL, and DoF for integrated planning.

3.4 Project Plan, Design, Standard, and Specification

3.4.1 Project Plan

3.4.1.1 Implementation Approach

The HARD Project will retain the proven integrated model from HFMLIP, where LGED leads Component 2 (Rural Infrastructure) and Component 3.2 (Fisheries Promotion), coordinating closely with BWDB, MoL, DAE, and DoF. MoUs with the Ministry of Land will formalize beel handover and tenure arrangements, while collaboration with the Department of Fisheries will ensure technical support and training for community-based fisheries management.

Project delivery will be anchored by a Project Management Office (PMO) in Dhaka, supported by Project Implementation Units (PIUs) in each of the five districts and Project Upazila Offices (PUOs) in the 13 target upazilas. A Design-Supervision-Monitoring Consultant (DSMC) team will assist in detailed design reviews, quality supervision, and performance monitoring. District and Upazila Progress Review Committees, already active in HFMLIP, will continue to provide oversight.

3.4.1.2 Institutional Coordination

LGED will strengthen its collaboration framework with BWDB, DoF, and MoL through updated MoUs to avoid overlap and leverage integrated basin-wide planning. Synergies will also be pursued with IFAD's HILIP-2, World Bank-financed rural transport programs, and other development partners operating in the north-east haor basin.

3.4.1.3 Seasonal Delivery Logic

Construction in the haor region is limited to a short dry-season window. To maximize efficiency:

- Surveys will be conducted in the dry season.
- Design and tendering will be undertaken during the flood season.
- Construction and excavation work will commence immediately in a post-flood recession.

Excavation packages will be tendered via OTM for rapid mobilization, while tree planting, sanctuaries, and related works will continue to be delivered using LCS where appropriate.

3.4.1.4 Coordination with Other Projects

The HARD Project will maintain active alignment with parallel interventions in the haor region, including IFAD's HILIP-2 and other partner-funded projects, to ensure harmonized investments and maximize integrated water resources management (IWRM) impacts.

3.4.2 Design

3.4.2.1 Road Typology and Function

The road typology and function will be associated with

- **Submergible Roads:** Designed for seasonal overtopping with full dry-weather standards, ensuring connectivity for village access during non-flood months.
- **Non-submergible Roads:** Upgraded for strategic links to markets, ghats, and growth centers.

All roads will incorporate cross-drainage structures, revetments, and wave-protection works where required.

3.4.2.2 Bridges and Culverts

Pre-feasibility analysis identified approximately 950 m of bridges and 4,180 m of culverts across the candidate network. From these, 700 m of bridges and 1,000 m of culverts will be finalized during detailed design, considering flood discharge, debris clearance, and climate resilience.

3.4.2.3 Protective Works and Village Protection Walls

About 130 km of protective works will be placed on vulnerable road reaches. 13,000 m of village protection walls, a new feature in the HARD Project, will shield raised homesteads from wave attack and toe erosion during monsoon flooding.

3.4.2.4 Markets and Ghats

Fieldwork identified 41 markets and 83 ghats requiring intervention. Final selection will be based on two key criteria:

- Local economic and social importance.
- Confirmed or project-provided road connectivity.

3.4.2.5 CbFRM and Habitat Works

The beel package will include re-excavation, fish sanctuaries, and swamp tree planting around beel peripheries and khals to stabilize banks and enhance aquatic habitats. About 328 beels were screened, with ~300 expected to be included after due diligence. Over 600 km of connecting khals were identified, of which 450 km are programmed.

3.4.2.6 HARD Project Innovations

125 km Beel-connecting Roads: Access spurs from villages or ghats to BUG-managed beels, often using excavated spoil, constructed to dry-season standards.

Green Belts: Expanded swamp tree plantations into linear belts for waving energy dissipation and climate resilience.

Natural Resource Museum (1 unit): An exhibition and learning hub for haor ecosystems, livelihoods, and eco-tourism.

3.4.2.7 Procurement and Contracting

- Civil works will follow Open Tender Method (OTM) under Local Competitive Bidding (LCB).
- Sanctuary creation and swamp tree plantations will use Labor Contracting Society (LCS) arrangements where suitable.
- DSMC will oversee design vetting, construction supervision, and monitoring and evaluation.

3.4.3 Standard

The HARD Project will adhere to LGED's established standards from HFMLIP, including:

- Design classes for submergible and non-submergible roads.
- Hydraulic design for cross-drainage structures considering increased flood discharge.
- Wave and erosion protection standards for char and homestead margins.
- OTM/LCB procurement standards for civil work and maintenance.

These standards are reaffirmed in the pre-feasibility study as the baseline for the HARD Project implementation.

3.4.4 Specification

Key specifications to guide detailed design and contract packages include:

- **Roadworks:** Engineered embankments with suitable fill and compaction; pavement structures based on submergence class; shoulders, side drains, and geotechnical stabilization for soft haor soils.
- **Cross-drainage:** Reinforced concrete box or pipe culverts sized using updated hydrological models; scour protection; fish-friendly hydraulics where feasible.
- **Protective works:** Revetments, concrete blocks, or bio-engineering methods on exposed reaches; RCC/brick masonry village protection walls with toe protection.
- **Beel and khal works:** Excavation profiles with stable side slopes; spoil reuse for beel access spurs; swamp tree stabilization; sanctuary piles and brush shelters following proven HFMLIP practices.

3.5 Project Schedule

3.5.1 Seasonal Execution Plan

Implementation in the Haor region must respect its unique hydro-ecological cycle, where annual flooding dictates the construction calendar. The HARD Project will therefore follow a seasonally adaptive execution schedule to maximize productivity while minimizing risks:

Dry Season (November – April) – Core Construction Period

- Major civil works including improvement of submergible and non-submergible roads, construction of bridges, culverts, and protective works.
- Earthworks, embankment strengthening, slope protection, and excavation of beel-connecting khals.
- Delivery and stockpiling of construction materials (aggregate, sand, bitumen, reinforcement) in project sites prior to rising water levels.
- Initial community mobilization for fisheries management and alternative livelihood training.

Pre-Monsoon (May – June) – Completion and Transition Phase

- Finishing works such as road surfacing, compaction, installation of guardrails, and roadside plantation for erosion control.
- Finalization of structural interventions and stabilization works before the onset of flash floods.
- Mobilization of community groups (Beel User Co-operative Association, market committees) for O&M preparedness.
- Short-duration training and awareness programs on fisheries, aquaculture, and resource management.

Monsoon Season (July – October) – Suspension and Capacity-Building Phase

- Suspension of heavy civil works due to extensive inundation.
- Monitoring of completed structures, early detection of damages, and data collection for adaptive planning.
- Focus on community-based interventions: training, livelihood support, institutional strengthening, and preparatory surveys for the next construction cycle.
- Procurement planning, contract packaging, and tendering for dry-season activities.

3.5.2 Resources and Utilities Requirement

Institutional Resources

LGED **PMO** with PD and two DPDs; **PIUs** in 7 districts; **PUOs** in 24 upazilas; DSMC and individual experts. District/Upazila committees provide local oversight and problem-solving.

Operational Resources

- **Manpower and operations**: staffing, vehicles, equipment, office O&M, training/workshops, and DSMC inputs are provisioned in the HARD Project cost framework to keep supervision/M&E effective.
- **Construction utilities/materials**: borrow fill for embankments, aggregates/cement for RCC structures and protection, fuel/power for plant and site offices, and water for compaction and curing – all to be sourced by LGED norms and environmental safeguards. Spoil from beel/khals excavation will be prioritized for local beneficial use (e.g., beel-connecting spurs, land raising) where design permits.

Community Resources

BUGs provide on-ground stewardship for CbFRM assets; CAIGA and capacity building continue to diversify incomes and reinforce compliance with fisheries bans.

3.5.3 Operational Resources

3.5.3.1 Construction Equipment

The successful execution of civil work in the haor region will depend on the availability and efficient use of specialized construction equipment. Earthworks such as excavation, embankment preparation, and land shaping will require excavators, bulldozers, graders, and dump trucks. For road stabilization and surfacing, vibratory rollers, compactors, and water bowsers will be essential to ensure durable pavements under both submergible and non-submergible conditions. Structural works, including bridges, culverts, protective walls, and drainage infrastructure, will rely on concrete mixers, batching plants, vibrators, and precision equipment such as cutting and welding machines. Given the seasonal inundation of the haor areas, conventional land transport will often be disrupted; therefore, boats and pontoons will be indispensable for mobilizing construction materials and transporting the workforce to sites that remain waterlogged or isolated during certain months of the year.

3.5.3.2 Supporting Facilities

To ensure uninterrupted implementation, the project will establish a range of supporting facilities close to construction zones. Temporary site offices, labor camps, and material storage yards will be strategically located in accessible areas, providing an operational base for contractors and project staff. On-site maintenance workshops and fuel depots will be set up to keep heavy machinery operational and to minimize downtime during the short construction season. Worker safety and welfare will be prioritized through the provision of first-aid centers, safety shelters, potable drinking water, sanitation blocks, and on-site health services. These facilities are particularly critical in the haor environment, where remoteness and seasonal flooding can otherwise limit access to emergency care and essential amenities.

3.5.3.3 Institutional and Community Resources

Beyond physical resources, institutional capacity and community participation form the backbone of project operations. LGED field offices and dedicated project units will provide technical oversight, contract administration, and monitoring and evaluation to maintain quality and accountability across all interventions. Local governance bodies, particularly Union Parishads and Upazila Administrations, will play an enabling role by supporting land access, facilitating community mobilization, and resolving local disputes. At the grassroots level, community-based organizations such as Beel User Co-operative Association, market committees, and women's cooperatives will be directly involved in fisheries management, Compensatory Alternative Income-Generating Activities (CAIGA), and the operation and maintenance of rural infrastructure. Their participation not only ensures local ownership of project

assets but also strengthens the long-term sustainability of interventions by embedding management responsibilities within the beneficiary communities themselves.

3.6 Survey Information

As part of the Project Preparation and Pre-feasibility Study for the Haor Area Resilience and Development (HARD) Project, detailed surveys were conducted in the 15 selected haors. The purpose of these surveys was to quantify existing infrastructure gaps, identify livelihood support opportunities, and establish priorities for new investments.

The surveys applied a structured methodology combining field inspections, measurements, and community consultations. The results capture the physical and social infrastructure needs of the haor basin and serve as the baseline for planning the HARD Project interventions.

3.6.1 Road Infrastructure

The survey placed strong emphasis on rural road networks, as connectivity remains one of the most significant challenges in the haor region. Both submergible and non-submergible road types were assessed at the Upazila, Union, and Village levels. The data highlights the dominance of village and union-level submergible roads in the haor context, reflecting the seasonal isolation of settlements. Improving these networks is expected to significantly reduce travel times, improve access to schools and health centers, and strengthen rural trade.

Table 3-3: HARD Project indicative quantities of rural road network

Sub-component	Unit	Indicative Quantity
Upazila Road (submergible)	km	23.04
Upazila Road (non-submergible)	km	2.71
Union Road (submergible)	km	39.09
Union Road (non-submergible)	km	9.57
Village Road (submergible)	km	203.69
Village Road (non-submergible)	km	41.5

3.6.2 Infrastructure for Trade and Access

In parallel, the survey assessed rural markets, growth centers, and boat landing stations (ghats). These facilities are critical for enabling rural commerce and ensuring that agricultural products and fish can reach broader markets. Strengthening these facilities will directly enhance local economies, particularly for small farmers and fisher households. Improved ghats will also provide reliable connectivity between water and road transport systems during flood seasons.

Table 3-4: Improvements required for rural markets, growth centers, and ghats

Particulars	Unit	Quantity
Improvement of Growth Center and Rural Market	No	10
Improvement of Boat Landing Station (Ghat)	No	32

3.6.3 Protective and Supporting Structures

The survey also captured the pressing need for protective works and community resilience structures. The demand for village protection walls reflects the acute vulnerability of homestead land to wave erosion and seasonal flooding. These works are expected to safeguard lives, homes, and community assets from recurring climate shocks.

Table 3-5: Protective works and community resilience structures

Particulars	Unit	Quantity
Protective Work	km	15.6
Construction of Village Protection Wall	m	44,200

3.6.4 Fisheries and Livelihood Interventions

Recognizing the critical role of fisheries in haor livelihoods, the survey documented requirements for beel development, connecting khals, and other related facilities. These findings emphasize both ecological restoration (through re-excavation and swamp tree plantation) and livelihood enhancement (via beel fisheries, CAIGA, and aquaculture support). The proposed Haor Natural Resource Museum will also promote awareness, conservation, and eco-tourism.

Table 3-6: Fisheries and beel development requirements

Particulars	Unit	Quantity
Beel Development (Re-excavation/Tree plantation/Fish Sanctuary/CAIGA)	No	300
Beel Connecting Khal Development	km	450
Beel Connecting Road	km	125
Natural Resource Museum	No	1

CHAPTER 4

Environmental and Social Baseline

4 ENVIRONMENTAL AND SOCIAL BASELINE

The baseline conditions define the physical and biological conditions that prevail in the project study area. This chapter provides an overview of environmental and social baseline conditions within the project area and its surroundings, including topography conditions, geological conditions, climate and meteorology, land use, and socio-economic conditions. This information is to assess the quality of the existing environment as well as to assess potential impacts caused by the project in both construction and operation phases and to provide mitigation measures and monitoring programs to reduce adverse impacts.

Information in this chapter is primarily based on the feasibility study report, and a desktop review of reliable sources.

4.1 Study Area and Methodology

4.1.1 Study Area

The project area extends across several districts in north-eastern Bangladesh, focusing on 15 priority haors with a combined gross area of 83,247 hectares. These haors were selected from the pre-feasibility study as part of a priority list, drawn from a much larger pool of 373 haors covering about 858,460 hectares.

The Haor Area Resilience and Development (HARD) Project is located in the north-eastern floodplain region of Bangladesh, covering parts of Sunamganj, Habiganj, Sylhet, Netrokona, and Kishoreganj districts. This zone is characterized by large bowl-shaped depressions known as haors, which remain inundated during the monsoon and gradually dry out in the dry season, supporting both agriculture and fisheries.

The project focuses on 15 proposed haor locations, identified for intervention under the HARD Project. These include:

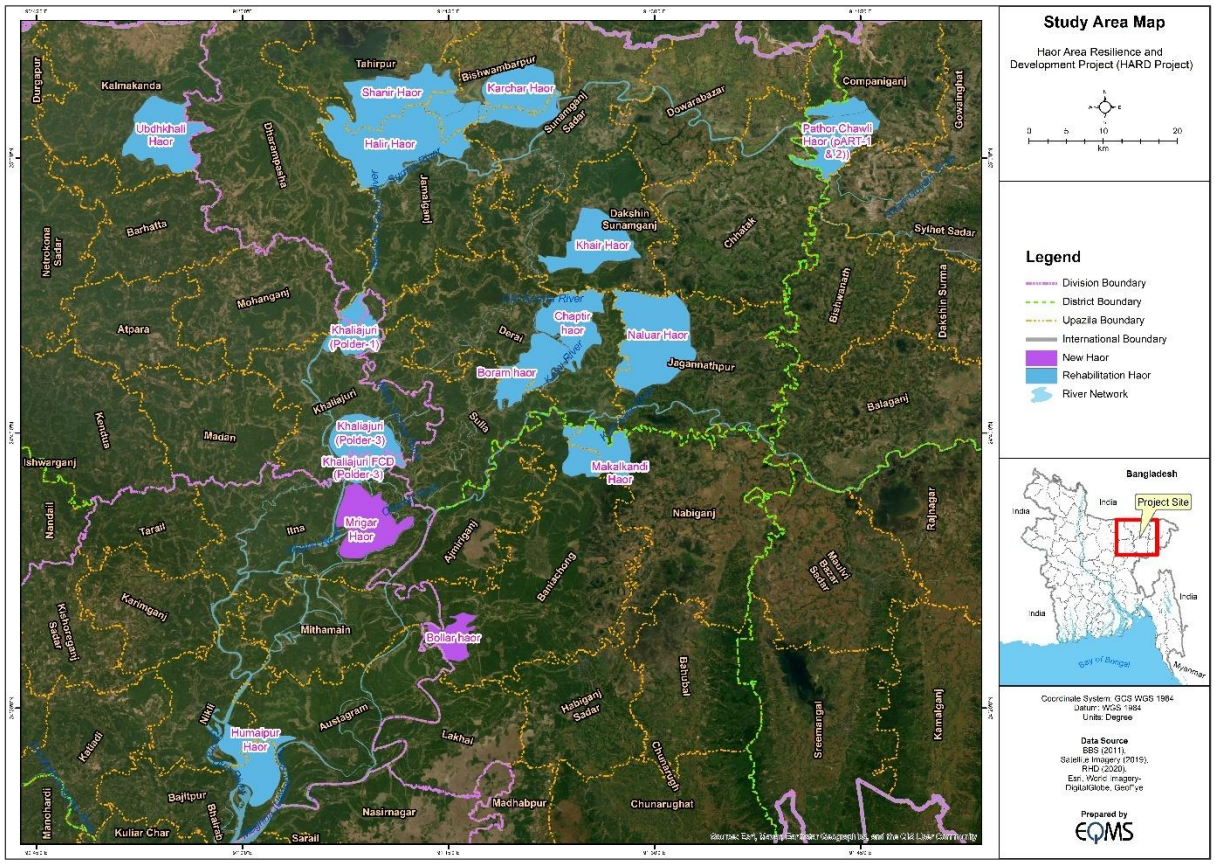
- Naluar Haor (Polder-1)
- Mrigar Haor
- Makalkandi Haor
- Chaptir Haor
- Shanir Haor
- Pathor Chauli Haor
- Karchar Haor
- Halir Haor
- Khai Haor
- Humaipur Haor
- Updakhali Haor
- Khaliajuri Haor (Polder-1)
- Khaliajuri Haor (Polder-3)
- Baram Haor
- Ballar Haor (Chegaiya Haor).

Administratively, these haors are spread across several upazilas including Austagram, Bajitpur, Itna, Nikli, Kalmakanda, Khaliajuri, Baniachong, Nabiganj, Bishwambharpur, Derai, Jagannathpur, Jamalganj, Madhyanagar, Shalla, Shantiganj, Sunamganj Sadar, Tahirpur, and Companiganj.

This project area is ecologically and socio-economically significant. The haors function as natural wetlands, supporting biodiversity, migratory birds, capture fisheries, and boro paddy cultivation, while also being highly vulnerable to seasonal flooding, flash floods, and climate change impacts. The

interventions under the HARD Project aim to enhance resilience, protect livelihoods, and ensure sustainable management of these wetland ecosystems. The study area map is presented in Figure 4-1.

Figure 4-1: Study area map



Source: Study Team, 2025

4.1.2 Methodology

The baseline data is collected through primary and secondary sources of information with reference to the scope of work. This data is collected through a concerted effort of:

- Primary monitoring of key environmental parameters such as air, water, soil, and noise was carried out.
- Information about geology, geomorphology, topography, physiography, agro-ecology, soil types, prevailing natural hazards like floods, earthquakes, cyclones, etc. has been collected from literature reviews and authenticated information made available by government departments.
- Meteorological data such as temperature, rainfall, wind speed and direction, and humidity for a long-term basis (1994 to 2023) of the Sylhet Meteorological Station, Sreemangal Meteorological Station, and Mymensingh Meteorological Station has been obtained from Bangladesh Meteorological Department (BMD).
- Surveys have been carried out to understand and record the biological environment prevailing in the area and the same has been verified against published information and literature (detail in section 4.3).

- The socio-economic environment has been studied through consultation with various stakeholders in the study area. Additionally, socio-economic data have been obtained from the Bangladesh Population and Housing Census.

4.2 Physical Environment

4.2.1 Land Environment

4.2.1.1 Land Use

The haor districts together cover about 2 million hectares. Around 55 percent of this area is cultivated land, while the rest is occupied by rivers, canals (khals), water bodies, forests, homesteads, ponds, hills, and infrastructure. There are approximately 1.68 million farm households and 1.37 million non-farm households in these districts. Among the farm households, about 80 percent are smallholders (owning less than 1 ha of land), 17 percent are medium (1–3 ha), and only 3 percent are large farms (more than 3 ha). Large farms are typically managed through tenants or hired labor.

Land use in the study area is strongly shaped by the ecological and hydrological features of the haor basin. The haors are large bowl-shaped floodplains that remain under water for much of the year. As a result, land use and livelihood practices shift sharply between the dry and wet seasons.

In the dry season, when the water recedes, fertile soils are used almost exclusively for agriculture. Single-crop Boro rice dominates the landscape and is the main source of food and income for most households. Cultivation is concentrated in the central parts of the haor, while the relatively higher land around the edges supports homesteads, kitchen gardens, scattered trees, and in some cases small vegetable plots.

During the monsoon, the haors turn into vast water bodies. Agricultural lands are completely submerged, and the floodplains are used mainly for fisheries and grazing. Open-water fisheries are especially important for local livelihoods, providing both food and employment. Seasonal grazing land along the embankments and haor fringes supports cattle and buffalo rearing during this period.

Settlements are typically located on natural levees or on raised mounds built to avoid flooding. These clusters of villages are connected by rural roads, markets, schools, and other basic services. Local trade is small in scale and revolves mostly around agriculture, fish, and rural bazaars.

Natural vegetation is limited because of prolonged flooding and intensive land use, though scattered reed beds, aquatic plants, and homestead trees are still present. These areas are valuable for biodiversity and provide essential resources such as fuelwood and fodder.

Overall, the land use pattern follows a distinct seasonal rhythm: agriculture and settlement activities dominate in the dry months, while fisheries and other water-based livelihoods define the monsoon. This seasonal transformation is the defining feature of the haor landscape and the foundation of community life in the project area.

4.2.1.2 Topography

Topography is a configuration of a land surface including its relief and contours, the distribution of mountains and valleys, the patterns of rivers, and all other features, natural and artificial, that produce the landscape. The overall landscape of Bangladesh can be divided into three broad categories based on topography, physical features, and geological history.[2]

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

a) 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.

b) Terraces – These are isolated tracts of land, primarily found within central northern and north-western Bangladesh which occupy, in total, about 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.

c) Floodplain – Most of the land surface of Bangladesh is floodplain, which is 114,580 km^2 or 79% approximately of the total land surface. These areas generally comprise quaternary sediments which have been deposited over subsurface geological formations by the Ganges, Meghna, and Brahmaputra rivers.

The study area represents one of the lowest-lying basins in the country, with elevations significantly lower than the surrounding floodplains. Approximately 25 percent of the land lies below EL. 5 meters PWD, while about 50 percent lies below EL. 8 meters PWD. This low elevation makes the entire basin highly prone to seasonal flooding and prolonged waterlogging.

The depression of the haor basin stretches almost to the foothills of Meghalaya in the north, where rainfall and hill runoff directly contribute to the basin's hydrological regime. In contrast, floodplain lands situated farther inland, about 200 kilometers from the coast, are considerably higher, generally ranging between EL. 8 to 20 meters PWD. This sharp difference in elevation underlines the unique character of the haor basin as a vast natural bowl.

Because of its topography, large areas remain under water during the monsoon and only emerge in the dry season, when they are used for cultivation and settlement activities. The flatness of the terrain, combined with the shallow elevations, plays a central role in shaping land use, agriculture, fisheries, and overall livelihood patterns of the communities in the project area.

4.2.1.3 Geology

Bangladesh occupies a major part of the Bengal Delta, one of the largest in the world. The Ganges-Brahmaputra delta basin or the Bengal Basin includes part of the Indian state of West Bengal in the west and Tripura in the east. Geological evaluation of Bangladesh is basically related to the uplift of the Himalayan Mountains and outbuilding of a large deltaic landmass by a major river system originating from the uplifted Himalayas. As a mega delta, Bangladesh covers the greater part of the current Bengal Basin with a huge thickness of fluvio-deltaic sediments, being formed by the merging deltas of the rivers Padma (Ganges), Jamuna (Brahmaputra), and Meghna. Major parts of the country, both onshore and offshore, are geologically built up of sediments deposited by these river systems, being active from Oligocene through to Recent. All these rivers are coming from the rising Himalayan Mountains to the north and Burmese hills to the east. The delta building is still continuing into the present Bay of Bengal. Only the eastern part of this country has been uplifted into hilly landform incorporating itself into the frontal belt of the Indo-Burman Range. All of these are the result of the Indian plate colliding with the Asian plate.

The geology of Bangladesh mainly falls under the following.

a) Stable Precambrian Platform in the Northwest – occupies Rajshahi, Bogura, Rangpur, and Dinajpur areas and is characterized by limited to moderate thickness of sedimentary rocks above a Precambrian igneous and metamorphic basement. This unit is geologically stable in relative terms and has not been affected by fold movement.

b) Geosynclinal Basin in the Southeast – occupies areas of greater Dhaka, Faridpur, Noakhali, Sylhet, Cumilla, Chattogram, and the Bay of Bengal. It is characterized by the huge thickness (maximum of about 20 km near the basin center) of clastic sedimentary rocks, mostly Sandstone, and shale of Tertiary age.

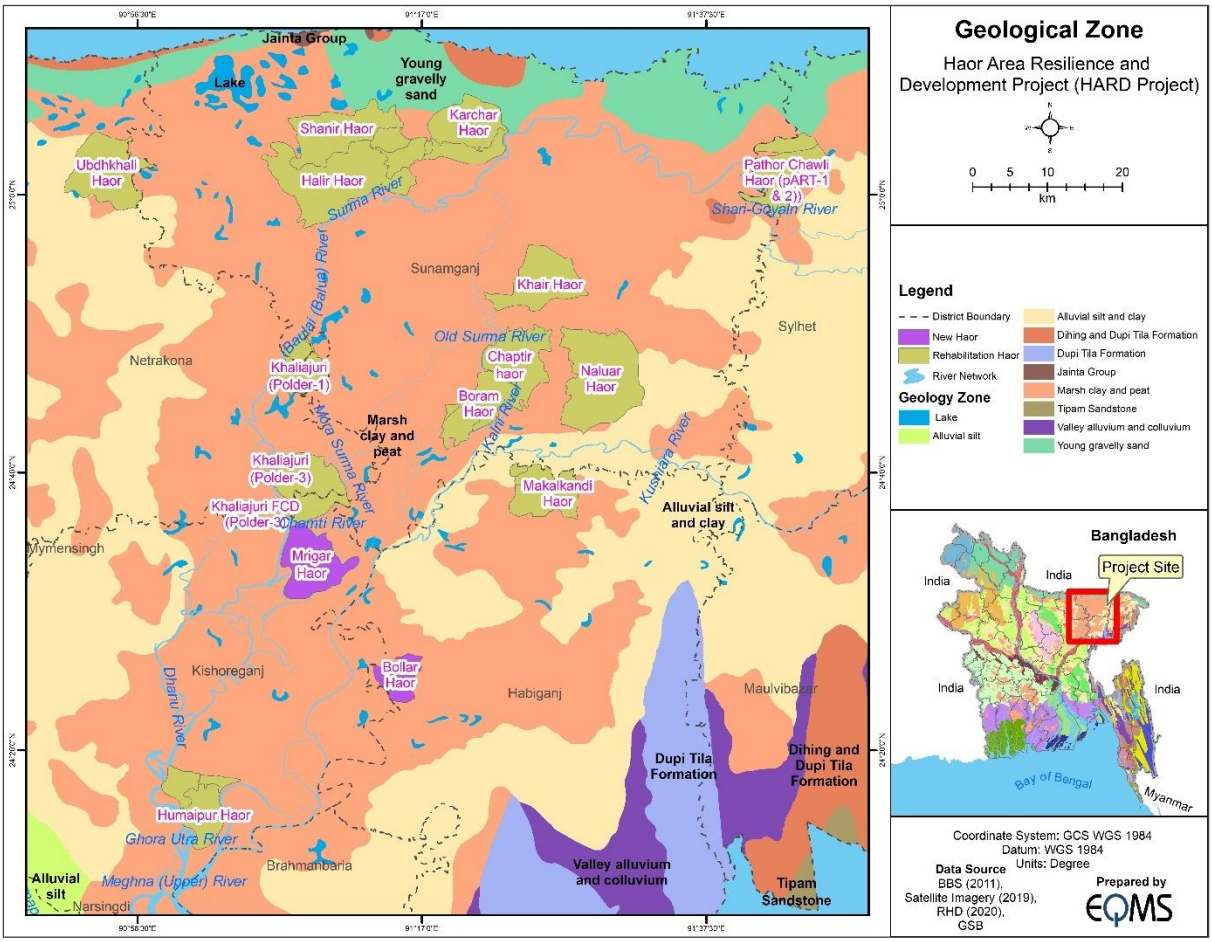
c) The Hinge Zone – a narrow northeast-southwest trending zone, separates the above two units almost through the middle of the country. It is also known as the Eocene hinge zone.

The geology of the project site is Marsh clay and peat and Alluvium Silt and Clay. Marsh clay and peat is Grey or Bluish-grey clay, black herbaceous peat, and yellowish-grey silt. Alternating beds of peat and peaty clay are common in bills and large structurally controlled depressions; peat is thickest in deeper parts. Thin beds of peat and clay are interbedded with alluvial silt in the north-central Sylhet depression. Chains of linear lakes north of the Ganges River and south of the Shillong Plateau in the Sylhet depression suggest these areas are subsiding.

Alluvial silt and clay are Medium- to dark grey in color, ranging from silt to clay; the color becomes darker as the amount of organic material increases. Map unit is a combination of alluvial and paludal deposits; it includes flood-basin silt, backswamp silty clay, and organic-rich clay in sag ponds and large depressions. Some depressions contain peats. Large areas underlain by this unit are dry only a few months of the year; the deeper part of the depression and beels (bhils) contain water throughout the year.

The geological map of the study area is presented in Figure 4-2.

Figure 4-2: Geology of the study area



Source: Geological Survey of Bangladesh, 1991

4.2.1.4 Physiography

The physiography of Bangladesh is characterized by two distinctive features: a broad deltaic plain subject to frequent flooding, and a small hilly region crossed by swiftly flowing rivers. In the context of physiography, Bangladesh may be classified into three distinct regions (a) floodplains, (b) terraces, and

(c) hills each having distinguishing characteristics of its own. The physiography of the country has been divided into 24 sub-regions and 54 units.[3] The project area belongs to the physiographic unit of Haor Basin and Surma-Kushiyara Floodplain.

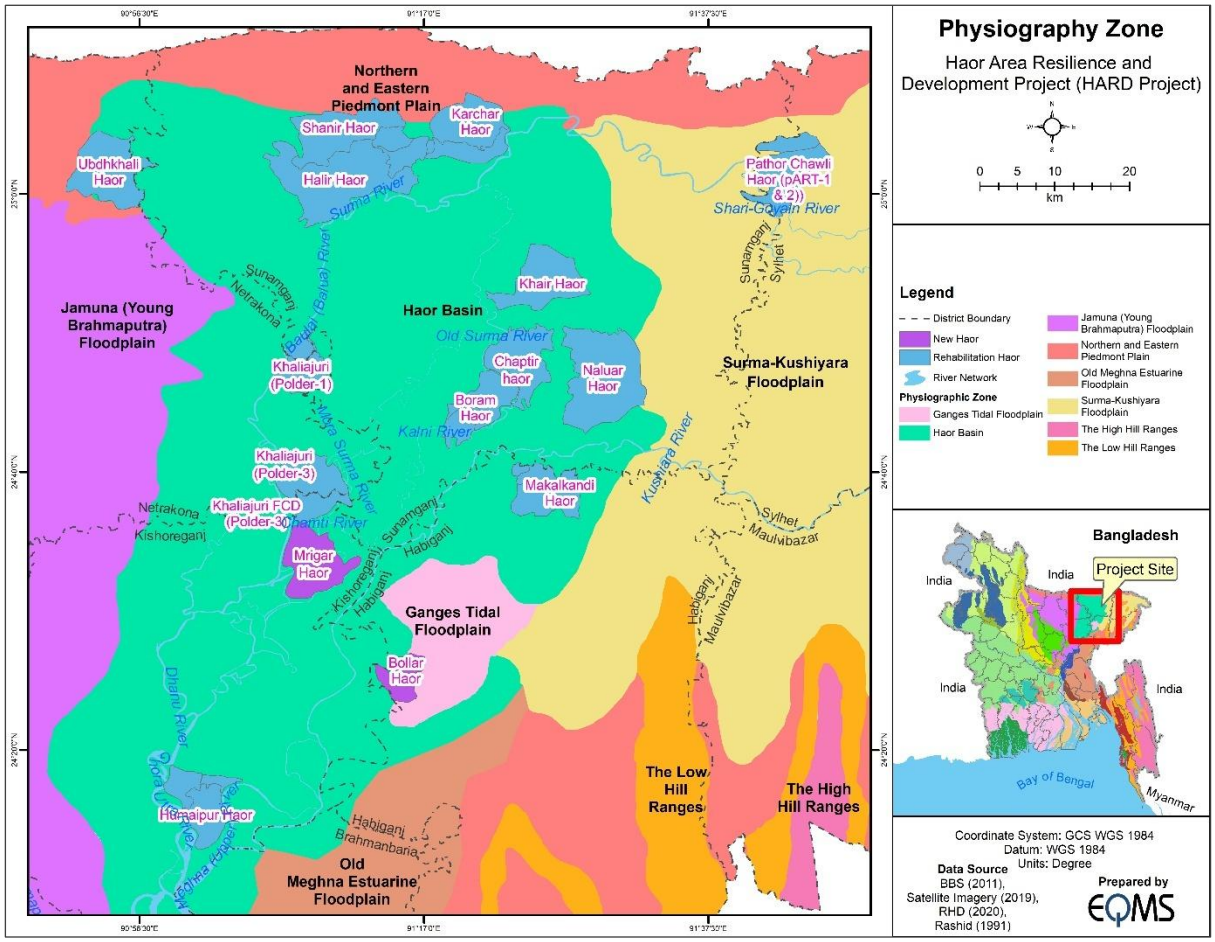
Haor basin, a large, gentle depressional feature, is bounded by the Old Brahmaputra floodplain in the west, the Meghalaya Plateau's foothills in the north, Sylhet High Plain in the east and Old Meghna Estuarine floodplain on the south. Its greatest length, both E-W and N-S, is just over 113 km. Numerous lakes (beels), large swamps and haors cover this saucer-shaped area of about 7,250 sq km. The sinking of this large area into its present saucer shape seems to be intimately connected with the uplift of Madhupur Tract. Local tradition has it that the land sank 9 to 12m in the last 200 years. This area is still undergoing persistent subsidence. In addition to the hills located along the southern spur of the Shillong Massif, a number of hillocks, locally known as tila, form minor but morphologically distinct, ranges around Sylhet in northeastern Bangladesh. These elevations, like for instance Kailas Tila, Dupi Tila and the tilas at Beanibazar, east of Sylhet, are generally built up of Plio-Pleistocene clastic sediments and reach maximum elevations of about 60m above MSL. It is regularly flooded during the monsoon.[3]

Surma-Kushiyara floodplain comprises the floodplain of rivers draining from the eastern border towards the Sylhet Basin (Haor Basin). Some small hills and piedmont areas near Sylhet are included within the boundaries. Elsewhere, the relief generally is smooth, comprising broad ridges and basins, but it is locally irregular alongside river channels. The soils are mainly heavy silts on the ridges and clays in the basins. This area is subject to flash floods in the pre-monsoon, monsoon and post-monsoon seasons, so the extent and depth of flooding can vary greatly within a few days. Normal flooding is mainly shallow on the ridges and deep in the basins.[3]

The physiography of the proposed project area is given in Figure 4-3.

[3] Banglapedia. (2021, June 17). *Physiography*. https://en.banglapedia.org/index.php/physiography

Figure 4-3: Physiography of the study area



Source: Rashid, 1991

4.2.1.5 Geomorphology

The landscape of Bangladesh has been shaped by the combined forces of rivers, hills, tectonics, and monsoon rainfall, making it one of the most dynamic deltaic environments in the world. Although a large part of the country is covered by floodplains, the geomorphology also includes piedmont plains and depressed lands that add to its diversity. Each of these units has its own formation processes, landforms, and significance for human settlement and ecology.

According to the Geological Survey of Bangladesh (GSB), the project area falls under the geomorphic unit of “Piedmont Plains”, “Depressed Lands”, and the “Flood Plains”. The geomorphology of the proposed project area is given in Figure 4-4.

Piedmont Plains

The piedmont plains are found along the northern and eastern fringes of Bangladesh, particularly at the foot of the Himalayas, the Shillong Plateau, and the Chittagong–Sylhet hill ranges. These gently sloping areas are formed by rivers that descend rapidly from the uplands, carrying coarse sediments such as sand, gravel, and pebbles. As the streams lose velocity upon reaching the lowlands, they spread the load into fans and aprons of alluvium. The soil here are generally sandy, well-drained, and less fertile than the central floodplains, and the terrain is prone to flash floods and erosion. These piedmont zones act as transitional belts, linking the steep hill regions with the wider lowland plains.

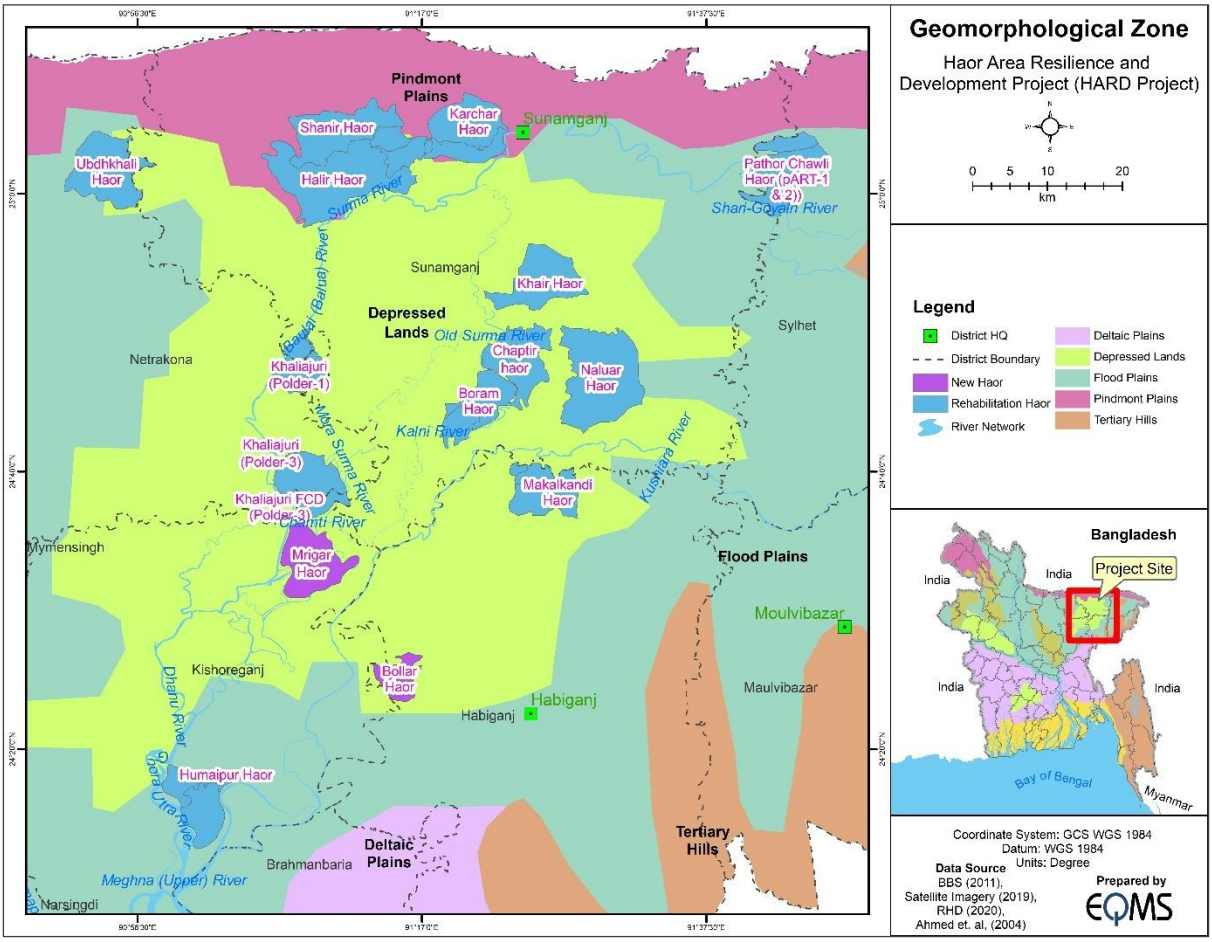
Depressed Lands

The depressed lands are the seasonally inundated basins that occupy significant portions of northeastern and central Bangladesh. The most prominent example is the Sylhet Haor Basin, where large saucer-shaped depressions remain submerged for several months during the monsoon, turning into expansive wetlands. Other depressions occur like backswamps along major rivers or as remnants of abandoned channels. Their origin is linked to tectonic subsidence, as well as fluvial processes of channel shifting and levee formation. These lands are ecologically important, supporting rich fisheries and migratory bird habitats, while also being agriculturally productive in the dry season when water recedes and boro rice is cultivated. However, they are highly vulnerable to flash floods, making farming and settlement a risky venture.

Floodplains

Floodplains dominate the geomorphology of Bangladesh, covering nearly 80 percent of the land area. They are continuously built and reshaped by the Ganges, Brahmaputra-Jamuna, and Meghna River systems, along with their tributaries. The floodplains are composed of active and abandoned segments: the active zones contain braided channels, chars, levees, and oxbow lakes, reflecting constant erosion and deposition, while the abandoned areas consist of older, more stable deposits left behind by shifting river courses. These floodplains provide some of the most fertile soils in South Asia, making them vital for agriculture and dense settlement. At the same time, their dynamic nature exposes millions of people to riverbank erosion, channel migration, and recurrent floods, underscoring the fragile balance between opportunity and risk in Bangladesh's floodplain environment.

Figure 4-4: Geomorphology of the study area



Source: Ahmed et al., 2004

4.2.1.6 Agroecology

Agroecological Zone land areas are recognized on the basis of hydrology, physiography, soil types, tidal activity, cropping patterns, and seasons. An agroecological zone indicates an area characterized by homogeneous agricultural and ecological characteristics. The agroecological zones of Bangladesh have been identified on the basis of four elements such as physiography, soils, land levels in relation to flooding, and agroclimatology. Bangladesh has been tentatively divided into 30 agroecological zones[4].

The proposed project area falls within three distinct physiographic regions: the Sylhet Basin, the Eastern Surma-Kushiyara Floodplain, and the Old Meghna Estuarine Floodplain. Each of these zones has unique landform characteristics, soils, and fertility conditions that shape their agricultural and ecological potential.

Sylhet Basin (4,573 sq km)

This region occupies the lower western side of the Surma-Kushiyara Floodplain. The relief is irregular in areas adjacent to rivers, with a landscape of higher ridges and lower basins. Soils on the higher ground are predominantly grey silty clay loams and clay loams, which dry out seasonally, while the basins are dominated by grey clays that remain wet for longer periods. Organic matter content is moderate, soil reaction is generally acidic, and overall fertility levels range from medium to high.

Eastern Surma-Kushiyara Floodplain (4,622 sq km)

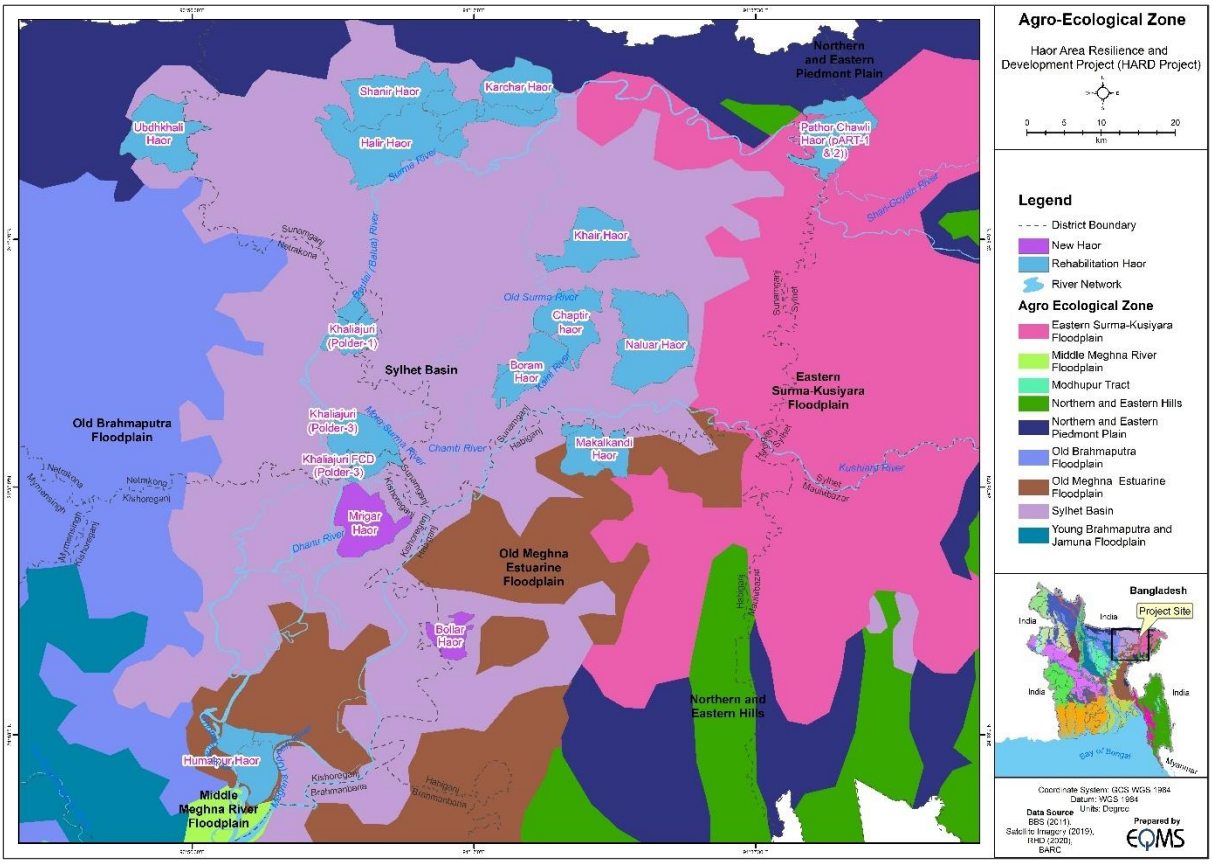
Located in the relatively higher part of the Surma-Kushiyara system, this floodplain has developed from sediments carried by rivers draining the surrounding hill regions into the Meghna catchment. The soil consists mainly of heavy grey silty clay loams on ridges and clays in the basins. Organic matter levels are moderate, while soil reaction varies from strongly acidic to neutral, reflecting the influence of both hill runoff and floodplain sedimentation.

Old Meghna Estuarine Floodplain (7,740 sq km)

This extensive region lies south of the Surma-Kushiyara Floodplain and north of the younger Meghna estuarine zone. The landscape is mostly low-lying, with silt loam soils dominating the higher areas and silty clay to clay soils in the lowlands. Organic matter content is moderate. Topsoils tend to be moderately acidic, while subsoils are generally neutral in reaction. Soil fertility is assessed as medium, supporting a variety of agricultural uses. The map of the agro-ecological region is given in Figure 4-5.

[4] FAO-UNDP. (1988). *Land Resources Appraisal of Bangladesh for Agricultural Development Report 2: Agroecological Regions of Bangladesh*.

Figure 4-5: Agro-ecological zone of the study area



Source: BARC

4.2.1.7 Soils Conditions

4.2.1.7.1 Soil Types

A major part of Bangladesh is on the delta formed by the three major rivers Brahmaputra, Ganges, and Meghna. 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 the variation of agroclimatic parameters in different seasons. The soil formation process differs significantly between floodplain, hill, and uplifted terraces.

A general soil type is a group of soils that are broadly similar in appearance and characteristics because they have developed in response to similar environmental factors such as climate, physiography, and drainage. The Soil Resource Development Institute (SRDI) has identified about 500 soil series in Bangladesh, which are further classified into 23 broad types[5].

The project site lies within soil zones that include the Sylhet Basin, Atrai Beel, Lower Atrai Basin, Lower Punarbhaba Floodplain, Surma–Kushiyara Floodplain, and portions of the Northern Piedmont Plain.

Sylhet Basin

Soils are dominantly fine-textured silt loams to silty clay loams, grading into heavy clays in low-lying basins. They are young alluvial soils, often acidic, seasonally flooded or waterlogged, with surface organic matter accumulation in persistently wet pockets (peat in permanently waterlogged hollows).

[5] FAO. (1988). *Land resources appraisal of Bangladesh for Agricultural Development*, Vol 2, Rome; FAO/UNDP, Classification of the soils of Bangladesh, 1986; H Brammer, The Geography of the Soils of Bangladesh, UPL, Dhaka, 1996.

Drainage ranges from imperfect on ridges to very poor in basins; fertility is moderate but renewed by seasonal silt deposition.

Atrai Beel / Lower Atrai Basin

The Atrai/Lower Atrai area is dominated by dark grey to black heavy clay and silty clay floodplain soils. They are very poorly drained and remain inundated long after monsoon; topsoils commonly have higher organic matter. Texture and clay-mineralogy (mica-rich 2:1 clays in many series) give high shrink–swell behavior and influence tillage and water management. Productive for boro/aman rice and fisheries where water control exists; cultivable areas concentrate on raised ridges and older levees.

Lower Punarbhaba Floodplain

Soils here are stratified floodplain silts and clays, ranging from sandy silts on raised micro-ridges to heavy grey clays in basin centers. Drainage is generally poor to imperfect; seasonal sedimentation maintains moderate inherent fertility. Several mapped soil series (Laskara, Tarash, Manda, etc.) show distinct mineralogy and chemical properties important for crop selection and fertilizer response.

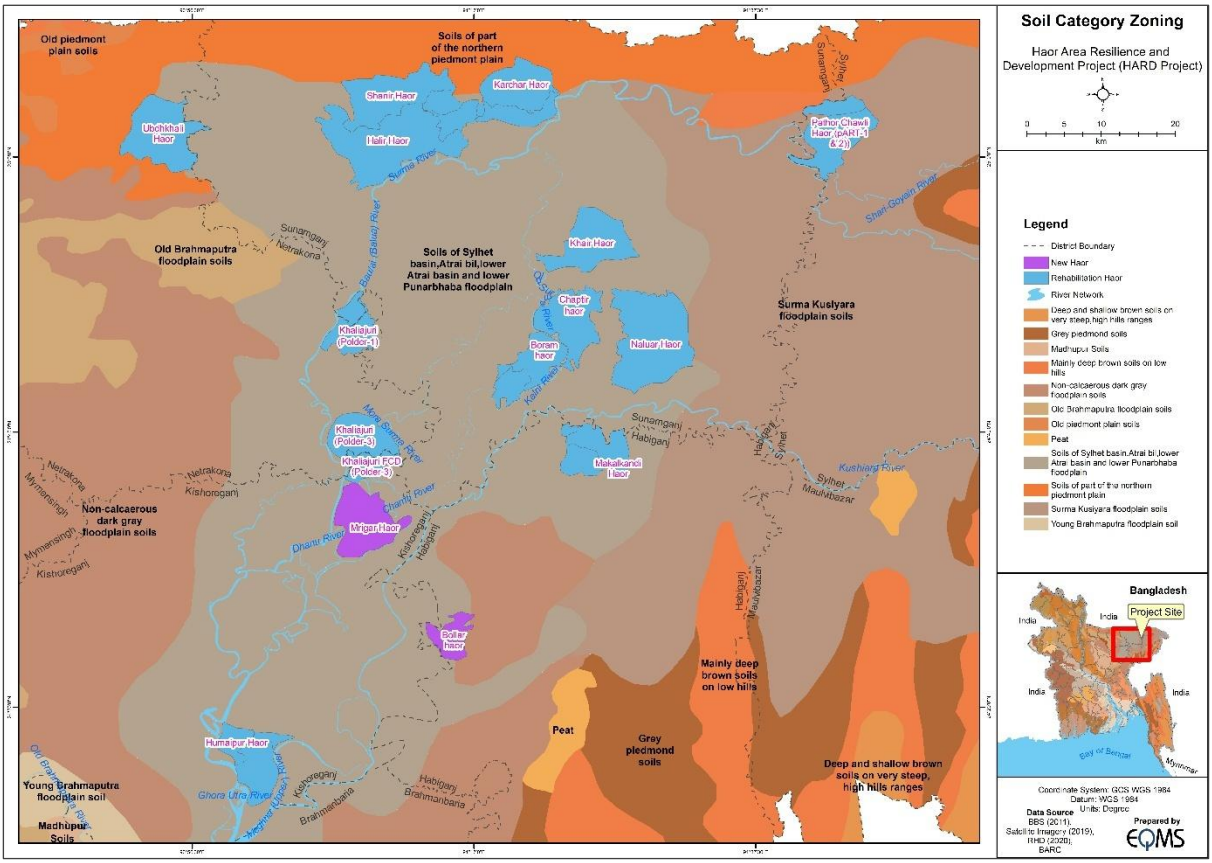
Surma–Kushiyara Floodplain

This floodplain contains non-calcareous brown to silty loam soils on ridges and acid basin clays in depressions. Soils are young, often acid, with frequent fresh silt deposition on active floodplains; surface horizons can be rich in organic matter where inundation is prolonged. Ridges are better drained and support winter crops; basins are mostly rice–fish wetlands.

Northern Piedmont Plain

Piedmont soils are formed in outwash/alluvium at hill-foot slopes and are typically grey, acidic, cambic soils (Gleysols/weakly developed B horizons). They commonly show a grey matrix with seasonally high-water table or imperfect drainage and are dominated by 2:1 clay minerals (mica/chlorite). Micronutrient dynamics and variable drainage make these soils distinct from central floodplain soils; they respond differently to amendments and cropping. The soils of the proposed project area are given in Figure 4-6.

Figure 4-6: Soil map of the study area



Source: SRDI

4.2.2 Air Environment

4.2.2.1 Climate and Meteorology

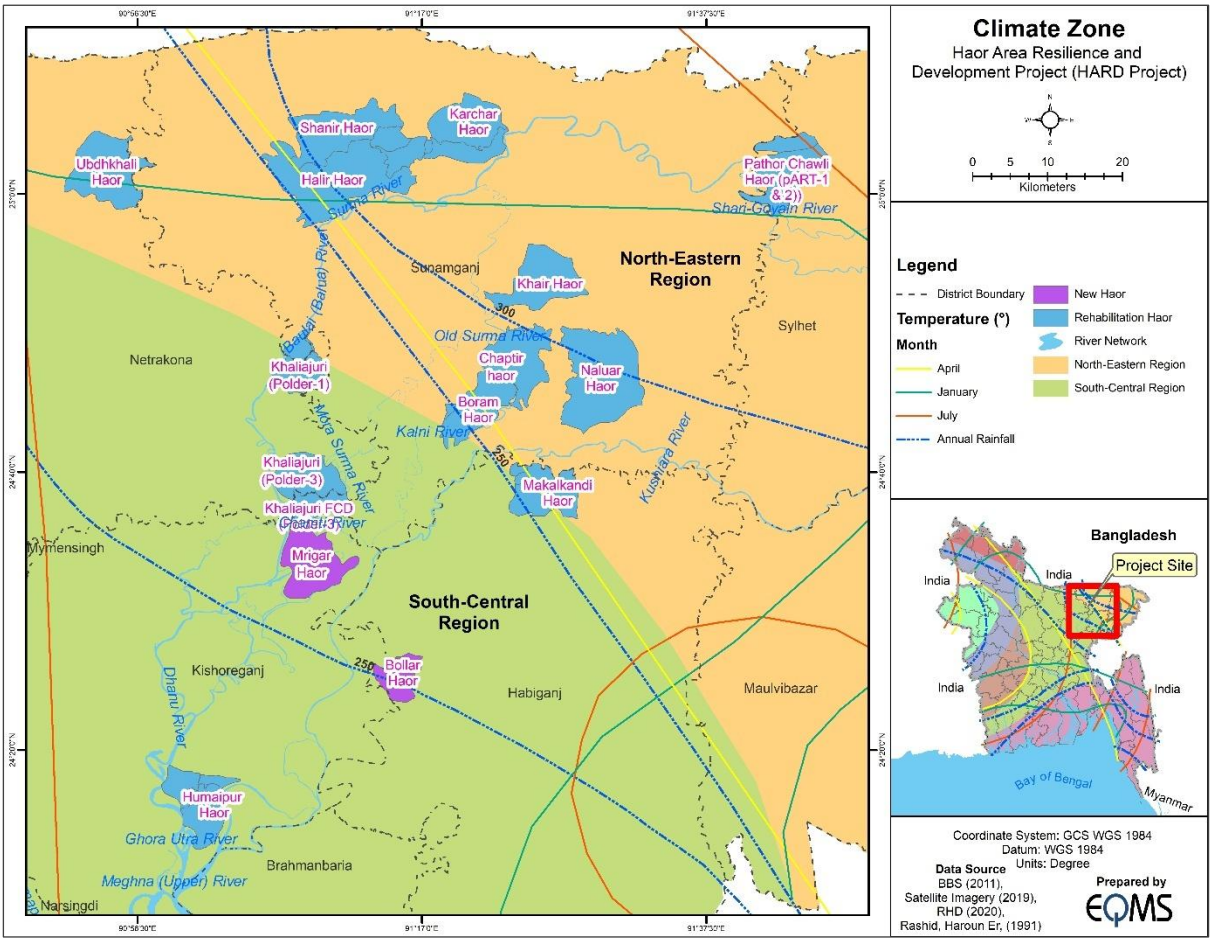
Bangladesh is located in the tropical monsoon region and its climate is characterized by high temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations. From the climatic point of view, four distinct seasons[6] can be recognized in Bangladesh.

- Pre-Monsoon Season (March to May) – Characterized by the highest temperatures of the year– up to 36°C and evapotranspiration rates. Occasional line-squalls (heavy thunderstorms with strong winds) occur. Tropical cyclones (typhoons) occasionally affect coastal areas.
- Rainy Monsoon Season (June to September) – Period of highest rainfall (more than 80% of the annual rainfall normally occurs), 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, but sunny, with heavy dew at night, though cloud cover decreases in this season. There are occasional thunderstorms. Tropical cyclones may still occur, particularly in coastal areas.
- Dry Season (December to February) – is relatively cool, dry, and sunny, with minimum temperatures below 10°C in some areas. Reduced humidity and cloud cover. Rainfall is scarce, however, their occurrence is uncertain.

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

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 South-Central Region and North-Eastern Region. The climatic sub-regions of the study area are shown in Figure 4-7. The climatic data for the study area was obtained from the Bangladesh Meteorological Department (BMD)[7].

Figure 4-7: Climatic sub-regions of the study area



Source: Data from Rashid, H. E. 1991 [8]

Long-term meteorological data for 30 years (1994-2023) was collected from the nearest BMD stations in Sylhet, Sreemangal, and Mymensingh, which is analyzed to get the overall micro-climatic conditions of the study area.

4.2.2.1.1 Temperature

Based on the temperature recorded at Sylhet Meteorological Station for the last 30 years (1994 to 2023), the maximum and minimum ambient temperatures are observed to be ranging from 23.3°C to 35.0°C and 11.8°C to 26.5°C, respectively. The lowest average temperature was in January 2013 (10.6°C). The highest average temperature reached 33.4°C in July 2018. Throughout the year, the

[7] 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.

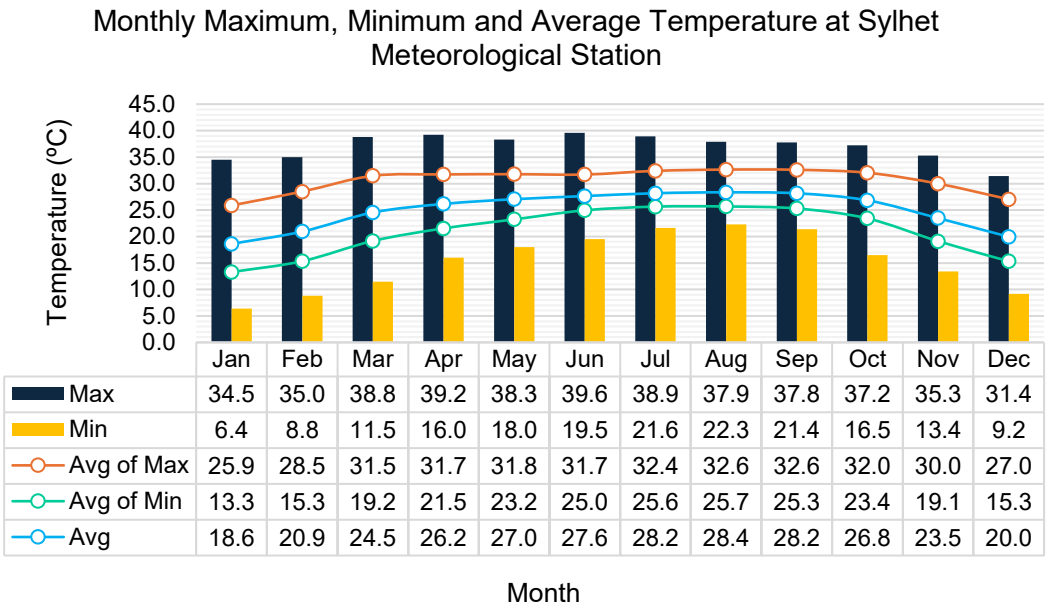
[8] Rashid, H.E. (1991). *Geography of Bangladesh*. The University Press Ltd., Dhaka.

highest temperatures are generally from March to October, and the lowest temperatures are from December to February. The monthly variation of the maximum, minimum, and average temperature at Dhaka Meteorological Station is shown in Figure 4-8.

Based on the temperature recorded at Sreemangal Meteorological Station for the last 30 years (1994 to 2023), the maximum and minimum ambient temperatures are observed to be ranging from 23.0°C to 35.8°C and 7.5°C to 26.2°C, respectively. The lowest average temperature was in January 2013 (8.5°C). The highest average temperature reached 32.5°C in June 2023. Throughout the year, the highest temperatures are generally from March to October, and the lowest temperatures are from December to February. The monthly variation of the maximum, minimum, and average temperature at Dhaka Meteorological Station is shown in Figure 4-9.

Based on the temperature recorded at Mymensingh Meteorological Station for the last 30 years (1994 to 2023), the maximum and minimum ambient temperatures are observed to be ranging from 21.8°C to 34.1°C and 10.2°C to 27.4°C, respectively. The lowest average temperature was in January 2013 (8.7°C). The highest average temperature reached 33.2°C in August 2007. Throughout the year, the highest temperatures are generally from March to October, and the lowest temperatures are from December to February. The monthly variation of the maximum, minimum, and average temperature at Dhaka Meteorological Station is shown in Figure 4-10.

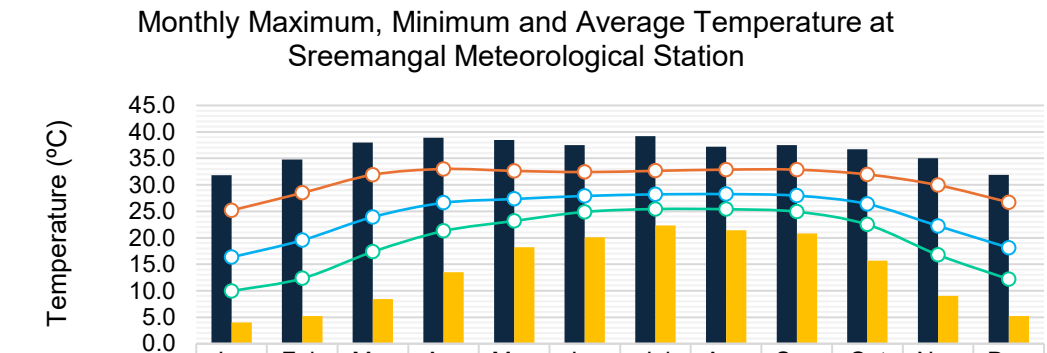
Figure 4-8: Monthly maximum, minimum, and average temperatures at Sylhet Meteorological Station



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	34.5	35.0	38.8	39.2	38.3	39.6	38.9	37.9	37.8	37.2	35.3	31.4
Min	6.4	8.8	11.5	16.0	18.0	19.5	21.6	22.3	21.4	16.5	13.4	9.2
Avg of Max	25.9	28.5	31.5	31.7	31.8	31.7	32.4	32.6	32.6	32.0	30.0	27.0
Avg of Min	13.3	15.3	19.2	21.5	23.2	25.0	25.6	25.7	25.3	23.4	19.1	15.3
Avg	18.6	20.9	24.5	26.2	27.0	27.6	28.2	28.4	28.2	26.8	23.5	20.0

Source: Bangladesh Meteorological Department (BMD)

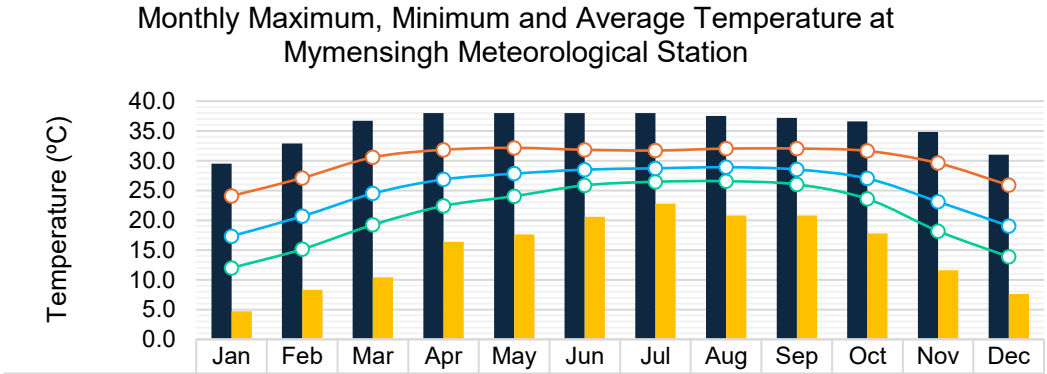
Figure 4-9: Monthly maximum, minimum, and average temperatures at Sreemangal Meteorological Station



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	31.8	34.8	38.0	38.9	38.5	37.5	39.2	37.2	37.5	36.7	35.0	31.9
Min	4.0	5.2	8.4	13.5	18.2	20.1	22.3	21.4	20.8	15.7	9.0	5.2
Avg of Max	25.2	28.5	31.9	33.0	32.6	32.4	32.6	32.9	32.9	32.0	29.9	26.7
Avg of Min	9.9	12.3	17.4	21.3	23.2	24.9	25.4	25.4	24.9	22.5	16.8	12.2
Avg	16.3	19.5	23.9	26.6	27.3	27.9	28.2	28.3	28.0	26.4	22.2	18.1

Source: Bangladesh Meteorological Department (BMD)

Figure 4-10: Monthly maximum, minimum, and average temperatures at Mymensingh Meteorological Station



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	29.5	32.9	36.7	38.0	38.0	38.0	38.0	37.5	37.2	36.6	34.8	31.0
Min	4.7	8.3	10.4	16.4	17.6	20.6	22.8	20.8	20.8	17.8	11.6	7.6
Avg of Max	24.1	27.1	30.6	31.8	32.1	31.8	31.7	32.0	32.0	31.6	29.6	25.9
Avg of Min	12.0	15.1	19.2	22.4	24.0	25.9	26.5	26.5	26.0	23.6	18.2	13.9
Avg	17.3	20.7	24.5	26.8	27.8	28.5	28.7	28.9	28.5	27.0	23.1	19.0

Source: Bangladesh Meteorological Department (BMD)

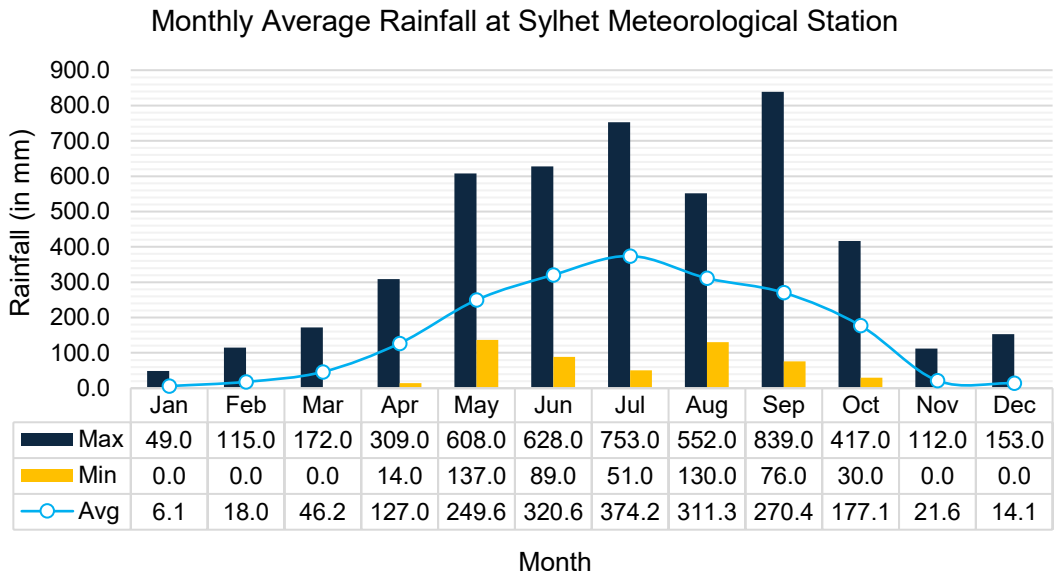
4.2.2.1.2 Rainfall

The annual rainfall based on rainfall data recorded at Sylhet Meteorological Station for the last 30 years (1994 to 2023) is 4033.9 mm. Annual rainfall shows considerable variability from year to year. The rainfall also varies considerably within a year (Figure 4-11) with 65.9% of rainfall occurring during the monsoon season (June to September). The highest rainfall is recorded in June 2022 (1485.0 mm). An insignificant amount of rainfall has also been recorded in winter (November to February).

The annual rainfall based on rainfall data recorded at Sreemangal Meteorological Station for the last 30 years (1994 to 2023) is 2369.1 mm. Annual rainfall shows considerable variability from year to year. The rainfall also varies considerably within a year (Figure 4-12) with 58.8% of rainfall occurring during the monsoon season (June to September). The highest rainfall is recorded in June 2017 (925.0 mm). An insignificant amount of rainfall has also been recorded in winter (November to February).

The annual rainfall based on rainfall data recorded at Mymensingh Meteorological Station for the last 30 years (1994 to 2023) is 2112.8 mm. Annual rainfall shows considerable variability from year to year. The rainfall also varies considerably within a year (Figure 4-13) with 66.7% of rainfall occurring during the monsoon season (June to September). The highest rainfall is recorded in June 2007 (849.0 mm). An insignificant amount of rainfall has also been recorded in winter (November to February).

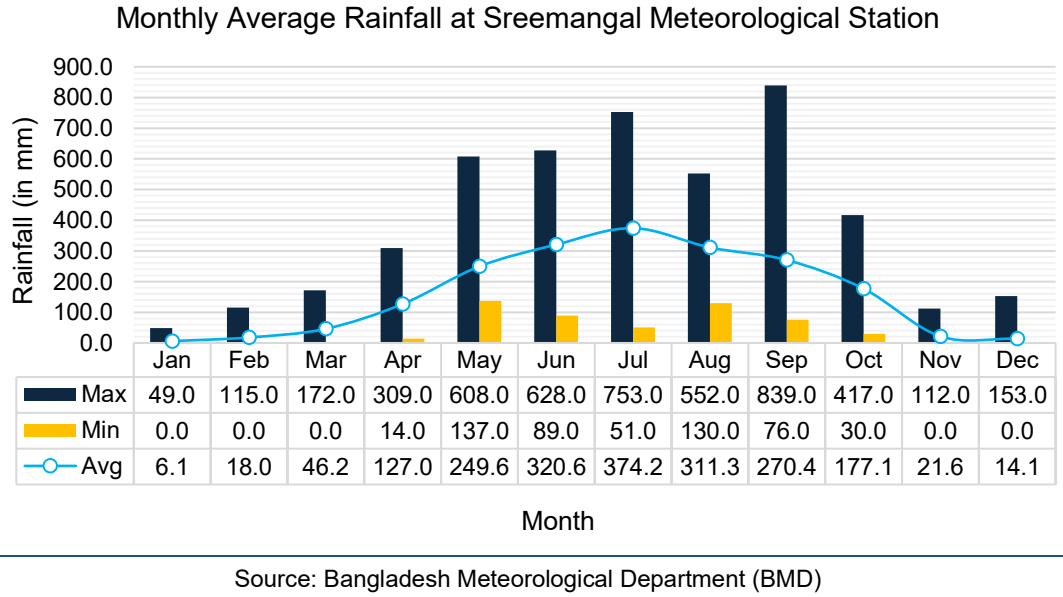
Figure 4-11: Monthly maximum, minimum, and average rainfall at Sylhet Meteorological Station



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	49.0	115.0	172.0	309.0	608.0	628.0	753.0	552.0	839.0	417.0	112.0	153.0
Min	0.0	0.0	0.0	14.0	137.0	89.0	51.0	130.0	76.0	30.0	0.0	0.0
Avg	6.1	18.0	46.2	127.0	249.6	320.6	374.2	311.3	270.4	177.1	21.6	14.1

Source: Bangladesh Meteorological Department (BMD)

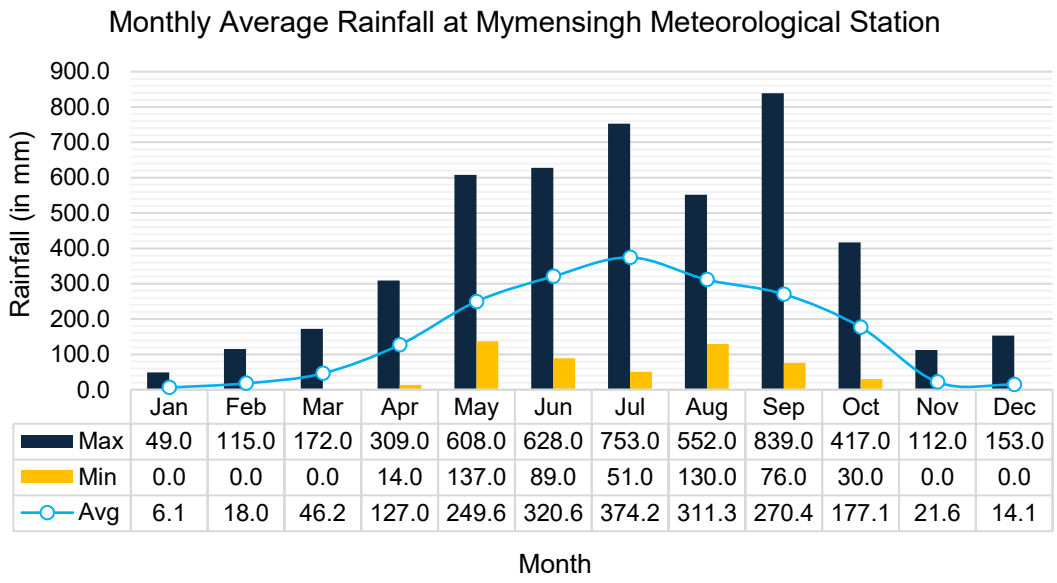
Figure 4-12: Monthly maximum, minimum, and average rainfall at Sreemangal Meteorological Station



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	49.0	115.0	172.0	309.0	608.0	628.0	753.0	552.0	839.0	417.0	112.0	153.0
Min	0.0	0.0	0.0	14.0	137.0	89.0	51.0	130.0	76.0	30.0	0.0	0.0
Avg	6.1	18.0	46.2	127.0	249.6	320.6	374.2	311.3	270.4	177.1	21.6	14.1

Source: Bangladesh Meteorological Department (BMD)

Figure 4-13: Monthly maximum, minimum, and average rainfall at Mymensingh Meteorological Station



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	49.0	115.0	172.0	309.0	608.0	628.0	753.0	552.0	839.0	417.0	112.0	153.0
Min	0.0	0.0	0.0	14.0	137.0	89.0	51.0	130.0	76.0	30.0	0.0	0.0
Avg	6.1	18.0	46.2	127.0	249.6	320.6	374.2	311.3	270.4	177.1	21.6	14.1

Source: Bangladesh Meteorological Department (BMD)

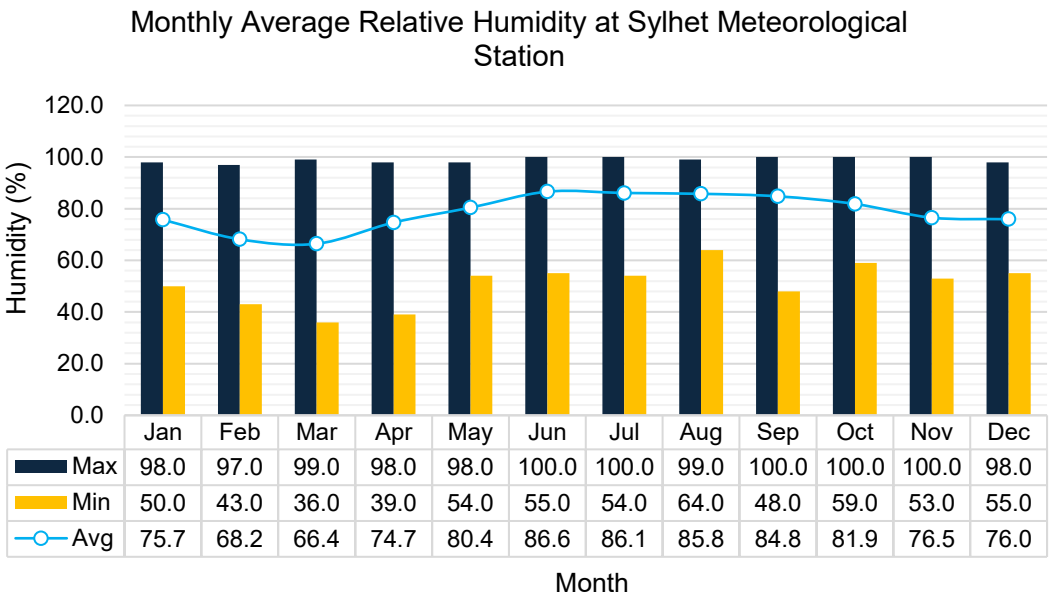
4.2.2.1.3 Humidity

Due to the heavy rainfall and proximity to the Bay of Bengal, the humidity levels in Bangladesh remain high. The average relative humidity in the project area in Sylhet is generally above 78.6% from May to October. The month of March is the driest month with an average relative humidity of around 66.4%. The monthly average relative humidity in the project area varies from 59.6% to 92.6% throughout the year. The monthly maximum, minimum, and average humidity for the last 30 years (1994-2023) of Sylhet Meteorological Station are shown in Figure 4-14.

The average relative humidity in the project area in Sreemangal is generally above 81.2% from May to October. The month of March is the driest month with an average relative humidity of around 70.9%. The monthly average relative humidity in the project area varies from 63.2% to 89.0% throughout the year. The monthly maximum, minimum, and average humidity for the last 30 years (1994-2023) of Sreemangal Meteorological Station are shown in Figure 4-14.

The average relative humidity in the project area in Mymensingh is generally above 81.6% from May to October. The month of March is the driest month with an average relative humidity of around 74.0%. The monthly average relative humidity in the project area varies from 66.9% to 90.8% throughout the year. The monthly maximum, minimum, and average humidity for the last 30 years (1994-2023) of Mymensingh Meteorological Station are shown in Figure 4-14.

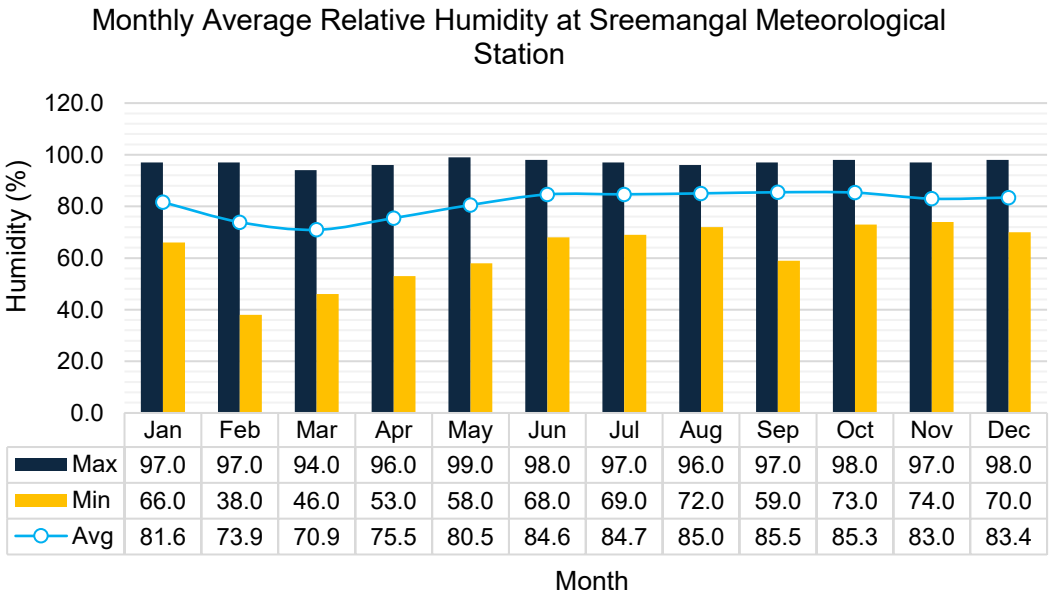
Figure 4-14: Monthly maximum, minimum, and average relative humidity at Sylhet Meteorological Station



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	98.0	97.0	99.0	98.0	98.0	100.0	100.0	99.0	100.0	100.0	100.0	98.0
Min	50.0	43.0	36.0	39.0	54.0	55.0	54.0	64.0	48.0	59.0	53.0	55.0
Avg	75.7	68.2	66.4	74.7	80.4	86.6	86.1	85.8	84.8	81.9	76.5	76.0

Source: Bangladesh Meteorological Department (BMD)

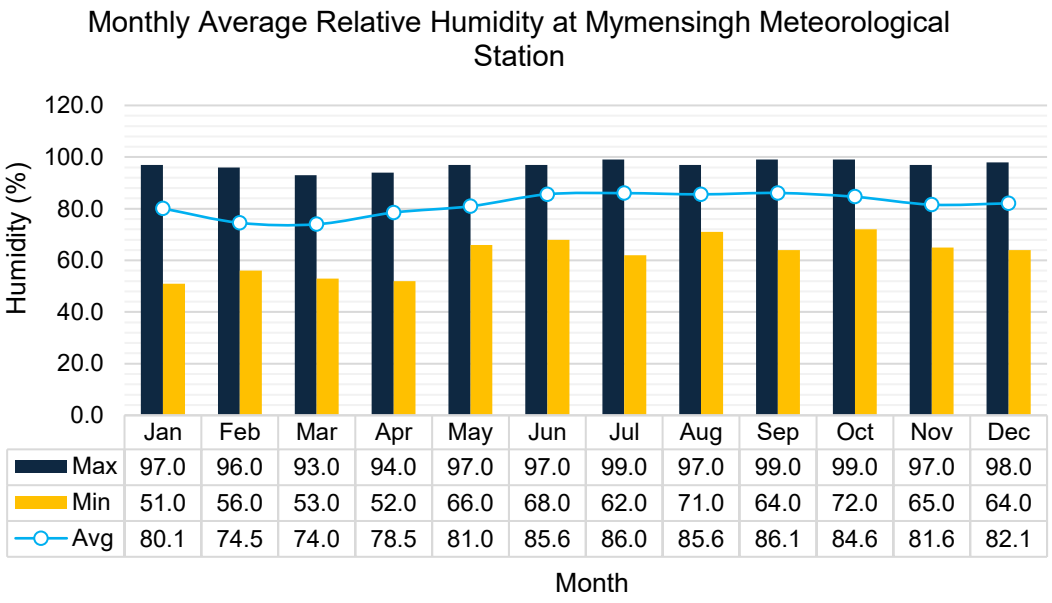
Figure 4-15: Monthly maximum, minimum, and average relative humidity at Sreemangal Meteorological Station



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	97.0	97.0	94.0	96.0	99.0	98.0	97.0	96.0	97.0	98.0	97.0	98.0
Min	66.0	38.0	46.0	53.0	58.0	68.0	69.0	72.0	59.0	73.0	74.0	70.0
Avg	81.6	73.9	70.9	75.5	80.5	84.6	84.7	85.0	85.5	85.3	83.0	83.4

Source: Bangladesh Meteorological Department (BMD)

Figure 4-16: Monthly maximum, minimum, and average relative humidity at Mymensingh Meteorological Station



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	97.0	96.0	93.0	94.0	97.0	97.0	99.0	97.0	99.0	99.0	97.0	98.0
Min	51.0	56.0	53.0	52.0	66.0	68.0	62.0	71.0	64.0	72.0	65.0	64.0
Avg	80.1	74.5	74.0	78.5	81.0	85.6	86.0	85.6	86.1	84.6	81.6	82.1

Source: Bangladesh Meteorological Department (BMD)

4.2.3 Water Environment

4.2.3.1 River Network within the Project Area

The river network of the project area is shaped by three dominant river systems. These are the Surma-Baulai River System, Kalni-Kushiyara River System, and Kangsa-Dhanu River System. Together these river systems create a dense and interconnected drainage network that sustains the haor landscape. The project site is located on a naturally depressed area, which remains submerged during monsoon and dry in winter. Figure 4-17 shows the river system and water body around the project area.

Surma-Baulai River System

The Surma-Baulai river system carries the flow of the Surma River along with several transboundary rivers that originate in the north and flow south across the haor basin. Among them the Surma, Baulai, and Sari Gowain rivers are the most significant. This river system merges with the Kalni-Kushiyara river system at Bajitpur upazila of Kishoreganj district. The river network shown on the map highlights the Surma River as a central channel passing through Sunamganj and connecting multiple haors such as Shanir, Halir, and Sonamoral. Seasonal variation in the Surma River is pronounced, with very high flows during the monsoon and extremely low flows in the dry season. Seasonal variation of hydrological parameters in the Surma River at Kanaighat (Station ID: 266) is presented in the Table 4-1.

Table 4-1: Seasonal variation of hydrological parameters in the Surma River at Kanaighat (Station ID: 266)

Season	Discharge (m^3/s)			Water Level (m, PWD)		
	Maximum	Mean	Minimum	Maximum	Mean	Minimum
Pre-monsoon	1,532	388	29	12.53	7.90	5.92
Monsoon	2,185	1,232	377	15.52	12.22	8.37
Post-monsoon	1,508	363	31	12.52	8.15	5.56

Season	Discharge (m³/s)			Water Level (m, PWD)		
	Maximum	Mean	Minimum	Maximum	Mean	Minimum
Dry	332	26	6	7.31	5.98	5.53
Yearly	2,185	555	6	15.52	8.51	5.53

Source: Master Plan of Haor Area, April 2012, CEGIS

Kalni-Kushiyara River System

The Kalni-Kushiyara river system is another key hydrological feature of the project area. It includes the Kalni, Kushiyara, Sonai Bordal, Juri, Manu, Dhalai, and Lungla rivers. This river system also merges with the Surma-Baulai river system at Bajitpur upazila. The map shows the Kalni River flowing southward, linking several haors including Chapti Haor, Nalua Haor, and Makkalandi Haor, before joining downstream. The Kushiyara River, like the Surma, displays strong seasonal fluctuations in discharge and water level as indicated in the following Table 4-2.

Table 4-2: Seasonal variations of hydrological parameters in the Kushiyara River at Sheola (Station ID: 173)

Season	Discharge (m³/s)			Water Level (m, PWD)		
	Maximum	Mean	Minimum	Maximum	Mean	Minimum
Pre-monsoon	1,582	506	151	12.31	7.97	5.22
Monsoon	2,315	1,558	631	13.96	12.28	9.05
Post-monsoon	1,716	598	209	12.65	9.08	6.33
Dry	531	128	70	7.91	5.35	5.38
Yearly	2,315	709	70	13.96	8.72	5.38

Source: Master Plan of Haor Area, April 2012, CEGIS

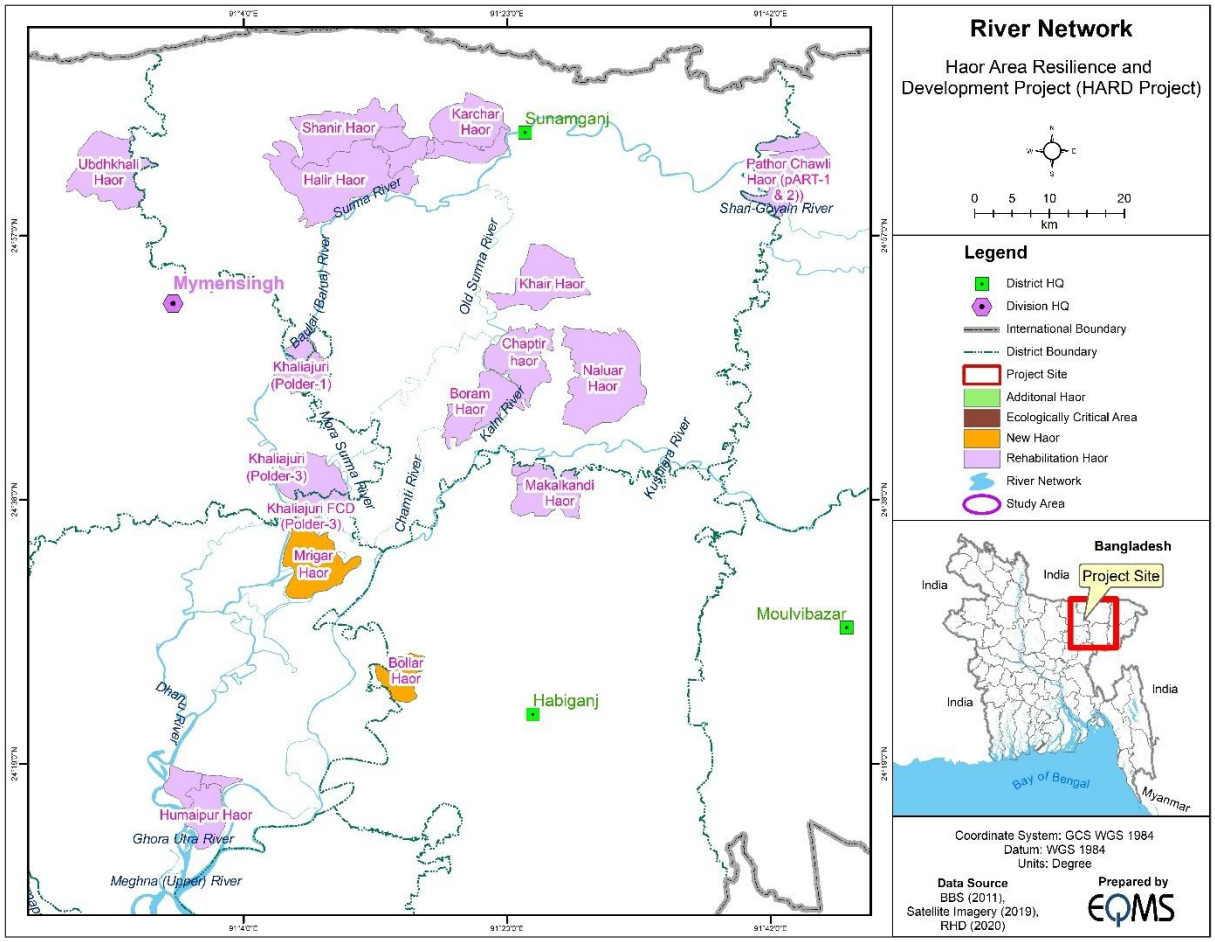
Kangsa-Dhanu River System

The third river system is the Kangsa-Dhanu river system, which covers a significant portion of the project area. The Kangsa and Dhanu rivers are the principal channels within this network. Both rivers drain southward and ultimately join the Meghna River near the borders of Bajitpur and Bhairab upazilas. The project map shows the Kangsa River passing through the Khaliajuri area and connecting with the Dhanu and other distributaries before flowing into the Meghna.

Hydrological modeling carried out by IWM indicates that new project interventions may lead to a minor increase in flood levels in adjacent haors and rivers. The projected rise is between 8 and 10 centimeters, which has been addressed in the project design by incorporating a freeboard of 30 centimeters in the crest level of the submersible embankment.

Overall, the three river systems together define the hydrological regime of the project area. The Surma-Baulai river system dominates the northern part, the Kalni-Kushiyara river system governs the eastern and central areas, and the Kangsa-Dhanu river system influences the western and southern stretches. The seasonal patterns of discharge and water level recorded in the Surma and Kushiyara rivers highlight the flood-prone nature of the haor region.

Figure 4-17: River system of the study area



Source: Satellite Imagery, 2019

4.2.3.2 Hydrological Condition of the Haors

4.2.3.2.1 Hydrological Condition of Naluar Haor

Naluar Haor is located in Jagannathpur upazila of Sunamganj district and forms part of the Surma-Kushiyara (Kalni) floodplain system. The haor is hydrologically influenced by the Surma River and its distributaries (connected to Dauka, Naljur, Kamarkhal, Pogardhar, and Kasto Chonua Balla River), which convey monsoonal discharge from upstream catchments. During the monsoon, overbank flow and lateral spreading result in extensive inundation of the haor, while in the dry season water recedes through interconnected floodplain channels toward the Surma-Kushuyara drainage network. The hydrological regime is further shaped by upstream rainfall and flash flood events.

The pre-monsoon water level is about 6.77 m, while it rises to about 15.0 m at its maximum in the monsoon season.

4.2.3.2.2 Hydrological Condition of Mrigar Haor

Mrigar Haor is situated in Itna Upazila of Kishoreganj District. It is a seasonally flooded wetland that forms by the Dhanu-Baulai-Ghorautra river system which flows south through Sunamganj, Netrokona, and Kishoreganj districts and ultimately acts as a tributary of the Meghna River basin meets the Upper Meghna River. The haor is hydrologically influenced by flows from the Dhanu River (as well as the Surma-Kushiyara River) and its distributary channels. During the monsoon season, overbank flow and lateral water spread lead to widespread inundation, whereas in the dry season, water levels recede

through the Dhanu-Meghna drainage network. The hydrological regime is further influenced by upstream rainfall and flash flood events.

The pre-monsoon water level is approximately 5.02 m, while it rises approximately 9.16 m at peak monsoon.

4.2.3.2.3 Hydrological Condition of Makalkandi Haor

Makalkandi Haor is located in Baniachong and Nabiganj upazilas of Habiganj district and forms part of the Kushiyara-Kalni transitional floodplain system. The haor is primarily influenced by the Kushiyara River and its distributary channels, with additional hydraulic linkage to the Surma system. During the monsoon, overbank flow and lateral spreading result in extensive inundation, while in the dry season water recedes through the Kushiyara-Kalni drainage network. The hydrological regime is further influenced by upstream rainfall and seasonal flood dynamics.

The pre-monsoon water level stands at about 6.07 m, while it increases to nearly 8.5 m during the monsoon maximum.

4.2.3.2.4 Hydrological Condition of Chaptir Haor

Chaptir Haor, located in Derai upazila of Sunamganj district, is a seasonally inundated floodplain wetland forming part of the Surma-Kalni river floodplain system. The haor is hydrologically influenced by the Surma River and distributary channels (connected to Old Surma, Kalni, Mohasingh, Hera Chamti, Chapti, Masura Chapti, Kamarkhal River) of the Surma-Kushiyara river system, along with monsoonal rainfall and local runoff from adjacent catchments. During the monsoon, overbank flow and lateral spreading result in extensive inundation, while in the dry season water recedes through the Surma-Kalni drainage network.

The pre-monsoon water level is around 6.74 m, increasing to nearly 15.0 m during peak monsoon conditions.

4.2.3.2.5 Hydrological Condition of Shanir Haor

Shanir Haor is a seasonally inundated floodplain wetland forming part of the Surma basin. It is primarily hydrologically connected to the Rakti and Baulai rivers, which function as important distributary and floodplain channels. These rivers facilitate hydraulic connectivity and water exchange between the Surma River system and adjacent haor depressions through overbank flow, distributary channels, and lateral floodplain inundation.

The pre-monsoon water level is approximately 7.09 m, while it rises to nearly 10.0 m during peak monsoon flooding.

4.2.3.2.6 Hydrological Condition of Pathor Chauli Haor

Pathor Chauli Haor is located in Companiganj upazila of Sylhet district and forms part of a hill-fed floodplain system influenced by the rivers originating from the Meghalaya catchments (e.g., Dhala River, Chela River, Jaila Chara River, and Piyain River). These rivers convey monsoonal discharge and flash flood flows from the Meghalaya hill catchments into the haor basin. During the monsoon, rapid inflow and lateral spreading result in extensive inundation, while in the dry season water recedes through the Jadukata-Piyain-Surma drainage network. The hydrological regime is strongly influenced by upstream rainfall and flash flood dynamics.

The pre-monsoon water level is about 9.32 m, while it rises to about 11.16 m at its maximum in the monsoon season.

4.2.3.2.7 Hydrological Condition of Karchar Haor

Karchar Haor is a seasonally inundated floodplain wetland forming part of the Surma basin, with hydrological influence from both hill-fed and floodplain river systems, including the Surma, Rakti,

Jalukhali (Chalti), and Koula rivers. These rivers collectively control the inflow, distribution, and drainage of water within the haor. The Jalukhali (Chalti) River, Koula, and Rakti River convey hill-origin flash flood flows from the Meghalaya catchments, while the Surma River provides the main regional discharge. During the monsoon, overbank flow and lateral inundation result in extensive flooding of the haor, while in the dry season water recedes through the interconnected floodplain and Surma drainage network.

The pre-monsoon water level is approximately 7.44 m, and it increases to nearly 10 m during peak monsoon.

4.2.3.2.8 Hydrological Condition of Halir Haor

Halir Haor, located in Jamalganj, Tahirpur, and Bishwambharpur upazilas of Sunamganj district Halir, is a seasonally inundated floodplain wetland forming part of the Surma basin, with hydrological influence from both hill-fed inflows and floodplain channel systems. The haor receives water from upstream hill-origin rivers draining from the Meghalaya catchments, as well as from regional discharge within the Surma floodplain and local runoff.

The pre-monsoon water level is around 7.04 m, while it rises to about 10 m at its highest in the monsoon season.

4.2.3.2.9 Hydrological Condition of Khai Haor

Khai Haor is located within the Surma basin and is hydrologically influenced by regional discharge from the Surma River system (Old Surma and Mohasingh River), monsoonal rainfall, and interconnected floodplain channels. During the monsoon, overbank flow and lateral inundations result in extensive flooding of the haor, while in the dry season water recedes through the surrounding floodplain drainage network toward the Surma system. The hydrological regime is further influenced by upstream rainfall and seasonal flood dynamics.

The pre-monsoon water level is approximately 6.77 m, while it surges to about 15.0 m at peak monsoon.

4.2.3.2.10 Hydrological Condition of Humaipur Haor

Humaipur Haor, located in Bajitpur, Nikli, and Austogram upazilas of Kishoreganj district, is a seasonally inundated floodplain wetland forming part of the Dhanu-Baolai-Ghorautra and Kalni-Kushiyara river system within the Upper Meghna basin. The haor is influenced by regional river discharge, monsoonal rainfall, and strong hydraulic connectivity with adjacent haor depressions and floodplain channels. During the monsoon, lateral spreading of river discharge and strong floodplain connectivity result in extensive inundation, while in the dry season water recedes through the Upper Meghna drainage network toward the Meghna system. The hydrological regime is characterized by low-gradient flow conditions, seasonal flooding, and high hydraulic connectivity within the haor basin.

The pre-monsoon water level is about 3.29 m, while it rises to about 9.5 m at its maximum in the monsoon season.

4.2.3.2.11 Hydrological Condition of Updakhali Haor

Updakhali Haor lies in the northwestern part of the haor basin and is hydrologically connected to the Updakhali, Gunai, Gumai, and Kangsa river, which originate from the Meghalaya hill catchments (e.g., Someswari River). These rivers convey significant monsoonal flow and flash flood discharge into the haor basin. The rivers function as a local distributary channel, linking upstream flow from the Someswari and other hill-fed rives to adjacent floodplain depressions, including Updakhali Haor. As a result, the haor operates as an upper floodplain storage system within the Upper Meghna basin, receiving inflow from hill-origin rivers and contributing to downstream drainage toward the Meghna river system.

The water level is approximately 7.0 m during the pre-monsoon period, while it increases to approximately 9.5 m at its maximum in the monsoon season.

4.2.3.2.12 Hydrological Condition of Khaliajuri Haor

Khaliajuri Haor is located within the Upper Meghna basin and forms part of a large interconnected floodplain wetland system. The hydrology of the haor is primarily influenced by the Dhanu River system, which conveys monsoonal flow and upstream runoff from the surrounding catchments into the haor basin. Due to the very low gradient of the floodplain, water spreads laterally across the basin during the monsoon season, forming an extensive and hydraulically connected water body. Rather than a confined channel flow system, water movement occurs through a network of distributary channels, floodplain depressions, and overbank flow. During peak monsoon, the haor functions as a major floodwater storage area, while in the dry season water levels recede, exposing land for agricultural use. The system is also highly susceptible to flash flood events, which can rapidly increase water levels due to upstream inflow and intense rainfall.

The pre-monsoon water level is around 5.57 m, while it rises to about 9.55 m at its maximum in the monsoon season.

4.2.3.2.13 Hydrological Condition of Baram Haor

Baram Haor is located in Derai and Shulla upazila of Sunamganj district, within the central haor basin of northeastern Bangladesh. It lies in proximity to major floodplain channels and is part of the Surma basin system.

Baram Haor is a seasonally inundated floodplain wetland whose hydrology is primarily influenced by the Kalni River system, a major distributary of the Surma River. It is hydrologically connected to Kalni, Chamti, and Darain River. The haor forms part of a low-gradient, interconnected floodplain, where water movement is governed by lateral overflow, distributary channels, and hydraulic connectivity with adjacent wetlands.

The pre-monsoon water level is approximately 6.70 m, while it increases to about 15.0 m at its maximum during peak monsoon.

4.2.3.2.14 Hydrological Condition of Ballar (Chegaiya) Haor

Ballar Haor is a seasonally inundated floodplain wetland that forms part of the Kalni-Kushiyara River floodplain system. Its hydrological regime is primarily influenced by the Kushiyara (Kalni) River and its distributary channels, in addition to monsoonal rainfall and local runoff from adjacent catchments. Due to the low-gradient floodplain setting, water spreads laterally during the monsoon season, creating a hydraulically connected wetland system through river overbank flow, distributary channels, and floodplain depressions.

The pre-monsoon water level is about 4.86 m, while it rises to nearly 16.71 m at peak monsoon.

4.3 Biological Environment

A biological environment study is essential for any project that may have an impact on the environment. Haor wetlands are vital ecological systems that provide important habitats for aquatic life, serve as major breeding grounds for fish, support migratory birds and wildlife, and play a crucial role in the national economy and food security of Bangladesh. At the same time, these areas are heavily populated and highly dependent on agriculture, fishing, and other development activities. However, embankments, roads, and flood control structures fragment habitats and block fish migration routes, while wetland drainage for settlements and infrastructure reduces open water areas critical for biodiversity. Such development activities can lower water quality, fragment habitats, diminish fish stocks, and threaten migratory birds ultimately leading to a decline in overall biodiversity and ecosystem services that millions of local people rely on.

In this context, as part of the Environmental Impact Assessment (EIA) for the Haor Area Resilience and Development Project, an ecology and biodiversity survey was undertaken to document the existing

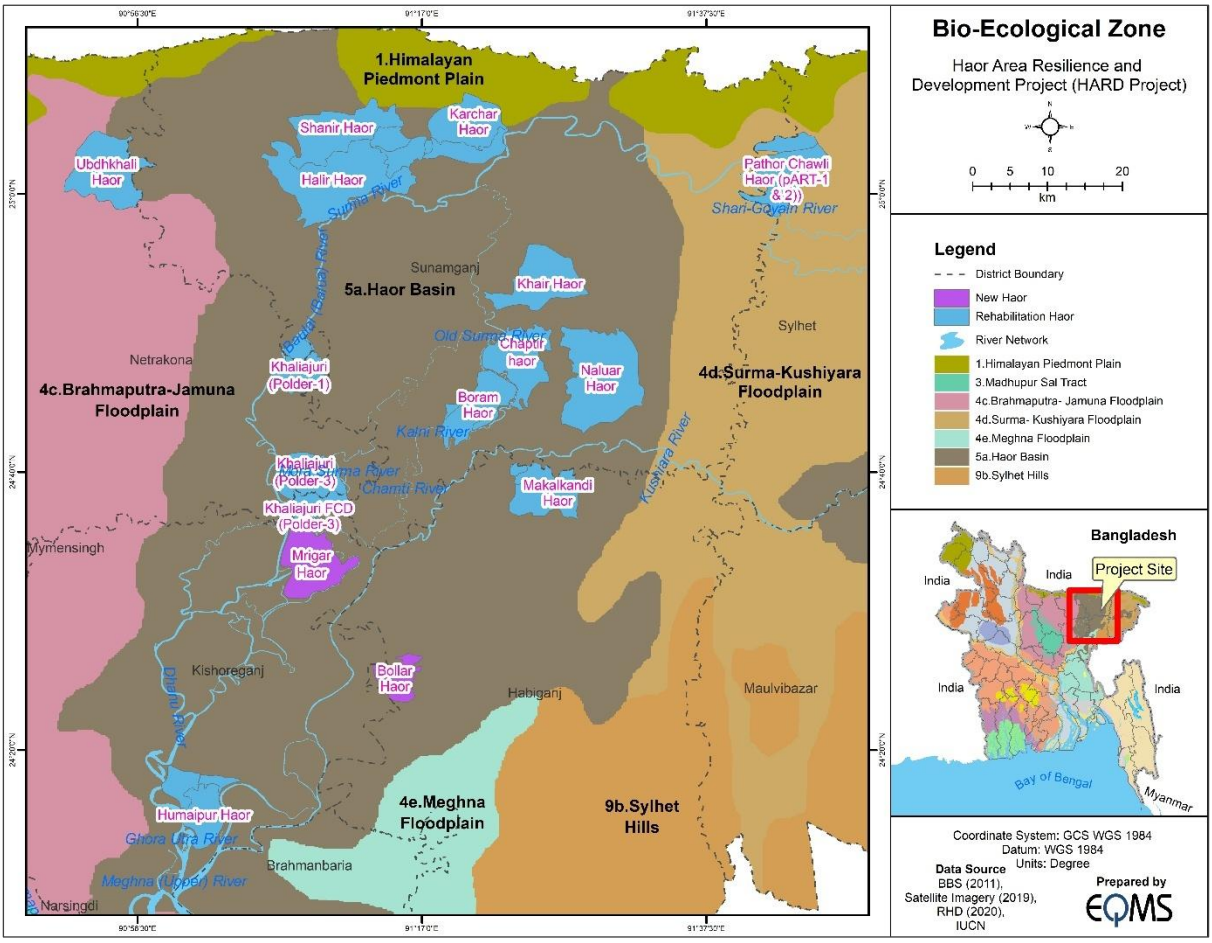
baseline conditions. Field surveys were conducted during the dry season (May 24–June 1, 2025) and the wet season (August 19–30, 2025) at nine major haor sites across the districts of Kishoreganj, Sunamganj, Sylhet, and Moulvibazar. The objective was to identify sensitive ecological receptors and biodiversity resources within the study area in order to assess potential project-related impacts and recommend appropriate mitigation measures.

4.3.1 Bio-ecological Zones of the Study Area

Flora and fauna in a particular bio-geographic region or zone tend to have shared characteristics in terms of broader climatic and geographical feature preferences/requirements. Bio-geographically, Bangladesh is situated in the Oriental Region lying at the transitional point between the Indo-Himalayan and Indo-Chinese sub-region. In the context of physiographic and biological diversity, IUCN has classified Bangladesh into Twenty-Five (25) Bio-Ecological Zones[9].

The study area falls within six bio-ecological zones: 1. Himalayan Piedmont, 4c. Brahmaputra–Jamuna Floodplain, 4d. Surma–Kushiyara Floodplain, 4e. Meghna Floodplain, 5a. Haor Basin, and 9b. Sylhet Hills. The map of bio-ecological zones of the study area is provided in Figure 4-18.

Figure 4-18: Map of the Bio-ecological zone of the study area



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

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

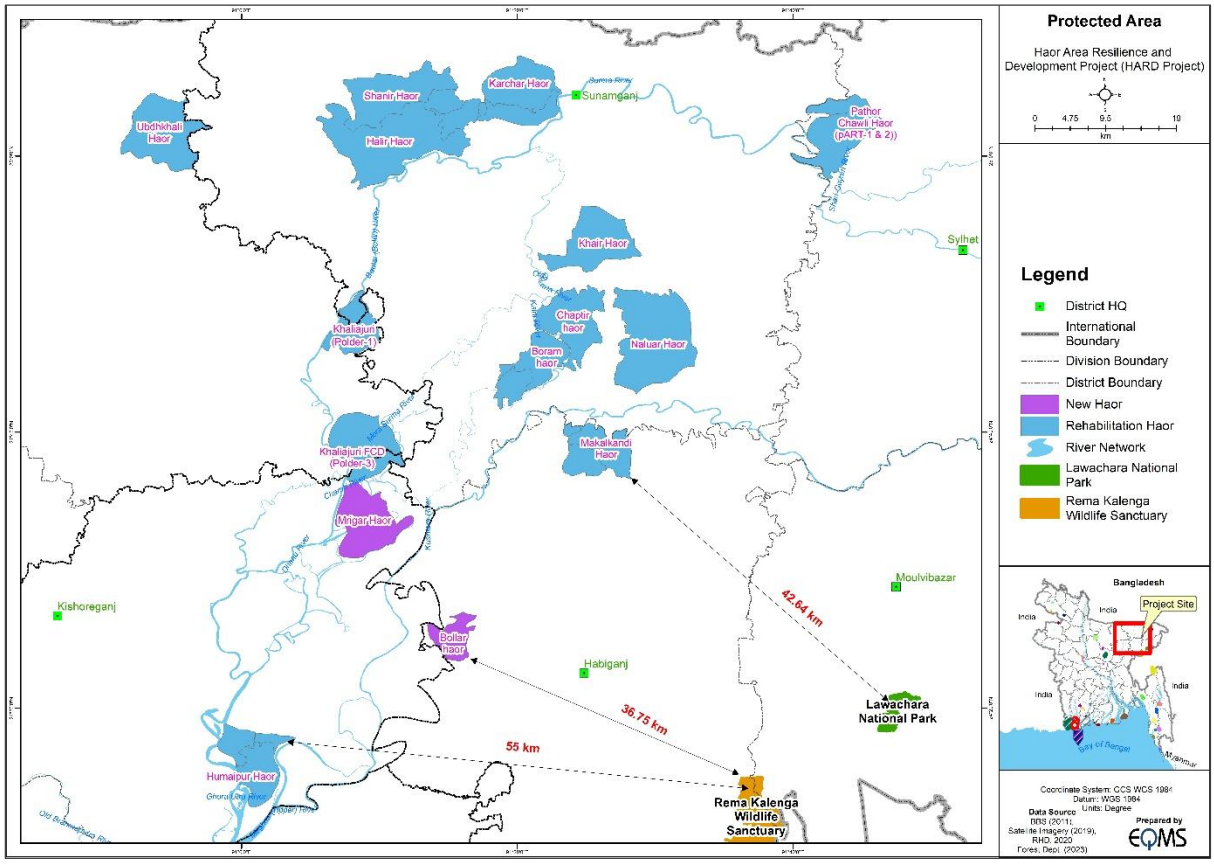
4.3.2 Ecological Sensitive Areas

4.3.2.1 Protected Areas (Pas)

Protected Areas (Pas) or conservation areas are locations that receive protection because of their recognized natural, ecological or cultural values. There are fifty-seven (57) PAs in Bangladesh which are managed by Bangladesh Forest Department.

However, the study area itself does not contain any designated protected areas under Bangladesh regulations. The nearest protected area to the project site is the Rema-Kalenga Wildlife Sanctuary, located approximately 37 km from the nearest Bollar Haor (Figure 4-19).

Figure 4-19: Map of nearest Protected Areas of the Study Area

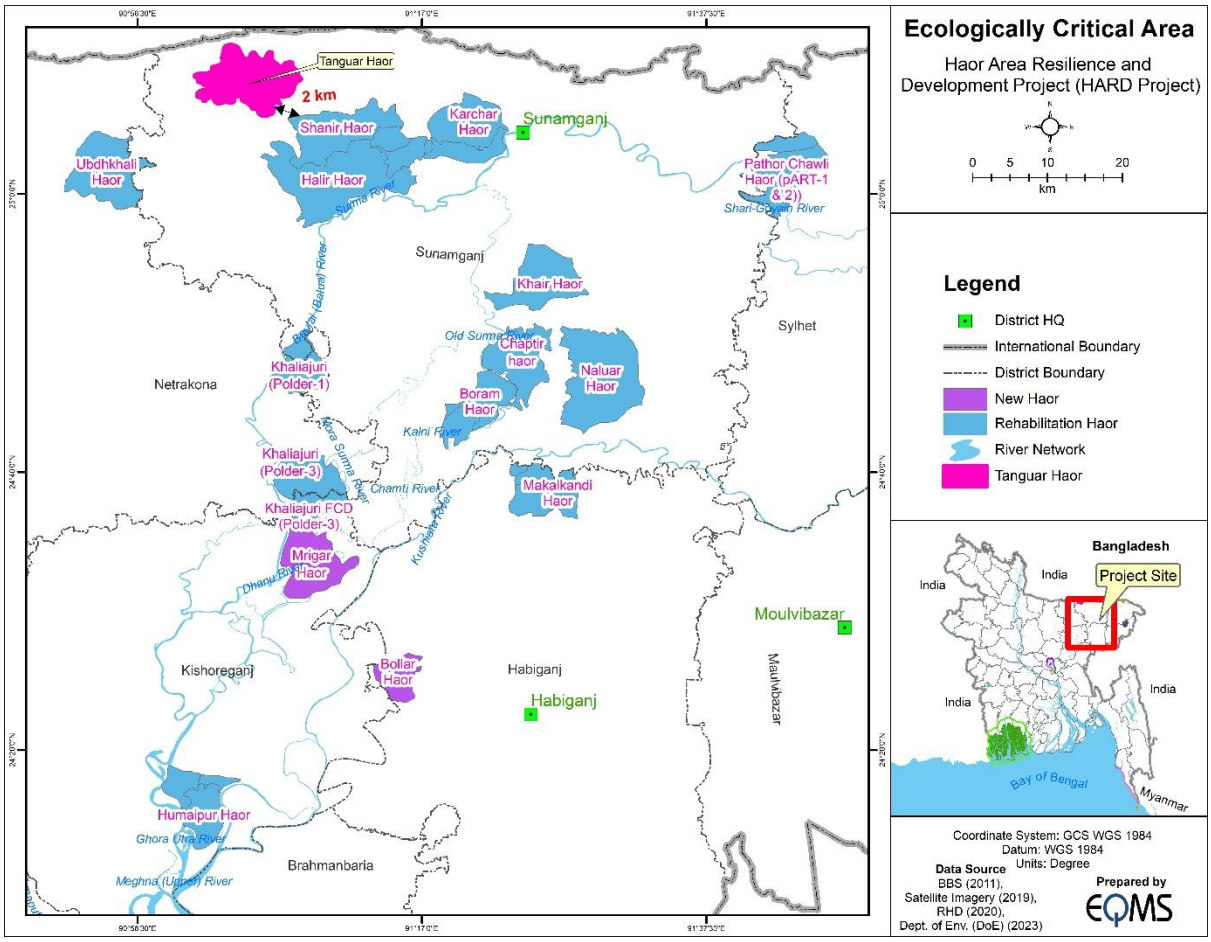


Source: Study Team, September 2025

4.3.2.2 Ecologically Critical Areas (ECAs)

Ministry of Environment, Forest and Climate Change (MoEFCC) has designated thirteen (13) areas as Ecologically Critical Areas (ECAs). However, the study area does not contain any designated ECAs. The nearest ECA to the project site is the Tanguar Haor, located approximately 2 km from the nearest Shanir Haor (Figure 4-20).

Figure 4-20: Location Map of Nearest ECA from Project Study Area

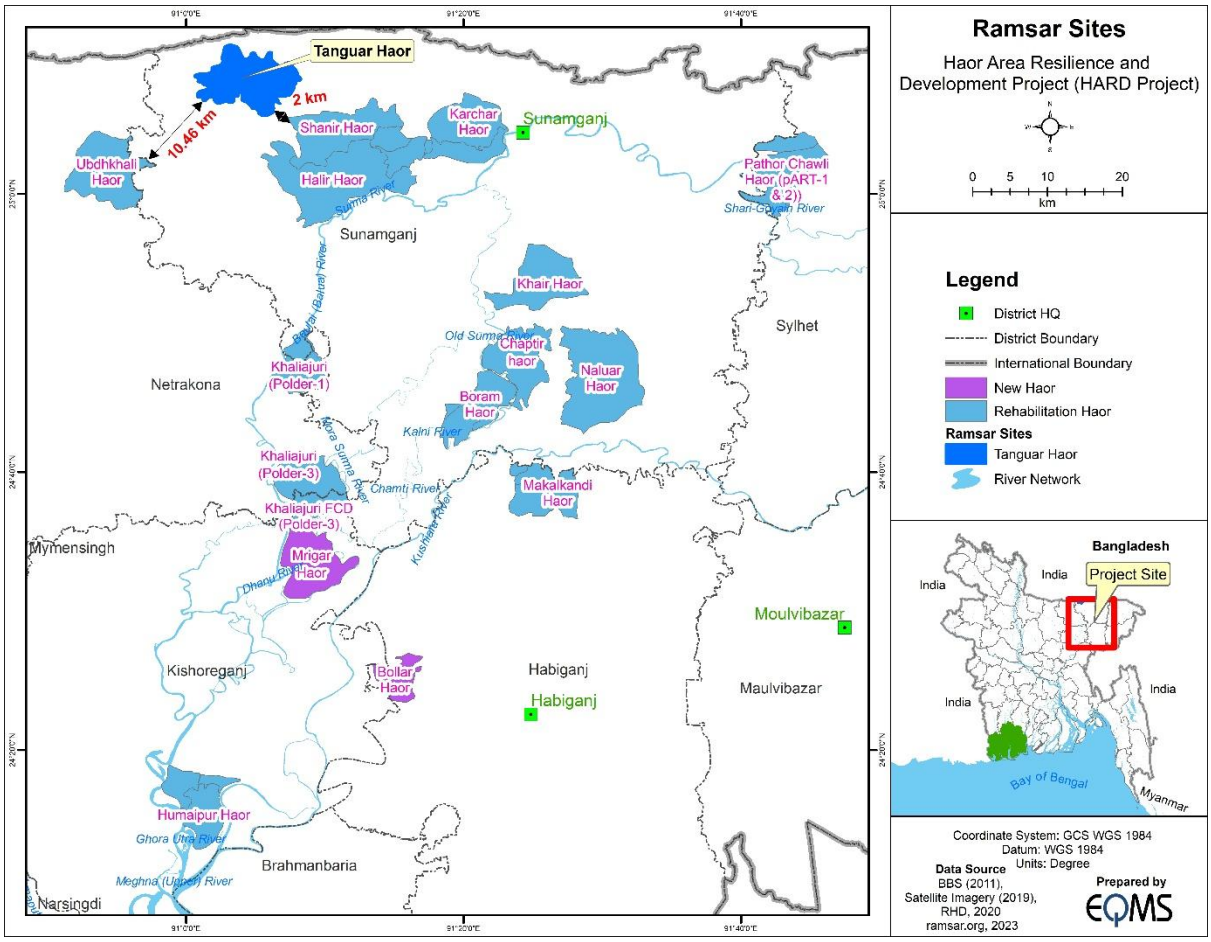


Source: Study Team, September 2025

4.3.2.3 Ramsar Sites

Ramsar site is a wetland site designated to be of international importance under the Ramsar Convention. Bangladesh currently has two (2) sites designated as Wetlands of International Importance (Ramsar Sites) with a combined surface area of 611,200 hectares: the Sundarbans Reserved Forest and Tanguar Haor. The study area of this project does not include any Ramsar site. However, the nearest Ramsar site is Tanguar Haor, located approximately 2 km away from Shanir Haor (Figure 4-21).

Figure 4-21: Location Map of Nearest Ramsar Sites from Project Study Area

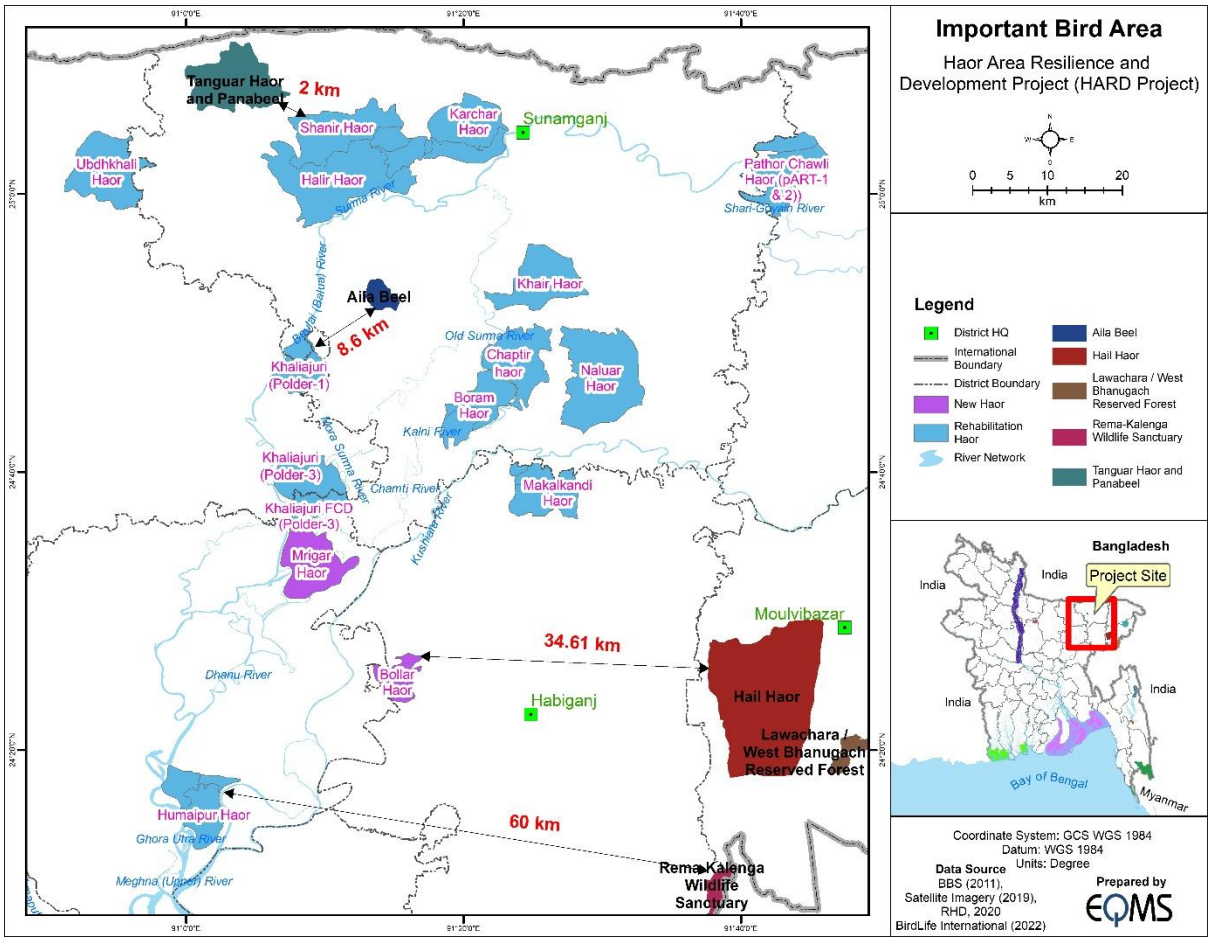


Source: Study Team, September 2025

4.3.2.4 Important Bird and Biodiversity Areas (IBAs)

According to BirdLife International (2025), there are twenty (20) Important Bird and Biodiversity Areas (IBAs) in Bangladesh. The project site does not fall within any IBA. However, the nearest IBA is Tanguar Haor, located approximately 2 km from Shanir Haor (Figure 4-22).

Figure 4-22. Important Bird and Biodiversity Area (IBA) near the Project Site



Source: Study Team, September 2025

4.4 Socio-economic Environment

The present socio-economic conditions of the project area's population will serve as a key reference for evaluating the potential impacts of the proposed interventions. This baseline assessment will allow for a comparison of changes and outcomes resulting from future project activities. The socio-economic baseline scenario outlines the key characteristics of the project area, derived from secondary data, including administrative boundaries, demographic profiles, household size, education levels, housing conditions, employment status, and access to water and sanitation facilities. This analysis provides a foundation for measuring the effects of planned interventions over time.

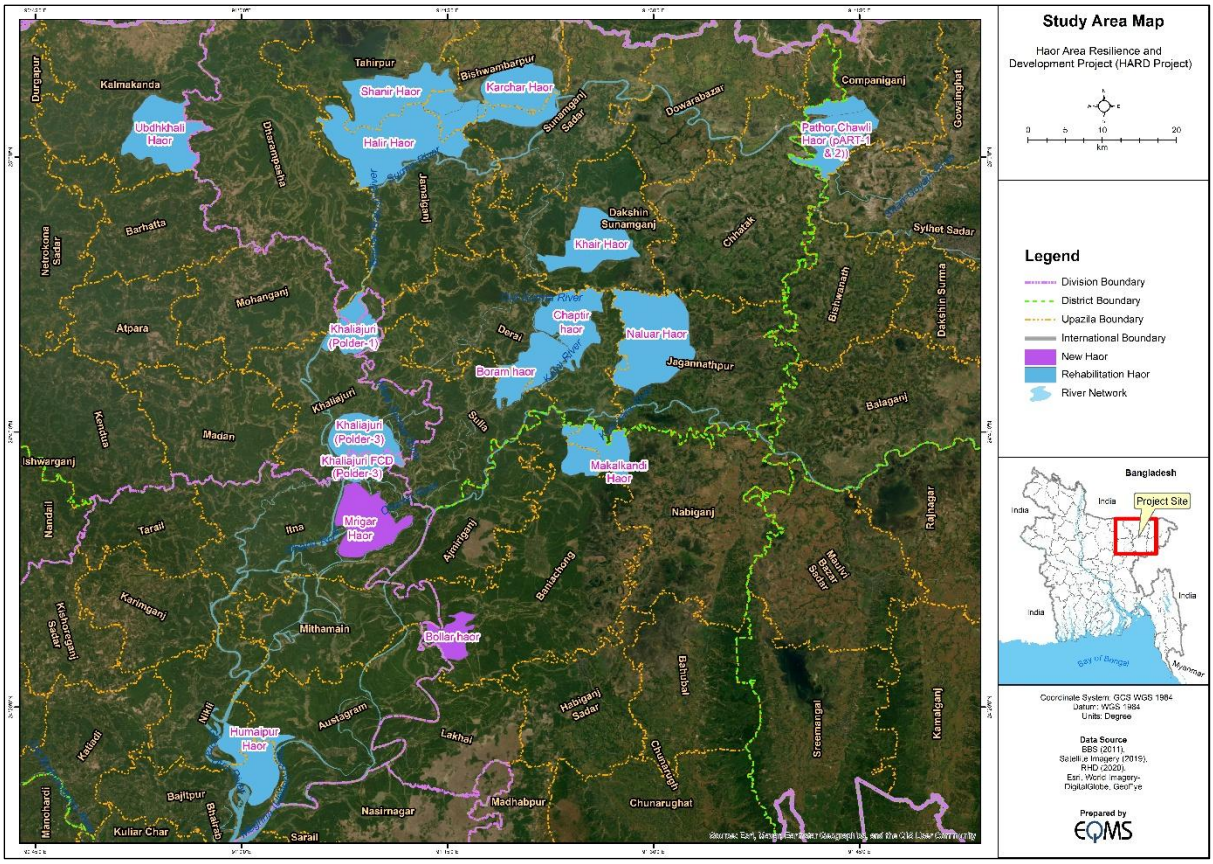
4.4.1 Administrative Area and Location

The proposed study area covers 18 upazilas within 5 districts under 3 divisions (Dhaka, Sylhet and Mymensingh divisions). Based on the assessment of the proposed project, its surroundings, and its environmental and social impacts, the study area for the social assessment encompasses the communities as to be affected by the project. Table 4-3 and Figure 4-23 shows the study area of the project across upazilas, districts and divisions. The socio-economic features of the study area are discussed in following sections.

Table 4-3: Administrative area of the project area

Division	District	Upazila
Sylhet	Sunamganj	Jagannathpur
		Shalla
		Shantiganj
		Sunamganj Sadar
		Derai
		Jamalganj
		Tahirpur
		Bishwambharpur
		Madhyanagar
	Sylhet	Companiganj
	Habiganj	Baniachong
		Nabiganj
Dhaka	Kishoregonj	Itna
		Bajitpur
		Nikli
		Austagram
Mymensingh	Netrokona	Kalmakanda
		Khaliajuri

Figure 4-23: Study area



Source: Study Team, 2025

The project is planned to be implemented across three major divisions of Bangladesh Dhaka,Sylhet, and Mymensingh, covering several districts and upazilas. In Dhaka Division, the study area covers Itna, Bajitpur, Nikli, and Austagram upazila in Kishoregonj District. In Sylhet Division, the study area covers 9 Upazilas of Sunamganj District namely Jagannathpur, Shalla, Shantiganj, Sunamganj Sadar, Derai, Jamalganj, Tahirpur, Bishwambharpur, and Madhyanagar upazilas, along with Companiganj upazila in Sylhet District, and Baniachong and Nabiganj upazila in Habiganj Distric. While in Mymensingh Division, project activities target Kalmakanda and Khaliajuri upazilas of Netrokona District.

4.4.2 Demography

According to BBS 2022[10], in the proposed study area, there are about 3,875,510individuals residing in 798,504 households. The average sex ratio across the project area is 97.00, slightly below the national average of (98.07[11]). While the average household size of 4.86 people exceed the national average (3.98[11]). Demographic analysis reveals considerable regional variations, with household sizes ranging from (4.26%) in Kalmakanda to (5.52%) in Companiganj, and sex ratios showing notable differences from (90.97%) in Austagram to (101.88%) in Tahirpur. The demography of the study area is shown in Table 4-4. The data shows variations in household size and sex ratio across eighteen upazilas, reflecting the diverse demographic characteristics of these regions.

[10] Bangladesh Bureau of Statistics. (2025) Population and Housing Census 2022, Community Report:

[11] Bangladesh Bureau of Statistics. (2024). Population and Housing Census 2022 National Report (Volume 1). Dhaka: BBS.

Table 4-4: Demography of the study area

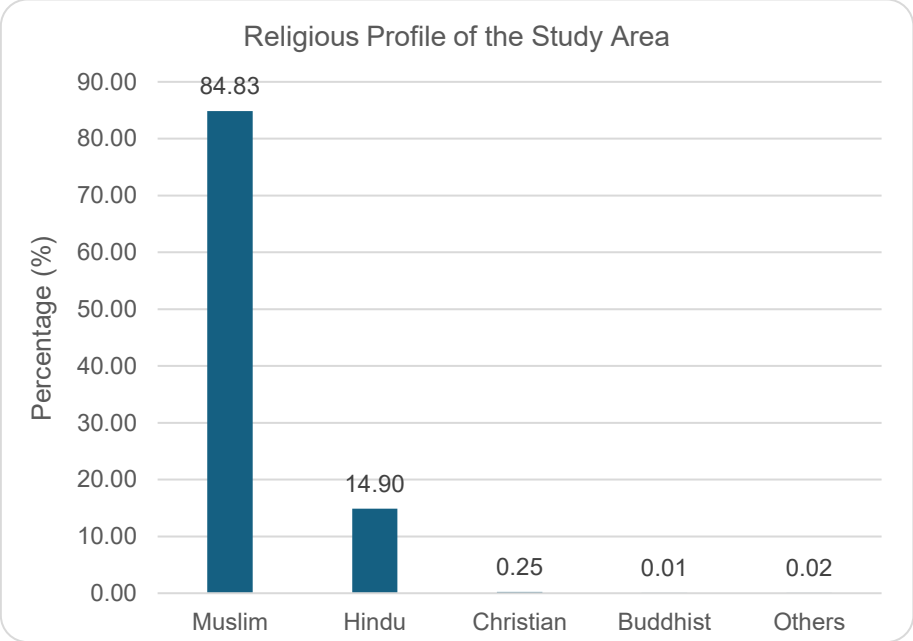
Division	District	Upazila	Total HHs	Total Population	Sex Ratio	Avg. HH size
Sylhet	Sunamganj	Jagannathpur	49192	264198	94.59	5.34
		Salla	23010	117630	101.17	5.12
		Shantiganj	39142	204998	93.15	5.23
		Sunamganj Sadar	63303	318099	97.38	5
		Derai	49740	253705	97.52	5.09
		Jamalganj	36015	185866	98.7	5.17
		Tahirpur	43543	224853	101.88	5.15
		Bishwambharpur	37815	190350	98.93	5.03
		Madhyanagar	21174	96237	100.98	4.53
	Sylhet	Companiganj	34848	192350	98.06	5.52
	Habiganj	Baniachong	70279	356425	93.03	5.06
		Nabiganj	72650	367385	93.22	5.03
Dhaka	Kishoreganj	Itna	37650	168840	101.52	4.48
		Bajitpur	62234	269756	93.4	4.28
		Nikli	33773	145887	96.71	4.29
		Austagram	33898	151238	90.97	4.46
Mymensingh	Netrokona	Kalmakanda	63302	271348	97.31	4.26
		Khaliajuri	21736	96345	99.76	4.43
Total			**793,304**	**3875,510**	**97.13**	**4.86**

Source: Population and Housing Census, 2022

4.4.3 Religion

According to BBS 2022, the religious composition of the study area is predominantly Muslim, with 84.83% of the population adhering to Islam. Hindus form a significant minority at 14.90%, while Christian 0.25% and Buddhists 0.01%. Figure 4-24 indicates the various religious profiles of the project study area.

Figure 4-24: Religious profile of the study area



Source: BBS, 2022

4.4.4 Ethnic Composition

According to BBS 2022, the total ethnic population in the study area is 15141, with 7,516 males and 7,625 females. The distribution of ethnic communities varies widely across districts and upazilas. In Sunamganj District, the Madhyanagar upazila hosts the largest ethnic population of 2,581, primarily comprising Garo (907), Hajong (1,109) and others (565), while Tahirpur Upazila has 629 ethnic individuals, Garo (335), Hajong (250) and others (41). In Sunamganj Sadar has 561 ethnic individuals, mostly Garo (500). Smaller ethnic populations are found in Shalla,Jagannathpur, Derai, Jamalganj and other upazilas, mainly among the Monipur and Hajong communities. In Sylhet District, Companiganj upazila has 1093 ethnic individuals, predominantly Monipur (490), Khasia/Khasi (1) and others (602), while Habiganj District records 458 ethnic individuals across Baniachong and Nabiganj upazilas, including Saontal and Munda communities. Kishoreganj District contains very small ethnic populations in Itna, Bajitpur, Nikli, and Austagram, with a few Chakma members. Netrokona District has the largest concentration of ethnic populations, especially in Kalmakanda (9,374), dominated by Garo (6,802) and Hajong (2,505), whereas Khaliajuri has only 27 ethnic individuals. Overall, the ethnic population in the study area is unequally distributed, with the majority concentrated in Netrokona and Sunamganj districts, reflecting significant social diversity that should be considered in project planning and community engagement. Table 4-5 shows the ethnic composition of the study area.

Table 4-5: Ethnic composition in the study area

District Name	Upazila	Ethnic Population					Ethnic Population in Main Group											
		Total	Male	%	Female	%	Garo	Hajong	Monipur	Hudi	Patro	Khasia/ Khasi	Munda	Saontal	Bhumij	Barma	Chakma	Others
Sunamganj	Jagannathpur	56	28	50.00	28	50.00	0	0	11	0	0	0	0	0	0	0	0	45
Sunamganj	Salla	6	3	50.00	3	50.00	1	0	0	0	0	0	0	0	0	0	0	5
Sunamganj	Shantiganj	40	19	47.50	21	52.50	4	1	12	0	0	0	0	0	0	0	0	23
Sunamganj	Sunamganj Sadar	561	287	51.16	274	48.84	500	1	2	0	0	0	0	0	0	0	0	58
Sunamganj	Derai	27	13	48.15	14	51.85	0	0	6	0	0	0	0	0	0	0	0	21
Sunamganj	Jamalganj	6	2	33.33	4	66.67	3	0	0	0	0	0	0	0	0	0	0	3
Sunamganj	Tahirpur	629	322	51.19	307	48.81	335	250	3	0	0	0	0	0	0	0	0	41
Sunamganj	Bishwambharpur	212	108	50.94	104	49.06	32	145	20	0	0	0	0	0	0	0	0	15
Sunamganj	Madhyanagar	2581	1291	50.02	1290	49.98	907	1109	0	0	0	0	0	0	0	0	0	565
Sylhet	Companiganj	1093	566	51.78	527	48.22	0	0	490	0	0	1	0	0	0	0	0	602
Habiganj	Baniachong	56	41	73.21	15	26.79	0	0	0	0	0	0	3	5	0	0	0	48
Habiganj	Nabiganj	402	210	52.24	192	47.76	0	0	0	0	0	0	139	16	0	0	0	247
Kishoregonj	Itna	8	5	62.50	3	37.50	0	0	0	0	0	0	0	0	0	0	1	7
Kishoregonj	Bajitpur	55	29	52.73	26	47.27	5	0	0	0	0	0	0	0	0	0	1	49
Kishoregonj	Nikli	6	6	100.00	0	0.00	1	0	0	0	0	0	0	0	0	0	1	4
Kishoregonj	Austagram	2	0	0.00	2	100.00	1	0	0	0	0	0	0	0	0	0	0	1
Netrokona	Kalmakanda	9374	4576	48.82	4798	51.18	6802	2505	0	11	0	0	0	0	0	0	0	56
Netrokona	Khaliajuri	27	10	37.04	17	62.96	4	1	0	0	0	0	0	0	0	0	0	22
Total		**15141**	**7516**	**50.59**	**7625**	**49.41**	**8595**	**4012**	**544**	**11**	**0**	**1**	**142**	**21**	**0**	**0**	**3**	**1812**

Source: Population and Housing Census, 2022

4.4.5 Literacy

According to BBS 2022, the average literacy rate in the project area is 62.96%, below the national average of 74.80% (Bangladesh Bureau of Statistics, 2024). In Sunamganj District, rates range from 63.82 % in Shalla Upazila to 68.66% in Jagannathpur Upazila, with Shantiganj Upazila at 65.17%, Sunamganj Sadar Upazila 67.99%, Derai Upazila 67.69%, Jamalganj Upazila 58.56%, Tahirpur Upazila 60.71%, Bishwambharpur Upazila 64.17%, and Madhyanagar Upazila 57.7%. In Sylhet's, Companiganj Upazila, literacy is 61.33%. In Habiganj Upazila, Baniachong records 65.78% and Nabiganj Upazila, 70.55%. Kishoreganj shows 56.45% in Itna Upazila, 68.46% in Bajitpur Upazila, 59.28% in Nikli Upazila, and 60.86% in Austagram Upazila. In Netrokona Districts, Kalmakanda Upazila has 63.8% and Khaliajuri Upazila 52.28%. Overall, the combined average literacy rate for the project area is 62.96 %, with males at 63.94 % and females at 62.00 %. The data indicates that in most unions, female literacy rates are slightly lower than or comparable to male literacy rates, reflecting a relatively balanced gender distribution in educational attainment across the project area..

Communication and the transport system are different in the study areas from other regions of the country, which along with other socioeconomic factors reflected in the rate of literacy. In most of the areas, boats are the main means of transportation during the wet season and during the dry season, the transport is also less accessible due to either poor road conditions or inadequate road access to schools. The literacy rate of the study is shown in Table 4-6.

Table 4-6: Literacy rate of the study area

Districts	Upazila	Literacy (%) Both	Male	Female
Sunamganj	Jagannathpur	68.66	69.99	67.41
	Salla	63.82	65.48	62.15
	Shantiganj	65.17	65.89	64.52
	Sunamganj Sadar	67.99	69.65	66.39
	Derai	67.69	68.93	66.5
	Jamalganj	58.56	59.72	57.43
	Tahirpur	60.71	61.96	59.44
	Bishwambharpur	64.17	64.5	63.84
	Madhyanagar	57.7	59.1	56.3
Sylhet	Companiganj	61.33	62.17	60.52
Habiganj	Baniachong	65.78	65.51	66.02
	Nabiganj	70.55	71.28	69.89
Kishoreganj	Itna	56.45	57.35	55.53
	Bajitpur	68.46	69.13	67.83
	Nikli	59.28	60.19	58.42
	Austagram	60.86	61.71	60.09
Netrokona	Kalmakanda	63.8	64.69	62.94
	Khaliajuri	52.28	53.71	50.85
Total		**62.96**	**63.94**	**62.00**

Source: Population and Housing Census, 2022

4.4.6 Settlement and Housing

According to BBS 2022, the majority of households in the project area live in kancha structures, accounting for 80.76 % of all homes, followed by pucca houses at 6.12 %, semi-pucca at 12.30 %, and jhupri structures at 0.82 %. Housing patterns vary across districts and upazilas. In Sunamganj District, kancha houses subjugate, ranging from 57.78% in Jagannathpur Upazila to 91.4% in Madhyanagar Upazila, while pucca structures range from 1.58% to 21.87%. Sylhet (Companiganj Upazila) shows 64.61% kancha, 12.05% pucca, and 20.56% semi-pucca houses. In Habiganj Upazila, kancha homes construct 63.12 to 80.31%, with Nabiganj Upazila having the highest proportion of semi-pucca houses (25.45%). Kishoreganj upazilas have the highest portion of kancha houses, 90.07 to 94.65%. In Netrokona Upazila, kancha houses constitute 86.89 to 90.26% of all structures. The data highlights that a substantial portion of the population resides in jhupri and kancha housing, reflecting the overall vulnerability and poor housing quality in the project area. The type of structures in the study area is illustrated in Table 4-7.

Table 4-7: Type of structures in the study area

Districts	Upazila	Type of Structure (%)			
		Pucca[12]	Semi-pucca[13]	Kancha[14]	Jhupri[15]
Sunamganj	Jagannathpur	21.87	19.38	57.78	0.97
	Salla	1.91	5.4	92.49	0.21
	Shantiganj	9.27	12.61	76.51	1.61
	Sunamganj Sadar	13.34	22.66	63.4	0.59
	Derai	6.9	10.64	81.83	0.63
	Jamalganj	3.85	12.51	83.08	0.57
	Tahirpur	2.01	8.45	88.94	0.6
	Bishwambharpur	2.2	12.72	84.24	0.84
	Madhyanagar	1.58	6.06	91.4	0.96
Sylhet	Companiganj	12.05	20.56	64.61	2.78
Habiganj	Baniachong	4.62	14.68	80.31	0.39
	Nabiganj	11.05	25.45	63.12	0.38
Kishoreganj	Itna	1.35	3.5	94.65	0.43
	Bajitpur	7.6	18.37	73.59	0.44
	Nikli	3.41	6.06	90.47	0.06

[12] A structure is defined as a **Pucca** if its floor is made of cement/concrete/ brick/terracotta or tiles/mosaic, wall- cement/ concrete/brick/terracotta or ceramic tiles and roof- cement/concrete/tile.

[13] A structure is defined as a **Semi-pucca** if its floor is made of cement/concrete/brick/terracotta or tiles/mosaic, wall- Cement/concrete/brick/terracotta or ceramic tiles and roof- any other material except cement/concrete/tile.

[14] A structure is defined as **Kancha** if its floor is made of soil or wood or any other material except brick/cement/concrete and roof is made of bamboo/golpata/palm leaves/chhan/ straw etc. is defined as Kancha structure. Nevertheless, if the floor is made of cement/concrete/brick/terracotta etc., but the wall and roof are made of any other material except cement/concrete/ brick/terracotta.

[15] A structure is defined as a **Jhupri** if its floor is made of soil or wood/bamboo/trunk etc. and the wall & roof are made of straw/ bamboo/chhan/golpata/palm leaves/polythene etc.

Districts	Upazila	Type of Structure (%)			
		Pucca[12]	Semi-pucca[13]	Kancha[14]	Jhupri[15]
	Austagram	3.37	5.96	90.07	0.6
Netrokona	Kalmakanda	1.97	9.81	86.89	1.34
	Khaliajuri	1.74	6.65	90.26	1.36
Total		**6.12**	**12.30**	**80.76**	**0.82**

Source: Population and Housing Census, 2022

According to BBS 2022, the majority of households in the project area live in their own dwelling units (94.27%), but there are notable variations across districts and upazilas. In Sunamganj Districts, ownership ranges from a relatively lower 86.1% in Jagannathpur Upazila to 97.33% in Bishwambharpur Upazila, with other upazilas such as Shalla Upazila (96.2%), Shantiganj Upazila (96.14%), and Madhyanagar Upazila (97.23%) consistently high ownership. Sylhet's Companiganj reports slightly lower ownership at 90.73%, indicating a moderate level of non-owned households. Habiganj Upazilas vary between 91.01% in Nabiganj Upazila and 95.4% in Baniachong Upazila, showing generally strong ownership over the residential unit. In Kishoreganj Districts, ownership is high, ranging from 93.49% in Bajitpur Upazila to 96.93% in Itna upazila. Netrokona demonstrates consistently high ownership across upazilas, between 96.49% and 96.81%. Jagannathpur (Sunamganj) and Companiganj (Sylhet) have comparatively lower ownership rates than most other upazilas, these areas may have a proportion of rented or rent-free households. Most other upazilas across the project area show strong and secure dwelling ownership, indicating relatively stable housing conditions. The data reflects that while home ownership is predominant across the project area, certain unions, particularly in Companiganj, exhibit housing vulnerability due to lack of permanent tenancy. Table 4-8 presents data on housing tenancy in the study area.

Table 4-8: Housing tenancy in the study area

Districts	Upazila	Housing Tenancy (%)				
		Own Dwelling Unit	Rented but having Own Dwelling Unit Elsewhere	Rented and having No Own Dwelling Unit Elsewhere	Rent free but having Own Dwelling Unit Elsewhere	Rent Free and having No Own Dwelling Unit Elsewhere
Sunamganj	Jagannathpur	86.1	3.87	2.12	3.06	4.85
	Salla	96.2	1.42	0.33	0.46	1.59
	Shantiganj	96.14	0.75	0.28	0.77	2.06
	Sunamganj Sadar	88.16	7.92	2.4	0.44	1.08
	Derai	92.56	2.77	0.94	1.16	2.57
	Jamalganj	95.32	2.37	0.49	0.6	1.22
	Tahirpur	95.92	1.28	0.38	0.75	1.67
	Bishwambharpur	97.33	1.07	0.18	0.38	1.04
	Madhyanagar	97.23	1.14	0.16	0.43	1.04
Sylhet	Companiganj	90.73	3.93	1.48	0.83	3.03
Habiganj	Baniachong	95.4	1.06	0.61	0.68	2.25
	Nabiganj	91.01	3.47	0.95	1.09	3.48
Kishoreganj	Itna	96.93	0.47	0.28	0.59	1.72
	Bajitpur	93.49	3.85	0.92	0.57	1.17
	Nikli	95.79	1.02	1.23	0.46	1.51
	Austagram	95.27	1.27	1.43	0.6	1.43
Netrokona	Kalmakanda	96.81	1.59	0.37	0.35	0.88
	Khaliajuri	96.49	1.15	0.4	0.65	1.31
Total		**94.27**	**2.24**	**0.83**	**0.77**	**1.88**

Source: Population and Housing Census, 2022

4.4.7 Public Utilities

4.4.7.1 Source of Drinking Water

According to BBS 2022, the primary source of drinking water in the project area is tube-wells (98.06 %), showing strong dependence on groundwater. Other sources tap/pipe supply (0.32%), wells (0.30%), ponds/rivers/canals/lakes (1.15%), bottled/jar water (0.12%), and springs (0.01%) serve only small proportions of households. In the majority of Sunamganj upazilas, tube-wells are the primary source of water supply, with Derai Upazila (99.09%), Shalla Upazila (99.73%), Shantiganj Upazila (99.41%), and Jamalganj Upazila (99.78%) showing the highest coverage. Sunamganj Sadar Upazila records some tap supply (3.7%). In Sylhet's Companiganj Upazila, tube-well use is lower (90.75%) and 7.88% of households depend on surface water, raising water safety concerns.In Habiganj and Kishoreganj Districts, tube-well use exceeds 98% across all upazilas, with Bajitpur Upazila showing limited tap water use (1.6%). Nikli Upazila (99.98%), Itna Upazila (99.79%), and Austagram Upazila (99.8%) represent the highest coverage. In Netrokona Districts, tube-well use remains very high (97.71% to 98,77%), though 1 to 1.15% of households still rely on surface water. Study areas, tube-wells dominate drinking water supply, but localized exceptions such as surface water use in Companiganj indicate potential vulnerabilities. Table 4-9 shows the sources of drinking water in the study area.

Table 4-9: Source of drinking water (%)

Districts	Upazila	Tap/pipe (Supply)	Tube-well (Deep/ Shallow)	Bottled/Jar Water	Well	Pond/River/ Canal/ Lake	Spring	Rainwater	Other
Sunamganj	Jagannathpur	0.13	97.13	0.35	0.01	2.34	0	0	0.03
	Salla	0	99.73	0.06	0	0.21	0	0	0
	Shantiganj	0	99.41	0.01	0.04	0.47	0	0	0.07
	Sunamganj Sadar	3.7	93.38	0.48	1.4	1.03	0	0	0.01
	Derai	0.06	99.09	0.01	0.01	0.82	0	0	0
	Jamalganj	0	99.78	0.03	0	0.19	0	0	0
	Tahirpur	0	99.08	0.03	0.41	0.46	0	0	0.03
	Bishwambharpur	0	97.06	0.3	1.42	1.14	0	0	0.08
	Madhyanagar	0	98.16	0.01	0.75	1.04	0	0	0.03
Sylhet	Companiganj	0.09	90.75	0.53	0.42	7.88	0.16	0	0.17
Habiganj	Baniachong	0	98.02	0.01	0	1.9	0	0	0.06
	Nabiganj	0	99.1	0.05	0.02	0.83	0	0	0
Kishoreganj	Itna	0	99.79	0.05	0	0.09	0	0	0.07
	Bajitpur	1.6	98.34	0.03	0	0.01	0	0	0.03
	Nikli	0	99.98	0	0	0.01	0	0	0.01
	Austagram	0	99.8	0.09	0	0.04	0	0	0.06
Netrokona	Kalmakanda	0.12	97.71	0.11	1	1.06	0	0	0
	Khaliajuri	0	98.77	0.02	0	1.15	0	0	0.05
Total		**0.32**	**98.06**	**0.12**	**0.30**	**1.15**	**0.01**	**0.00**	**0.04**

Source: Population and Housing Census, 2022

4.4.7.2 Electricity

Electricity access in the project area is overwhelmingly dependent on the national grid, with 97.42 % of households connected, while only 0.96% use solar power, 0.46% rely on other sources, and 1.17% remain without electricity. Coverage is consistently high across districts, with Sunamganj, Habiganj, Kishoreganj, and Netrokona Upazilas all reporting more than 96% grid connectivity in their upazilas. In Sylhet's Companiganj Upazila, 96.59% of households are grid-connected with minimal reliance on solar power. Overall, the data indicates near-universal electricity access, with only small pockets of households depending on alternative sources or lacking electricity. Table 4-10 shows the electricity connection (%) of the study area.

Table 4-10: Electricity connection of the study area

Districts	Upazila	Main Sources of Electricity			No Electricity
		National Grid	Solar Power	Other Sources	
Sunamganj	Jagannathpur	96.54	0.83	1.01	1.62
	Salla	95.53	3.24	0.18	1.05
	Shantiganj	97.95	0.6	0.17	1.28
	Sunamganj Sadar	98.4	0.43	0.37	0.79
	Derai	96.32	1.57	0.4	1.72
	Jamalganj	98.04	0.66	0.32	0.98
	Tahirpur	96.23	1.37	1.57	0.82
	Bishwambharpur	97.79	0.89	0.24	1.08
	Madhyanagar	95.99	2.35	0.8	0.85
Sylhet	Companiganj	96.59	0.44	0.92	2.05
Habiganj	Baniachong	98.37	0.67	0.13	0.83
	Nabiganj	98.06	0.57	0.24	1.13
Kishoreganj	Itna	97.51	1.04	0.34	1.1
	Bajitpur	99.05	0.06	0.17	0.71
	Nikli	98.74	0.23	0.09	0.94
	Austagram	97.91	0.82	0.19	1.08
Netrokona	Kalmakanda	97.84	0.82	0.57	0.77
	Khaliajuri	96.67	0.62	0.51	2.2
Total		**97.42**	**0.96**	**0.46**	**1.17**

Source: Population and Housing Census, 2022

4.4.7.3 Toilet Facilities

According to BBS 2022, Sanitation practices in the project area show wide variation, with 27.0% of households using safe disposal with flushing or pouring water, 22.7% relying on unsafe disposal methods, and 20.4% using pit latrines with slabs, ventilated improved latrines, or composting latrines. Less improved practices remain common, with 12.5% using pit latrines without slabs or open pits, 14.3% using raw, open, or hanging latrines, and a notable proportion still practicing open defecation.

(Bangladesh Bureau of Statistics, 2025). Overall, the data highlights significant gaps in safe sanitation, particularly in upazilas such as Shalla, Madhyanagar, and Itna, where unsafe and unimproved practices are prevalent, underscoring the need for improving hygiene and access to safe latrines. Table 4-11 presents data on sanitation practices in the study area.

Table 4-11: Toilet facility in the study area

Districts	Upazila	Safe Disposal with Flushing/ Pouring Water	Unsafe Disposal with Flushing/ Pouring Water	Pit Latrine with Slab/ Ventilated Improved Latrine/ Composting Latrine	Pit Latrine without Slab/ Open Pit	Raw/Open/ Hanging Latrine (Permanent/ Temporary)	Open Defecation/ No Latrine Available
Sunamganj	Jagannathpur	45.43	20.44	17.54	7.32	6.61	2.66
	Salla	5.96	15.88	40.7	15.17	17.94	4.34
	Shantiganj	28.15	20.39	14.36	13.06	17.58	6.45
	Sunamganj Sadar	42.6	17.49	13.04	10.22	14.3	2.35
	Derai	24.52	15.61	31.54	14.92	11.18	2.23
	Jamalganj	14.29	12.76	32.63	12.04	22.67	5.61
	Tahirpur	26.3	17.7	17.23	13.39	22.1	3.28
	Bishwambharpur	27.29	19.57	18.72	14.63	15.67	4.11
	Madhyanagar	10.7	29.52	9.43	15.38	31.83	3.13
Sylhet	Companiganj	26.53	23.14	13.23	13.55	17.51	6.05
Habiganj	Baniachong	31.4	24.89	18.86	15.05	8.52	1.28
	Nabiganj	38.92	17.72	22.08	12.69	6.87	1.73
Kishoreganj	Itna	19.51	32.14	11.91	16.53	17.83	2.08
	Bajitpur	51.52	21.41	17.02	5.62	3.72	0.71
	Nikli	40.76	37.06	8.46	4.84	6.96	1.91
	Austagram	20.04	31.53	24.26	12.38	10.58	1.22
Netrokona	Kalmakanda	13.94	20.22	27.61	17.27	16.24	4.71
	Khaliajuri	17.27	31.72	28.05	10.62	10.07	2.27
Total		**27.0**	**22.7**	**20.4**	**12.5**	**14.3**	**3.12**

Source: Population and Housing Census, 2022

4.4.7.4 Health Care Facilities

According to BBS 2011[16], across the project area, healthcare infrastructure is limited, with only 12 private hospitals, 22 diagnostic centers, and 110 registered MBBS/FCPS doctors. Sunamganj Sadar stands out with the highest concentration (7 hospitals and 25 doctors), indicating it serves as the primary healthcare hub. Other upazilas, such as Derai, Tahirpur, Baniachong, Nabiganj, Bajitpur, and Austagram, have at least one hospital, while many upazilas including Jagannathpur, Shalla, Shantiganj, Jamalganj, Companiganj, and Bishwambharpur lack hospitals but depend on small diagnostic facilities and a few doctors. Several upazilas (Madhyanagar, Itna, Nikli, Kalmakanda, and Khaliajuri) have extremely limited or no private healthcare facilities, reflecting disparities in access. Study areas, the data highlights a strong centralization of healthcare services in urban upazilas and significant gaps in remote haor and rural areas. Table 4-12 provides information on healthcare facilities in the study area.

Table 4-12: Healthcare facilities

District	Upazila	Private Hospital	Diagnostic	MBBS/FCPS
Sunamganj	Jagannathpur	0	3	12
	Salla	0	0	3
	Shantiganj	0	0	5
	Sunamganj Sadar	7	2	25
	Derai	1	0	4
	Jamalganj	0	2	4
	Tahirpur	1	2	2
	Bishwambharpur	0	1	3
	Madhyanagar	0	0	0
Sylhet	Companiganj	0	2	4
Habiganj	Baniachong	1	1	13
	Nabiganj	0	3	13
Kishoreganj	Itna	0	0	0
	Bajitpur	1	5	10
	Nikli	0	0	4
	Austagram	1	1	5
Netrokona	Kalmakanda	0	0	2
	Khaliajuri	0	0	1
Total		**12**	**22**	**110**

Source: Population and Housing Census, 2011

4.4.8 Economy and Employment

According to BBS 2022, among the population not attending school but employed, agriculture is the dominant sector, engaging 63.92% of men and 77.91% of women, underscoring a heavy reliance on subsistence and small-scale farming. Industry employs a smaller share, with 8.16 % of men and 3.73

[16] Bangladesh Bureau of Statistics. (2013) District Statistics 2011

% of women, while the service sector provides livelihoods for 27.92 % of men and 18.36 % of women. Upazilas such as Derai, Itna, and Khaliajuri show particularly high agricultural dependence, whereas Bajitpur and Companiganj demonstrate relatively stronger service sector participation. Study areas, the data reflects limited economic diversification, with women concentrated heavily in agriculture and men more represented in services, pointing to both structural dependency and gendered labor patterns in the region. Table 4-13 shows the employment status of the study area.

Table 4-13: Employment status in the project area

Districts	Upazila	Agriculture		Industry		Service	
		Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
Sunamganj	Jagannathpur	27769	50.91	7560	77.17	4433	8.13
	Salla	87.36	83.38	4.63	3.48	8.01	13.14
	Shantiganj	26694	62.83	6765	84.20	3657	8.61
	Sunamganj Sadar	33427	46.36	7314	62.00	6849	9.50
	Derai	41236	73.52	7431	80.19	3808	6.79
	Jamalganj	29650	68.30	5411	82.05	1828	4.21
	Tahirpur	32539	63.26	6819	80.22	4030	7.83
	Bishwambharpur	27770	63.63	4847	77.51	3041	6.97
	Madhyanagar	18650	80.19	2904	80.60	1388	5.97
Sylhet	Companiganj	16549	44.11	5505	80.73	5052	13.46
Habiganj	Baniachong	43836	58.07	10349	78.48	8393	11.12
	Nabiganj	43120	53.41	11182	77.33	7714	9.55
Kishoreganj	Itna	31228	77.57	5295	85.61	2507	6.23
	Bajitpur	29587	45.04	7512	67.46	10922	16.63
	Nikli	23078	66.04	3970	76.67	3415	9.77
	Austagram	22372	67.53	4993	79.56	1949	5.88
Netrokona	Kalmakanda	41467	65.25	7358	76.92	4200	6.61
	Khaliajuri	18016	77.28	2545	72.30	1148	4.92
Total		**63.92**	**77.91**	**8.16**	**3.73**	**27.92**	**18.36**

Source: Population and Housing Census, 2022

4.4.9 Traffic and Transport

According to the BBS 2011, the project area has a total road network of 5,788.81 km, of which unmetalled kutcha roads dominate (4,314.41 km, 75.3%), followed by metalled roads (1,099.88 km, 18.6%) and semi-metalled roads (466.52 km, 7.9%). Nabiganj (723 km), Kalmakanda (672.13 km), and Baniachong (532 km) have the largest networks, while Itna (72 km) and Nikli (216 km) have the smallest. Sunamganj Sadar, Derai, and Bajitpur have a relatively balanced share of metalled roads, whereas areas such as Derai,Baniachong,Nabiganj and Kalmakanda remain heavily dependent on kutcha roads, reflecting poor rural connectivity. Madhyanagar records no formal road infrastructure. Overall, the data highlights significant reliance on kutcha roads across the study areas, underscoring the need for investment in durable metalled road expansion to improve accessibility, particularly in remote and haor-prone upazilas. Table 4-14 shows the road connectivity status of the study area.

Table 4-14: Length of metaled, semi metaled and unmetalled roads in the study area

District	Upazila	Metaled road (km)	Semi-metaled (km)	Unmetalled Kutcha Road (km)	Total (km)
Sunamganj	Jagannathpur	121	87	218	426
	Salla	25	10	200	227
	Shantiganj	56	20	205	260
	Sunamganj Sadar	85	15	80	180
	Derai	106	20	322	430
	Jamalganj	65	30	150	216
	Tahirpur	39	20	200	240
	Bishwambharpur	49	48	170	267
	Madhyanagar	0	0	0	0
Sylhet	Companiganj	82	5	238	325
Habiganj	Baniachong	72	11	449	532
	Nabiganj	156	46	521	723
Kishoreganj	Itna	15	7	50	72
	Bajitpur	97	7	260	364
	Nikli	29	1	186	216
	Austagram	25	15	268	308
Netrokona	Kalmakanda	53.29	5.5	610.34	672.13
	Khaliajuri	24.59	119.02	187.07	330.68
Total		**1099.88**	**466.52**	**4314.41**	**5788.81**

Source: Population and Housing Census, 2011

According to the BBS 2011, the transport infrastructure in the study area is dominated by road and water-based facilities, while railway access is very limited. Out of all upazilas, only Bajitpur has railway stations (3 in total). Steamer/launch stations are relatively common, with 41 recorded across the area, the highest concentration found in Austagram (12), Itna (6), and Baniachong (6). Bus stands are also widespread, with 24 in total, most notably in Nabiganj (5) and Bajitpur (4). This indicates that road and

waterways remain the primary modes of connectivity, whereas railway facilities play only a minimal role in study area transportation. Table 4-15 represents the number of stations found in the study area.

Table 4-15: Number of railway stations, steamer/launch station and bus stand in the study area

District	Upazila	Railway Station	Steamer/launch station	Bus Stand
Sunamganj	Jagannathpur	0	3	1
	Salla	0	3	1
	Shantiganj	0	0	1
	Sunamganj Sadar	0	1	1
	Derai	0	0	1
	Jamalganj	0	4	1
	Tahirpur	0	0	1
	Bishwambharpur	0	0	1
	Madhyanagar	0	0	0
Sylhet	Companiganj	0	0	2
Habiganj	Baniachong	0	6	2
	Nabiganj	0	1	5
Kishoreganj	Itna	0	6	0
	Bajitpur	3	2	4
	Nikli	0	0	1
	Austagram	0	12	0
Netrokona	Kalmakanda	0	0	2
	Khaliajuri	0	3	0
Total		**3**	**41**	**24**

Source: Population and Housing Census, 2011

CHAPTER 5

Analysis of Alternatives

5 ANALYSIS OF ALTERNATIVES

The project aims to enhance rural connectivity and promote sustainable fisheries management in the Haor region of north-eastern Bangladesh, an ecologically sensitive wetland area characterized by seasonal flooding and limited infrastructure. The HARD Project seeks to scale up interventions initiated during HFMLIP by improving rural roads, rehabilitating existing infrastructure, strengthening community-based fisheries resource management, and supporting alternative livelihoods. The core objectives are to:

- Improve access to education, healthcare, and markets through upgraded transport networks.
- Increase fisheries productivity and biodiversity through beel and khal restoration and sustainable aquaculture.
- Reduce poverty and climate vulnerability in Haor communities by creating resilient infrastructure and promoting livelihood diversification.

5.1 Alternatives Considered

The following alternatives were examined during the pre-feasibility stage to identify the most effective and sustainable approach.

5.1.1 Alternative 1: No-Project Scenario

This scenario assumes that no additional interventions are undertaken beyond existing infrastructure and natural resource management practices.

Pros: Avoids new construction-related environmental impacts.

Cons: Maintains current isolation of Haor villages, restricts economic growth, exacerbates climate vulnerability, and fails to address declining fisheries productivity.

Environmental Implications: Continued siltation of beels and khals, biodiversity loss, and soil erosion due to lack of protective measures.

Conclusion: Not feasible, as it contradicts national development priorities and Sustainable Development Goals (SDGs).

5.1.2 Alternative 2: Limited Infrastructure Development Only

This option focuses solely on improving submergible and non-submergible roads without fisheries or livelihood components.

Pros: Improves seasonal connectivity; requires relatively lower investment compared to full-scale intervention.

Cons: Fails to address declining fish production and socio-economic vulnerability; benefits remain seasonal and localized.

Environmental Implications: Road construction without integrated water management may exacerbate erosion and disrupt fish migration patterns.

Conclusion: Not recommended, as it offers limited socio-economic and environmental benefits compared to an integrated approach.

5.1.3 Alternative 3: All Weather Road

Description: Construction of high-elevation, all-weather roads across haor areas to ensure year-round connectivity.

Pros: Provides uninterrupted transport access and reduces seasonal isolation.

Cons: Elevated road embankments obstruct natural flood flow, change hydrology, and fragment aquatic habitats. They also restrict fisheries migration and increase localized flood risk.

Environmental Implications: It will disrupt water flow, alter wetland ecosystems, and contribute to the loss of biodiversity.

Conclusion: Dropped, as all-weather roads are unsuitable for the haor ecosystem and conflict with natural floodplain dynamics.

5.1.4 Alternative 4: Integrated Approach (Rural Infrastructure + Fisheries Promotion + Livelihood Support)

This option combines rural infrastructure development, fisheries management, and alternative income generation to maximize benefits.

Components:

- Improvement of 900+ km of Upazila, Union, and Village roads with appropriate drainage and protective works.
- Rehabilitation of 235 km of damaged roads.
- Development of 300 beels under Community-Based Fisheries Resource Management (CbFRM).
- Re-excavation of 450 km of connecting khals for fish migration.
- Aquaculture initiatives such as backyard pond culture and climate-resilient models.
- Construction of markets, ghats, and village protection walls.

Pros: Enhances connectivity, strengthens climate resilience, increases fish production, improves household income, and promotes gender inclusion.

Cons: Higher initial investment and more complex implementation structure.

Environmental Implications: Positive net impact if mitigation measures are adopted; includes biodiversity restoration, improved water flow, and soil protection through swamp tree plantation.

Conclusion: Preferred option due to its holistic and sustainable impact.

5.2 Justification for Selected Option

The integrated approach (**Alternative 4**) has been selected because it delivers the most significant socio-economic and environmental benefits while aligning with national strategies, including the Haor Master Plan (2012) and Bangladesh Delta Plan 2100. The rationale includes:

- **Economic Feasibility:** Cost-benefit analysis shows an estimated IRR of 18%, exceeding the economic viability threshold for infrastructure projects.
- **Environmental Benefits:** Promotes biodiversity conservation, mitigates erosion, and improves water quality through swamp forest restoration and regulated fishing practices.
- **Climate Resilience:** Incorporates green belts, elevated roads, and improved water connectivity to withstand extreme weather events and flash floods.
- **Social Impact:** Expected to benefit approximately 4.1 million people directly and indirectly by improving market access, reducing isolation, and creating new livelihood opportunities.
- **Regulatory Compliance:** Meets Environmental Conservation Rules (2023), ECA (1995), and JICA environmental guidelines for donor-funded projects.

CHAPTER 6

Screening and Scoping

6 SCREENING AND SCOPING

6.1 Screening

Screening is the step to categorize projects/activities based on the degree of environmental impacts caused by the project.

6.1.1 Categorization of the Project

6.1.1.1 Categorization of Project as per DOE, Bangladesh

Depending upon location, size and severity of pollution loads, projects/activities have been classified in the Environment Conservation Rules, 2023 into four categories: Green, Yellow, Orange, and Red, respectively, to nil, minor, medium, and severe impacts on important environmental components (IECs).

According to the Environment Conservation Rules, 2023, the proposed project refers to the Red Category list of the Department of Environment (DOE).

Component	Category	Reference	Requirement
Road construction/expansion (more than 10 km)	Red	Schedule 1: Serial Number 38 of Red Category List	Environmental Impact Assessment (EIA)

6.1.1.2 Categorization of Project as per JICA Guidelines

JICA classifies projects into four categories based on the extent of environmental and social impacts, taking into account the project's characteristics, scale, site condition, etc.

- **Category A:** Projects are classified as Category A if these are likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as Category A. These impacts may affect areas broader than the sites or facilities subject to physical construction. Category A, in principle, includes projects in sensitive sectors, projects with characteristics that are likely to cause adverse impacts, and projects located in or near sensitive areas.
- **Category B:** Projects are classified as Category B if the potential adverse impacts on the environment and society are less than those of Category A projects. Generally, these are site-specific, with few irreversible impacts, and can be addressed by general mitigation measures in most cases.
- **Category C:** Proposed projects are classified as Category C if these are likely to have minimal or little adverse impacts on the environment and society.
- **Category FI:** Proposed projects are classified as Category FI if these satisfy all of the following conditions: JICA's funding of projects is provided to a financial intermediary or executing agency; the financial intermediary or executing agency substantially undertakes the selection and appraisal of sub-projects under the projects, only after JICA's approval of the funding, so that the sub-projects cannot be specified prior to JICA's approval for the funding (or prior to JICA's appraisal of the project), and those sub-projects are expected to have potential impacts on the environment and society.

Based on the above guidelines, the Project is classified as Category B by JICA. The project does not involve large-scale road construction, is not located in a sensitive area, and has none of the sensitive characteristics under the JICA Guidelines, it is not likely to have significant adverse impact on the environment.

6.2 Scoping

In order to assess the likely significant environmental and social impacts, potential environmental and social impacts of the project were preliminarily identified based on the project description and overall environmental and social conditions in and around the project.

Scoping results for the entire project activities are shown in Table 6-1. A "✓" mark indicates that the Project is expected to have an important, or that it cannot be determined whether and impact will occur. The evaluation is made for the before construction, during construction and operation stages. The evaluation is based on the assumption that no advanced or mitigation measures are taken.

Table 6-1: Scoping matrix for the proposed project

S/N	Items of Impact	Forecasted Impact		Reason of Assessment
		Before/During Construction Stage	Operation and Maintenance Stage	
Pollution Measures				
1	Air pollution 【Common to all haors】	✓	✓	**During Construction:** Impacts on air quality are expected due to the operation of construction machinery and the movement of vehicles. Increased dust and particulate matter may be generated from aggregate production, transportation routes, and construction sites where diesel-powered equipment is used for earthmoving and excavation. **Operation and Maintenance:** Improved connectivity may increase traffic volumes, leading to more emissions. Paved roads reduce resuspension of dust compared to existing earthen roads.
2	Water quality 【Common to all haors】	✓	-	**During Construction:** Impact on water quality from accidental spillage of construction materials and toxic chemicals such as fuel, lubricants, and solvents is expected. Runoff from construction camps (domestic sewage, kitchen waste) may pollute surface water. **Operation and Maintenance:** No impact is expected.
3	Soil contamination 【Common to all haors】	✓	-	**During Construction:** Accidental spillage of fuel, chemicals, liquid waste, disposal of dredged spoils etc. may pollute soil quality.

S/N	Items of Impact	Forecasted Impact		Reason of Assessment
		Before/During Construction Stage	Operation and Maintenance Stage	
				Operation and Maintenance: No impact is expected.
4	Wastes 【Common to all haors】	✓	-	**During Construction:** Construction waste and garbage from labor camp are expected. **Operation and Maintenance:** No impact is expected.
5	Noise/vibration 【Common to all haors】	✓	✓	**During Construction:** Noise and vibration levels are expected to increase temporarily due to the operation of machinery, particularly stone crushing units, generators, and the movement of construction vehicles. **Operation and Maintenance:** Increased traffic on the completed road may lead to persistent noise and low-level vibrations, potentially affecting nearby settlements and sensitive habitats.
6	Ground subsidence 【Common to all haors】	-	-	**During Construction:** During construction, ground water usage may be very limited so there will be very minimum impact. **Operation and Maintenance:** No impact is expected.
7	Offensive odor 【Common to all haors】	✓	-	**During Construction:** Temporary odors may arise from fuel, oil leaks, and construction workers' sanitation facilities, causing local discomfort. **Operation and Maintenance:** No impact is expected.
8	Bottom sediment 【Common to all haors】	✓	-	**During Construction:** Development of the structures and construction of roads may disturb the bottom sediment profile of the water bodies. **Operation and Maintenance:** No impact is expected.

S/N	Items of Impact	Forecasted Impact		Reason of Assessment
		Before/During Construction Stage	Operation and Maintenance Stage	
Natural Environment				
9	Protected areas 【Common to all haors】	-	-	**During Construction:** There is no protected area in the project intervention haors. **Operation and Maintenance:** No impact is expected.
10	Biodiversity 【Common to all haors】	✓	✓	**During Construction:** Road construction may cause habitat fragmentation, loss of natural habitats, and increased water pollution, sedimentation, and habitat disturbance, collectively can reduce ecological integrity and hampering the resilience of plankton and benthic communities. **Operation and Maintenance:** Submersible roads can alter water flow and sediment patterns, affecting aquatic plants, plankton, benthos, and fish spawning and breeding areas, while having minimal long-term impact on terrestrial wildlife movement.
11	Hydrology 【Common to all haors】	-	✓	**During Construction:** No impact is expected. **Operation and Maintenance:** Project interventions may affect regional hydrology by restricting/ controlling natural water flow.
12	Topography/ geology 【Common to all haors】	✓	-	**During Construction:** Earth filling and leveling for road embankments can locally alter natural land contours and micro-topography. **Operation and Maintenance:** Submersible roads generally maintain seasonal water flow, so long-term changes to topography are minimal, limited to minor embankment-induced modifications.
Social Environment				
13	Land acquisition and resettlement	✓	-	**During Construction:** Construction of new roads may require land acquisition, potentially impacting

S/N	Items of Impact	Forecasted Impact		Reason of Assessment
		Before/During Construction Stage	Operation and Maintenance Stage	
	【Common to all haors】			the livelihoods of the people who own or use the affected land. **Operation and Maintenance:** There is no additional land acquisition.
14	Socially Vulnerable groups (marginal poor people, elderly, women & minorities group) 【Common to all haors】	✓	✓	**Before/During Construction:** The construction of roads is expected to create job and commercial opportunities for local residents, including vulnerable groups. **Operation and Maintenance:** Poor people/household members will be benefited by alternative income generation activities/livelihood supports. Road's development will allow timely crop harvesting with increased agricultural work opportunities for poor people. Fishery development and other activities will also benefit them in multiple ways.
15	Ethnic minorities/ indigenous people 【Common to all haors】	✓	✓	**Before/During Construction:** Not clear at this stage. **Operation and Maintenance:** Not clear at this stage.
16	Livelihood 【Common to all haors】	✓	✓	**During Construction:** Project-Affected Households (PAHs) who earn income from the acquired land may lose their source of income either permanently or temporarily. New job opportunities will be created for the local people. **Operation and Maintenance:** Implementation of the project will protect the crops from flash floods, thereby improving the livelihood of the local people.
17	Land use and utilization of local resources 【Common to all haors】	✓	-	**During Construction:** Improper excavation for construction/ reconstruction of roads and canals may degrade existing topography.

S/N	Items of Impact	Forecasted Impact		Reason of Assessment
		Before/During Construction Stage	Operation and Maintenance Stage	
				Operation and Maintenance: No impact is expected.
18	Water use 【Common to all haors】	✓	-	**During Construction:** Surface water from nearby rivers or groundwater will be used during the construction phase. **Operation and Maintenance:** No impact is expected.
19	Existing social infrastructure and services 【Common to all haors】	-	-	**Before/During Construction:** Impact on social infrastructure/service will be limited and/or negligible. **Operation and Maintenance:** No impact is expected.
20	Local communities and local decision-making bodies 【Common to all haors】	✓	✓	**Before/During Construction:** Social institutions and local decision-making institutions of the project area may be impacted. **Operation and Maintenance:** Access to the social infrastructure will be increased.
21	Uneven distribution of damage and benefits 【Common to all haors】	✓	-	**Before/During Construction:** Only landowners and affected laborers will be eligible for compensation and rehabilitation. **Operation and Maintenance:** No impact is expected.
22	Conflicts of interest within the region 【Common to all haors】	✓	-	**Before/During Construction:** Due to an increase in employment opportunities during construction, construction workers may experience some conflicts between local communities. **Operation and Maintenance:** No impact is expected.
23	Cultural heritages 【Common to all haors】	✓	✓	**Before/During Construction:** Not clear at this stage. **Operation and Maintenance:** Ditto.

S/N	Items of Impact	Forecasted Impact		Reason of Assessment
		Before/During Construction Stage	Operation and Maintenance Stage	
24	Land scape 【Common to all haors】	✓	-	**Before/During Construction:** Temporary visual alteration of the natural wetland landscape due to road construction, machinery, and material stockpiles. **Operation and Maintenance:** Submersible roads have minimal long-term visual impact, as they are submerged during the monsoon and blend with the natural haor environment.
25	Gender 【Common to all haors】	✓	✓	**During Construction:** The magnitude of impact is not clear at this stage. **Operation and Maintenance:** Many positive impacts will benefit women such as they will be involved in fisheries management, Compensatory Alternative Income-Generating Activities (CAIGA), and the operation and maintenance of rural infrastructure.
26	Children's rights 【Common to all haors】	✓	✓	**During Construction:** Not clear at this stage. **Operation and Maintenance:** Children will be benefited by improved access to schools as a result of road infrastructure development.
27	Infectious diseases such as HIV/AIDS 【Common to all haors】	✓	-	**During Construction:** Influx of workers may increase the risk of infectious diseases. **Operation and Maintenance:** No impact is expected.
28	Working environment (work safety) 【Common to all haors】	✓	-	**During Construction:** There would be a possibility to occur accidents and incidents during construction works for the implementation of the project. Physical trouble, Noise, vibration, lighting, electrical, heat and cold, nuisance dust, fire/explosion, machine grinding, working space, Chemical, Gases, dusts, fumes, vapors, liquids are the

S/N	Items of Impact	Forecasted Impact		Reason of Assessment
		Before/During Construction Stage	Operation and Maintenance Stage	
				major hazards which are harmful to workers health. **Operation and Maintenance:** No impact is expected.
Others				
29	Transboundary impacts and climate change 【Common to all haors】	✓	✓	**During Construction:** The operation of construction machines and vehicles will produce greenhouse gas (CO_2). **Operation and Maintenance:** Submersible roads have minimal direct GHG impact, though improved access may indirectly increase vehicle use in dry season, slightly raising emissions; however, proper design enhances climate resilience by maintaining natural flood flow and reducing vulnerability to extreme weather.
30	Accident 【Common to all haors】	✓	✓	**During Construction:** Operation of heavy vehicles and machinery may cause traffic accidents in and around the proposed project sites. Also, accidents may occur to the workers during the construction. **Operation and Maintenance:** The incidence of road accidents may increase with the rising volume of vehicles on the road.

CHAPTER 7

Primary Baseline Survey

7 PRIMARY BASELINE SURVEY

The baseline conditions define the physical and biological conditions that prevail in the project study area. It includes information on receptors and resources that were identified during the field visit as having the potential to be affected by the project, as well as having an impact on the sustainability of the project.

This chapter describes the baseline environment of the project area and its surroundings, including ambient air quality, ambient noise environment, water quality, soil quality, sediment quality, and ecological resources, including biodiversity. This information is to assess the quality of the existing environment as well as to assess potential impacts caused by the project in both construction and operation phases and to provide mitigation measures and monitoring programs to reduce adverse impacts.

The information outlined is primarily based on field surveys, which were carried out during the dry season (24 May 2025 to 1 June 2025) and wet season (19 August 2025 to 30 August 2025).

7.1 Physical Environment

7.1.1 Ambient Air Quality

The objective of the ambient air quality monitoring program in the Haor Region was to establish the baseline conditions of ambient air quality within the study area. The Haor landscape is predominantly rural, marked by scattered settlements, agricultural fields, water bodies, and seasonally flooded wetlands. The main sources of emissions include dust from unpaved and earthen roads, exhaust from motor vehicles and river vessels, fugitive dust from agricultural lands, sand-filled areas, and exposed soil surfaces, as well as smoke from domestic cooking practices.

Monitoring locations were selected based on aerial imagery, local knowledge of settlement distribution, and considerations of accessibility, safety, and the presence of sensitive receptors such as schools, healthcare facilities, and densely populated villages.

Ambient air quality was monitored at 9 (nine) locations[17] across the study area during the dry season. The ambient air quality parameters studied were particulate matter (PM_{10} and $PM_{2.5}$), suspended particulate matter (SPM), sulfur dioxide (SO_2), nitrogen dioxides (NO_x), carbon monoxide (CO), and ozone (O_3). The ambient air parameters were monitored for 24 hours (8 hours for Carbon Monoxide) and compared with the WHO and Bangladesh Standards.

7.1.1.1 Ambient Air Quality Monitoring Locations

Monitoring locations were chosen to determine the general background concentration in close proximity to human receptors that may be affected by the project activities.

The ambient air quality monitoring locations were based on the following aspects covered in the field survey plan developed prior to the fieldwork.

- Meteorological conditions of the area.
- The topography of the study area.
- Location of sensitive receptors such as major settlements.

Details of the ambient air quality monitoring locations are presented in Table 7-1 and Figure 7-1.

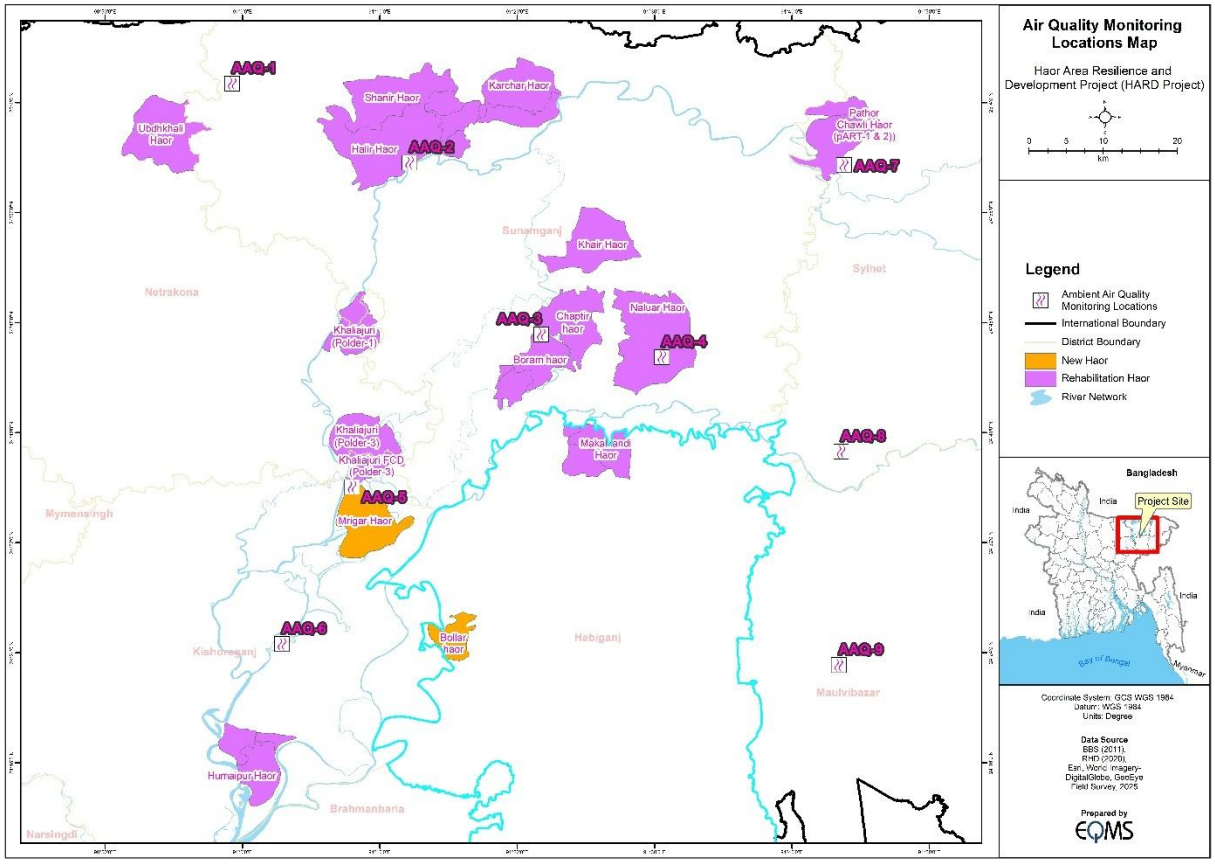
[17] Some monitoring locations are situated outside the selected haors. These locations were strategically selected to ensure spatial representativeness and to capture baseline environmental conditions across the broader haor ecosystem.

Table 7-1: Ambient air quality monitoring locations

Sampling Locations	Coordinates	Monitoring Date (Dry Season)	Location Description
AAQ-1	25°05'23.35"N 90°59'14.88"E	24 May 2025	Gurmar Haor
AAQ-2	24°59'37.40"N 91°12'10.20"E	25 May 2025	Halir Haor
AAQ-3	24°47'08.90"N 91°21'45.30"E	26 May 2025	Chaptir Haor
AAQ-4	24°45'30.10"N 91°30'32.40"E	27 May 2025	Naluar Haor
AAQ-5	24°36'03.10"N 91°07'58.70"E	28 May 2025	Mrigar Haor
AAQ-6	24°24'37.70"N 91°02'53.10"E	29 May 2025	Kazir Kola Boro Haor
AAQ-7	24°59'27.10"N 91°43'47.40"E	30 May 2025	Pathor Chauli Haor
AAQ-8	24°38'37.50"N 91°43'34.80"E	31 May 2025	Muktarpur Haor
AAQ-9	24°23'06.27"N 91°43'24.51"E	1 Jun 2025	Hail Haor

Source: Study Team, 2025

Figure 7-1: Monitoring location map



Source: Study Team, 2025

7.1.1.2 Monitoring Method

Particulate monitoring was accomplished with air quality detectors that deliver precise measurement data in real-time for a wide range of air pollutants in a discreet and compact package. AAS 271 is equipped with two flow meter which continuously display sampling flow rates of two streams controlled

by orifice. Glass Microfiber filters of 47.0 mm diameter is used for PM_{10} sampling while PTFE membrane (46.2 mm) is used for $PM_{2.5}$ sampling. All components of Impactor are made up of corrosion free metals fabricated with the help of CNC machines to ensure desired precision.

In AAS 118 improved valve design has been incorporated which ensures that flow is not reduced significantly during sampling period due to deposition of fine particles escaping from impingers. The instrument is housed within a robust powder coated cabinet designed for outdoor field use. This instrument could be attached with the AAS 271 Combo Sampler. The air quality parameter monitoring methods are presented in Table 7-2.

Table 7-2: Air Quality Parameters Monitoring Method

Parameter	Method
Particulate Matter (PM_{10})	Gravimetric
Particulate Matter ($PM_{2.5}$)	Gravimetric
Suspended Particulate Matter (SPM)	Gravimetric
Sulfur Dioxide (SO_2)	West-Geake
Nitrogen Oxides (NOx)	Jacob and Hochheiser
Carbon Monoxide (CO)	CO Meter
Ozone (O_3)	O_3 Meter

7.1.1.3 Ambient Air Quality Monitoring Results

The summary of the ambient air quality results is presented in Table 7-3.

Table 7-3: Summary of ambient air quality monitoring results

Sampling Locations	Observed	Ambient Air Quality						
		PM_{10}	$PM_{2.5}$	SPM	NO_x	SO_2	CO	O_3
		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	µg/m³
AAQ-1	Average	63.21	30.47	98.16	1.37	1.01	0.5	15.36
AAQ-2	Average	62.48	35.37	100.76	1.23	1.22	1	19.55
AAQ-3	Average	60.43	33.14	98.51	1.37	1.28	1	18.21
AAQ-4	Average	64.14	34.76	104.28	1.01	1.52	1	22.17
AAQ-5	Average	61.29	30.61	96.34	1.23	1.06	0.5	14.56
AAQ-6	Average	68.55	36.19	108.93	1.24	1.13	1	13.74
AAQ-7	Average	63.34	30.19	97.27	1.21	1.23	1	10.89
AAQ-8	Average	60.34	32.25	96.43	1.12	1.09	1	16.14
AAQ-9	Average	62.98	33.62	99.87	1.07	1.17	0.5	14.98
Duration (Hour)		24	24	24	24	24	1	8
Bangladesh Standard[18]	1-hourly	-	-	-	-	250	20	180
	8-hourly	-	-	-	-	-	5	100
	24-hourly	150	65	-	80	80	-	-
	Annual	50	35	-	40	-	-	-
WHO Standard[19]	1-hourly	-	-	-	-	-	35	-
	8-hourly	-	-	-	-	-	10	100

[18] Air Pollution (Control) Rules, 2022.

[19] WHO Global Air Quality Guidelines, 2021.

Sampling Locations	Observed	Ambient Air Quality						
		PM_{10}	**$PM_{2.5}$**	**SPM**	**NO_x**	**SO_2**	**CO**	**O_3**
		$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	$\mu g/m^3$
	24-hourly	45	15	-	25	40	4	-
	Annual	15	5	-	10	-	-	

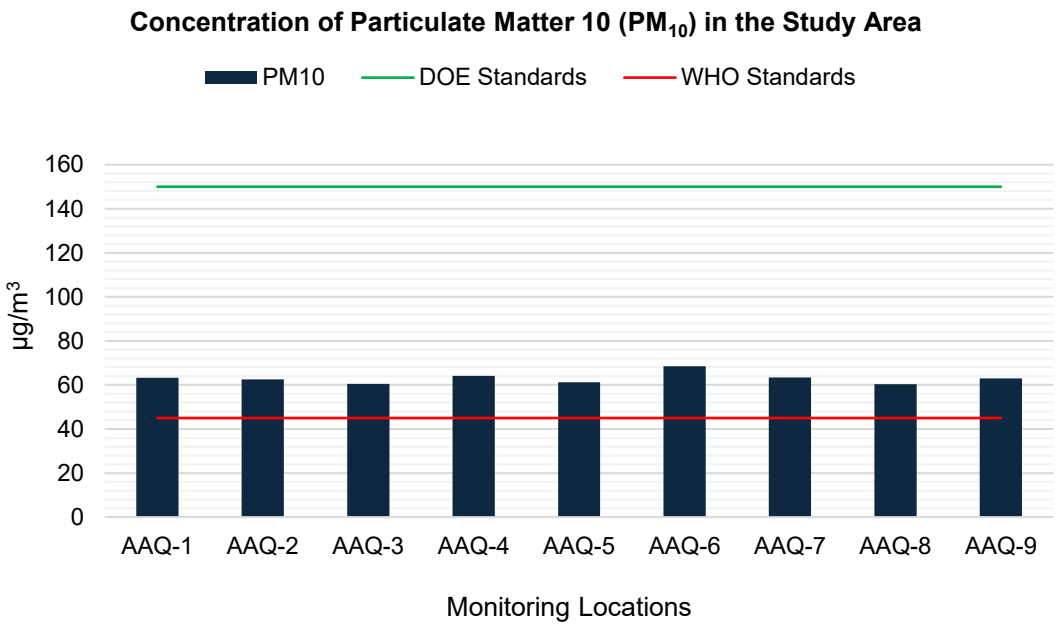
Source: Study Team, 2025

7.1.1.3.1 Interpretation of Air Monitoring Results

Particulate Matter (PM_{10})

The concentrations of PM_{10} recorded at the monitoring locations in the Haor Region during the dry season ranged between 60.34 µg/m³ and 68.55 µg/m³. These values remained within the permissible limits of the Bangladesh National Ambient Air Quality Standards. However, when compared with the World Health Organization (WHO) guideline values, the PM_{10} concentrations at all stations were found to be relatively higher. The concentrations of PM_{10} in the study area are shown in Figure 7-2.

Figure 7-2: Concentrations of PM_{10} in the study area

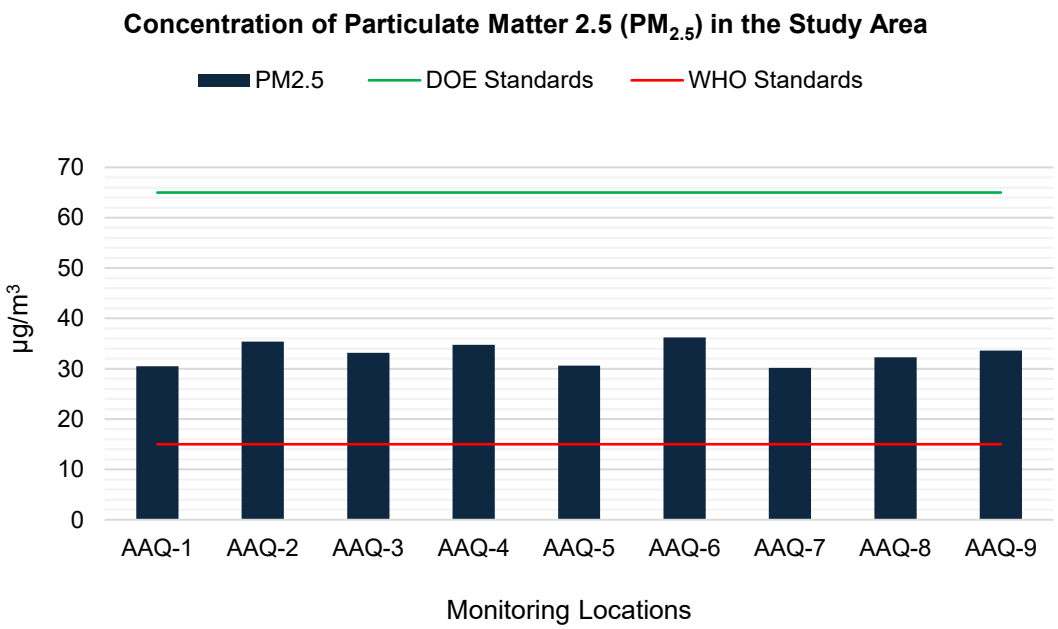


Source: Field Measurement and Laboratory Analysis, 2025

Particulate Matter ($PM_{2.5}$)

The concentrations of $PM_{2.5}$ at the monitoring locations in the Haor Region during the dry season ranged between 30.19 µg/m³ and 36.19 µg/m³. These concentrations were within the permissible limits of the Bangladesh National Ambient Air Quality Standards. However, the values at all stations exceeded the World Health Organization (WHO) guideline levels, indicating comparatively higher fine particulate matter in the area. The concentrations of $PM_{2.5}$ in the study area are shown in Figure 7-3.

Figure 7-3: Concentrations of $PM_{2.5}$ in the study area

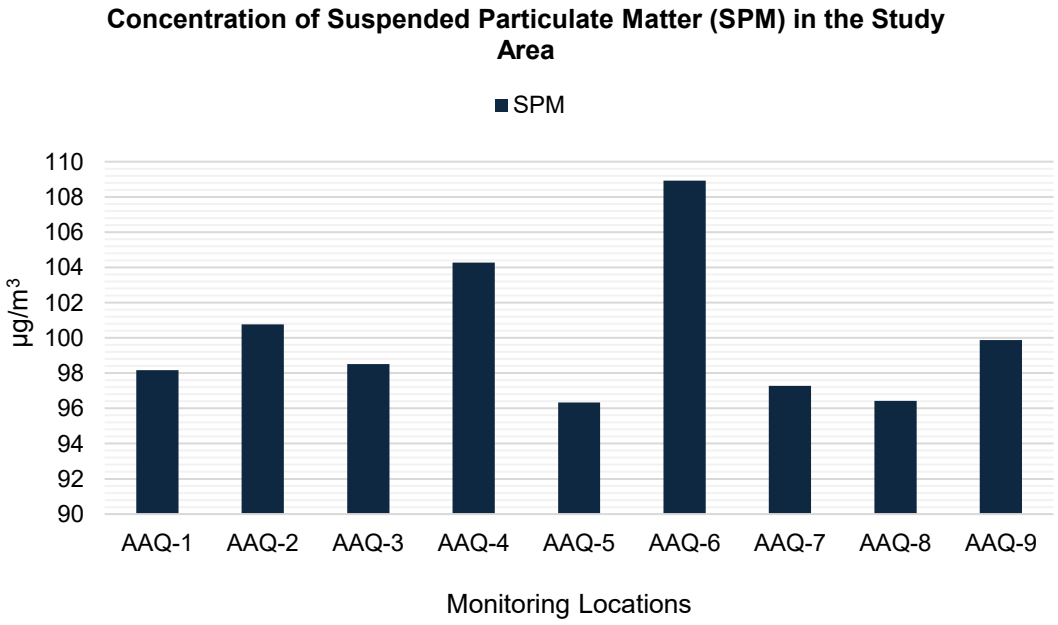


Source: Field Measurement and Laboratory Analysis, 2025

Suspended Particulate Matter (SPM)

The concentrations of SPM in the monitoring locations during the study period ranged from 96.34 µg/m^3 to 108.93 µg/m^3 during the dry season. The concentrations of SPM in the study area are shown in Figure 7-4.

Figure 7-4: Concentrations of SPM in the study area

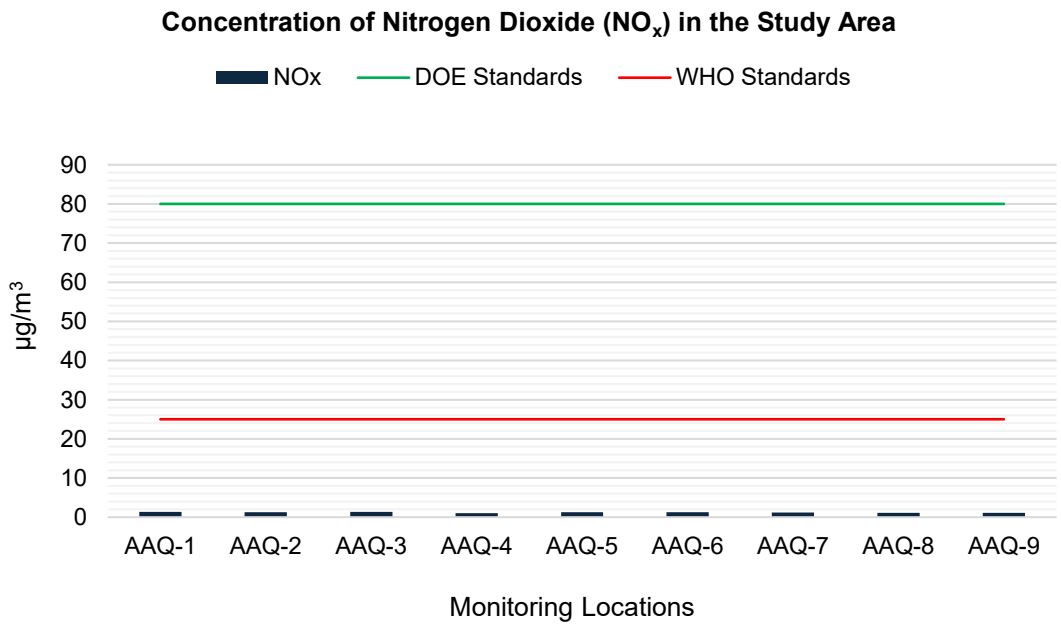


Source: Field Measurement and Laboratory Analysis, 2025

Nitrogen Oxides (NO_x)

The average concentrations of NO_x at the monitoring locations in the Haor Region during the dry season ranged between 1.01 µg/m³ and 1.37 µg/m³. These concentrations were well within the permissible limits of both the Bangladesh National Ambient Air Quality Standards and the World Health Organization (WHO) guidelines. The concentrations of NO_x in the study area are shown in Figure 7-5.

Figure 7-5: Concentrations of NO_x in the study area

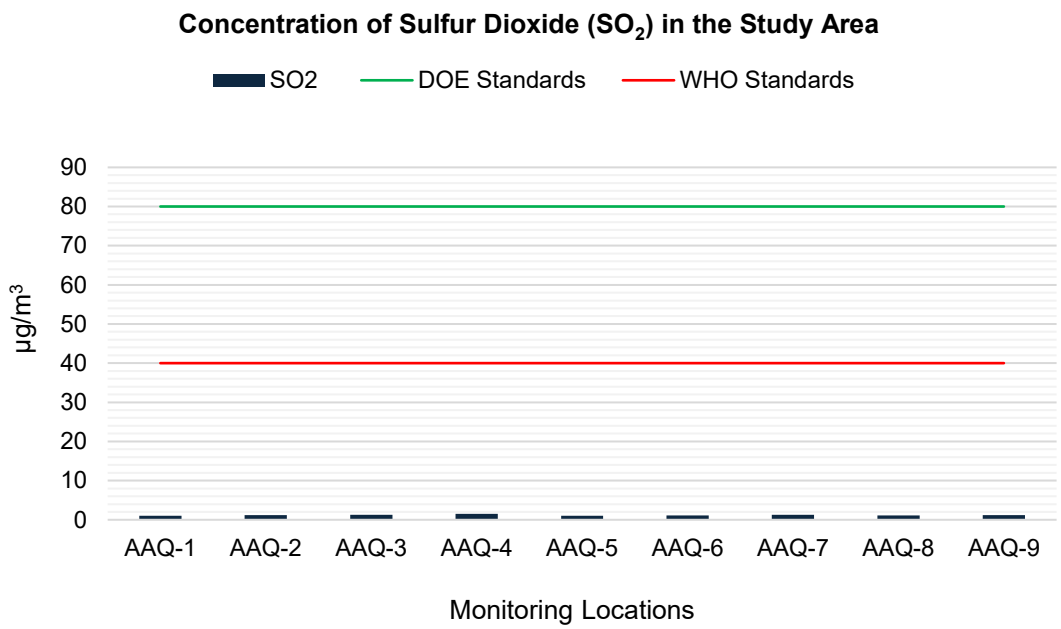


Source: Field Measurement and Laboratory Analysis, 2025

Sulfur Dioxide (SO_2)

The average concentrations of SO_2 at the monitoring locations in the Haor Region during the dry season ranged from 1.01 µg/m³ to 1.52 µg/m³. These concentrations were within the permissible limits of both the Bangladesh National Ambient Air Quality Standards and the World Health Organization (WHO) guidelines. The concentrations of SO_2 in the study area are shown in Figure 7-6.

Figure 7-6: Concentrations of SO_2 in the study area

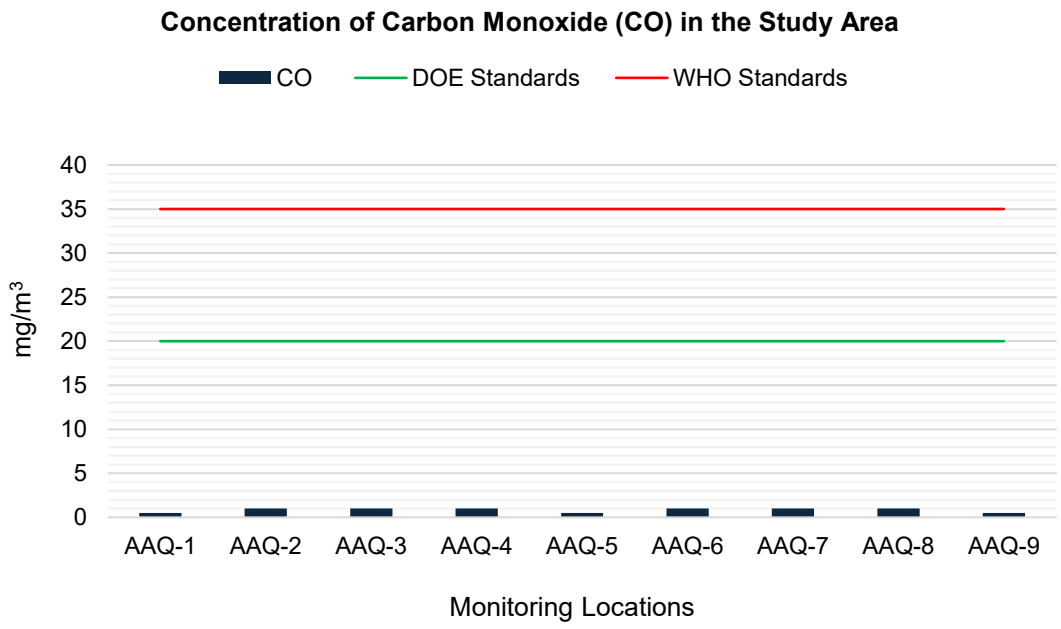


Source: Field Measurement and Laboratory Analysis, 2025

Carbon Monoxide (CO)

The concentrations of CO at the monitoring locations in the Haor Region during the dry season ranged between 0.5 mg/m^3 and 1.0 mg/m^3. These concentrations were within the permissible limits of both the Bangladesh National Ambient Air Quality Standards and the World Health Organization (WHO) guidelines. The concentrations of CO in the study area are shown in Figure 7-7.

Figure 7-7: Concentrations of CO in the study area

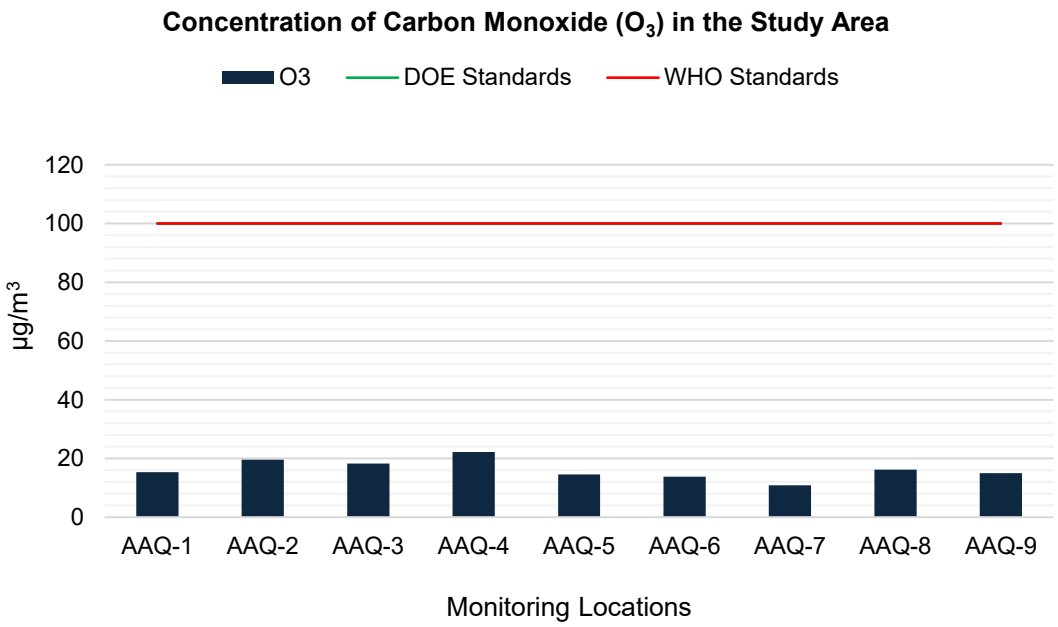


Source: Field Measurement and Laboratory Analysis, 2025

Ozone (O_3)

The concentrations of O_3 at the monitoring locations in the Haor Region during the dry season ranged between 10.89 µg/m³ and 22.17 µg/m³. These concentrations were within the permissible limits of both the Bangladesh National Ambient Air Quality Standards and the World Health Organization (WHO) guidelines. The concentrations of CO in the study area are shown in Figure 7-7.

Figure 7-8: Concentrations of O_3 in the study area



Source: Field Measurement and Laboratory Analysis, 2025

7.1.2 Ambient Noise Level

The ambient noise levels in the Haor Region reflect the activities of a rural wetland landscape, where boat engines, motorized three-wheelers, tractors, and occasional road traffic serve as the main sources of noise. To establish the baseline noise environment of the study area, primary noise monitoring was conducted at selected locations. Noise measured is assessed against the IFC and DOE criteria (Table 7-4 and Table 7-5).

Table 7-4: IFC Noise Level Guidelines [20]

Receptor	One Hour Leq in dB(A)	
	Day-time 07:00 – 22:00	Night-time 22:00 – 07:00
Residential; institutional; educational [21]	55	45
Industrial; commercial	70	70

Source: Guidelines for Community Noise, World Health Organization (WHO), 1999

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

[21] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).

Table 7-5: Bangladesh Noise Level Standards

Receptor	Limit in dB(A) Leq	
	Day-time 06:00 – 21:00	Night-time 21:00 – 06:00
Silent	50	40
Residential	55	45
Mixed	60	50
Commercial	70	60
Industrial	75	70

Source: Noise Pollution (Control) Rules, 2025

7.1.2.1 Sampling Methodology

Noise level monitoring has been performed for day and night (24 hrs) using Noise Meter (CEM Sound Level Meter). The day noise levels were monitored from 6 am to 9 pm and night levels from 9 pm to 6 am at all the locations of the study area to comply with the national guidelines for ambient noise levels.

7.1.2.2 Ambient Noise Monitoring Locations

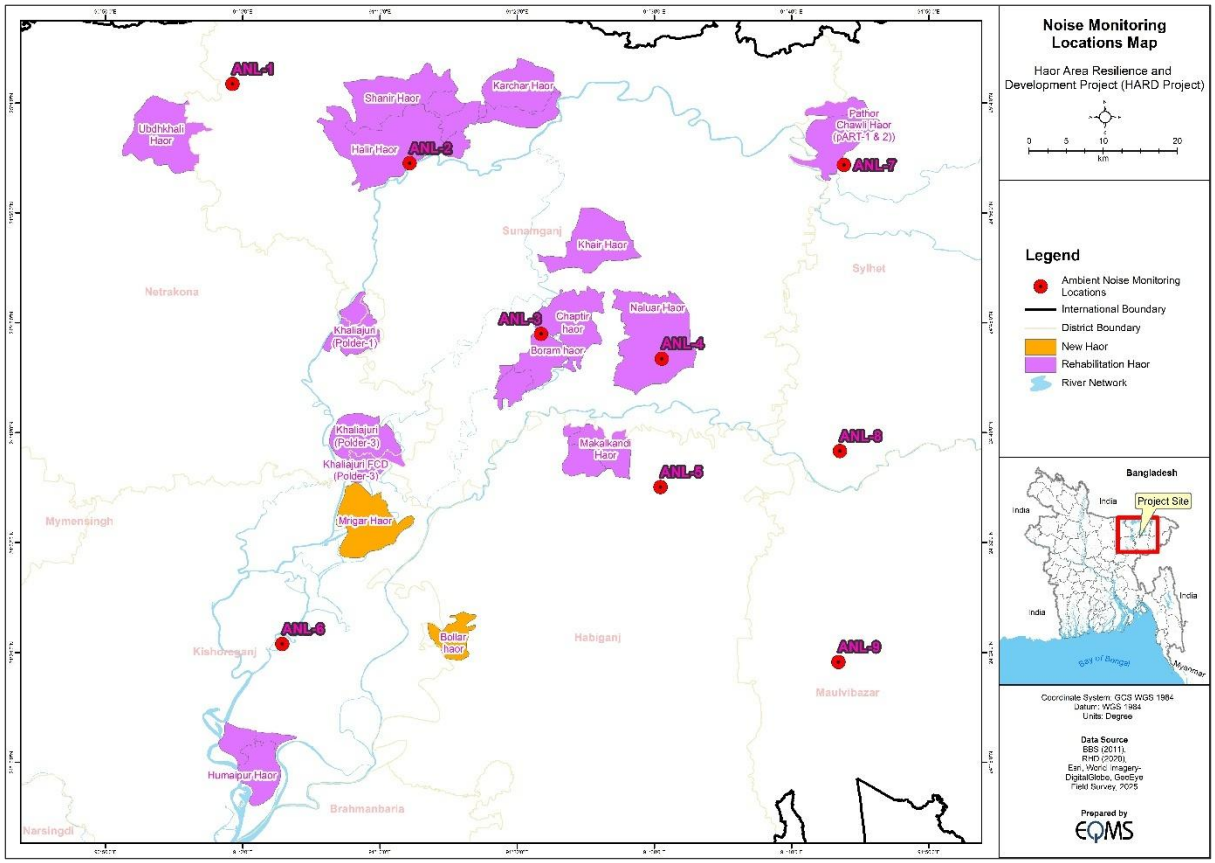
Noise monitoring was conducted at nine (9) locations within the study area during the baseline survey on 24 May 2025 to 1 June 2025. These locations are chosen in such a way that representative data can be recorded all over the study area. Details of the ambient noise monitoring locations are presented in Table 7-6 and Figure 7-1.

Table 7-6: Ambient noise monitoring locations

Sampling Locations	Coordinates	Monitoring Date	Location Description
ANL-1	25°05’23.49”N 90°59’15.00”E	24 May 2025	Gurmar Haor
ANL-2	24°59’37.40”N 91°12’10.20”E	25 May 2025	Halir Haor
ANL-3	24°47’11.70”N 91°21’44.60”E	26 May 2025	Chaptir Haor
ANL-4	24°45’23.60”N 91°30’32.40”E	27 May 2025	Naluar Haor
ANL-5	24°36’03.10”N 91°30’26.70”E	28 May 2025	Mrigar Haor
ANL-6	24°24’37.70”N 91°02’53.10”E	29 May 2025	Kazir Kola Boro Haor
ANL-7	24°59’30.20”N 91°43’48.80”E	30 May 2025	Pathor Chauli Haor
ANL-8	24°38’39.80”N 91°43’31.40”E	31 May 2025	Muktarpur Haor
ANL-9	24°23’18.79”N 91°43’24.85”E	1 Jun 2025	Hail Haor

Source: Study Team, 2025

Figure 7-9: Monitoring location map



Source: Study Team, 2025

7.1.2.3 Noise Monitoring Results

The equivalent day-time and night-time noise levels in comparison to the respective national and international standards are tabulated in Table 7-7.

Table 7-7: Ambient noise level in the study area

Sampling Locations	Location Setting (DOE/IFC)	Noise Level in dB(A) [22]						Bangladesh Standard[23]		IFC Guidelines[20]	
		Day Time			Night Time						
		Leq_{day}	L_{max}	L_{min}	Leq_{night}	L_{max}	L_{min}	Day-time	Night-time	Day-time	Night-time
ANL-1	Residential	44.2	60.1	38.2	40.1	53.3	36.1	55	45	55	45
ANL-2	Residential	45.2	62.4	39.7	42.5	56.1	38.3	55	45	55	45
ANL-3	Residential	43.3	60.2	38.9	41.4	54.0	35.4	55	45	55	45
ANL-4	Residential	42.4	56.0	37.2	39.8	52.4	36.3	55	45	55	45
ANL-5	Residential	45.3	60.2	41.7	41.1	50.1	37.4	55	45	55	45
ANL-6	Residential	44.7	63.7	40.0	41.7	53.8	39.1	55	45	55	45
ANL-7	Residential	43.2	61.3	39.5	40.9	52.3	36.6	55	45	55	45
ANL-8	Residential	45.2	57.4	38.4	40.2	53.2	37.3	55	45	55	45
ANL-9	Residential	42.1	58.6	38.8	41.3	52.4	36.7	55	45	55	45

Source: Field Survey, 2025

[22] A-weighted decibel, abbreviated dB(A), is an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted system, the decibel values of sounds at low frequencies are reduced, as the ear is less sensitive to low audio frequencies, especially below 1000 Hz, than to high audio frequencies.

[23] Ministry of Environment, Forest, and Climate Change. (2006). *Noise Pollution (Control) Rules, 2025* (S.R.O. No. 212-Law/2006). The People's Republic of Bangladesh.

7.1.2.3.1 Interpretation of Noise Monitoring Results

Noise monitoring in the Haor Region was carried out at nine residential locations during both day and night periods. The recorded daytime Leq values ranged between 42.1 dB(A) and 45.3 dB(A), while nighttime Leq values varied from 39.8 dB(A) to 42.5 dB(A). In all cases, the measured levels were well within the permissible limits of the Bangladesh National Standards (55 dB(A) for daytime and 45 dB(A) for nighttime) as well as the IFC guideline values for residential areas.

These results indicate that the noise environment in the study area is generally low, consistent with the rural and semi-urban setting of the Haor landscape, where occasional boat engines, light vehicular movement, and local community activities contribute to ambient sound levels.

7.1.3 Surface Water Quality

Primary monitoring of surface water quality is considered important in order to assess the water quality characteristics for critical parameters and to predict the impact of water quality by project operation and related activities.

7.1.3.1 Surface Water Sampling Locations

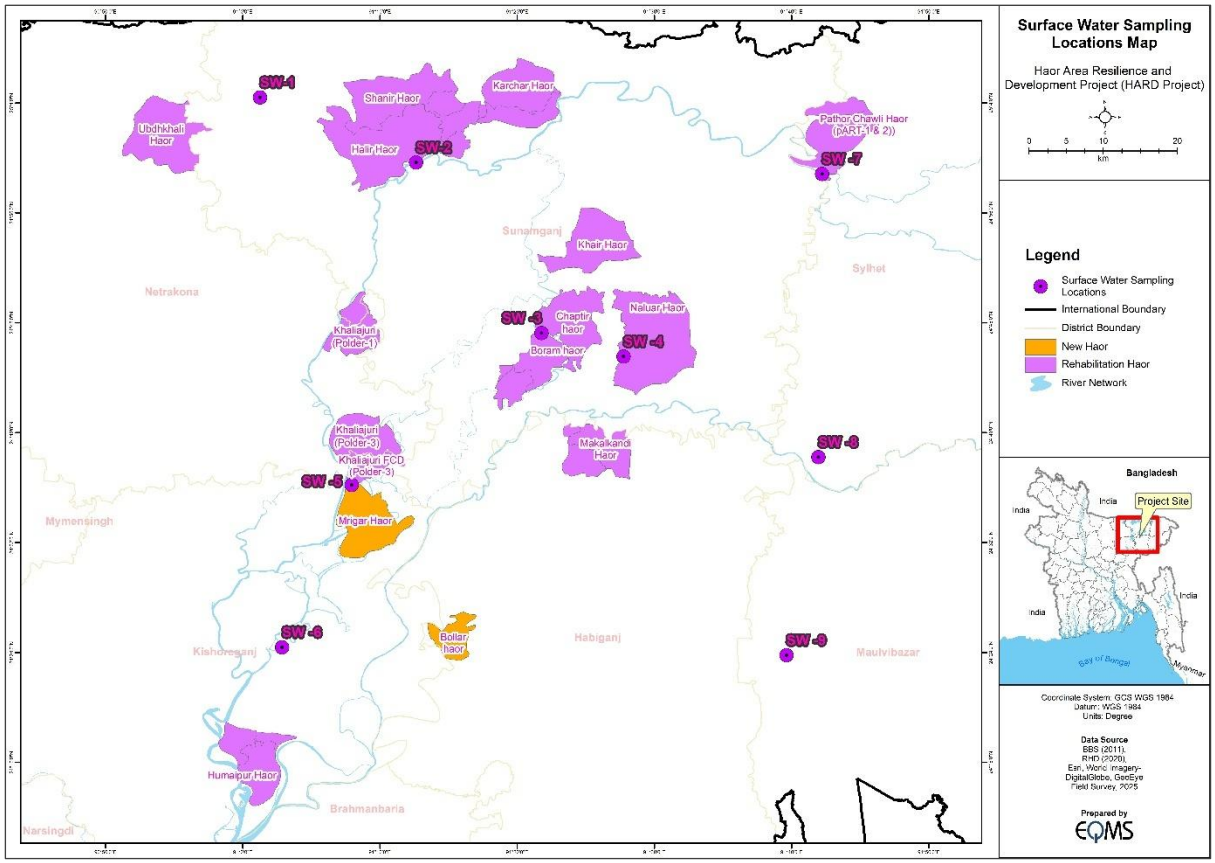
The surface water quality samples were collected from nine (9) locations in the study area for two seasons i.e., dry season and wet season. The samples were taken from representative selected water bodies representing the study area. The surface water sampling was based on the identification of major surface water bodies. The details of the surface water sampling locations are presented in Table 7-8 and Figure 7-1.

Table 7-8: Surface water sampling locations

Sampling Locations	Coordinates	Monitoring Date		Location Description
		Dry Season	Wet Season	
SW-1	25°4’24.43”N 91°1’15.49”E	24 May 2025	28 Aug 2025	Gurmar Haor
SW-2	24°59’40.48”N 91°12’37.82”E	25 May 2025	27 Aug 2025	Halir Haor
SW-3	24°47’15.50”N 91°21’46.60”E	26 May 2025	26 Aug 2025	Chaptir Haor
SW-4	24°45’32.90”N 91°27’45.50”E	27 May 2025	30 Aug 2025	Naluar Haor
SW-5	24°36’12.10”N 91°07’56.60”E	28 May 2025	21 Aug 2025	Mrigar Haor
SW-6	24°24’22.90”N 91°02’52.20”E	29 May 2025	20 Aug 2025	Kazir Kola Boro Haor
SW-7	24°58’50.50”N 91°42’13.30”E	30 May 2025	22 Aug 2025	Pathor Chauli Haor
SW-8	24°38’13.45”N 91°41’57.56”E	31 May 2025	23 Aug 2025	Muktarpur Haor
SW-9	24°23’48.12”N 91°39’37.69”E	1 Jun 2025	24 Aug 2025	Hail Haor

Source: Study Team, 2025

Figure 7-10: Monitoring location map



Source: Study Team, 2025

7.1.3.2 Surface Water Monitoring Results

The analyzed results for surface water are presented in Table 7-9.

Table 7-9: Surface water analysis result

S/N	Parameters	Unit	Concentration																Bangladesh Standard[24]	
			SW-1		SW-2		SW-3		SW-4		SW-5		SW-6		SW-7		SW-8		SW-9		d[25]	f[26]
			Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet		
1.	Temperature (T)	°C	22.3	25.6	20.2	25.4	22.8	25.4	21.6	25.4	20.8	25.6	21.1	25.6	21.8	25.3	22.4	25.4	22.5	25.5	-	-
2.	Turbidity	NTU	13.50	11.1	7.71	23.0	1.52	19.2	3.29	7.6	4.79	1.2	14.40	3.6	7.85	3.5	1.28	13.3	27.40	11.7	-	-
3.	pH	-	7.05	6.03	7.09	6.04	6.91	6.05	7.12	6.01	7.03	5.98	7.18	6.15	7.00	6.20	6.87	6.10	7.11	6.08	6.0-9.0	6.5-8.5
4.	Dissolved Oxygen (DO)	mg/L	5.23	6.4	6.19	6.6	5.55	6.5	5.98	6.2	6.28	6.2	6.11	6.6	6.27	6.6	5.98	6.4	5.42	6.3	≥ 5	-
5.	BOD_5	mg/L	1.5	<0.2	4.5	<0.2	2.0	<0.2	2.0	<0.2	2.5	<0.2	1.0	<0.2	2.0	0.24	2.0	0.40	2.0	<0.2	≤ 6	≤ 12
6.	COD	mg/L	27	0.9	36	0.7	32	0.8	38	0.7	27	1.1	21	1.0	25	0.9	30	1.4	26	0.6	50	100
7.	Total Dissolved Solids (TDS)	mg/L	70	30	84	30	69	30	77	30	81	30	92	30	111	30	102	30	89	30	1000	1000
8.	Total Suspended Solids (TSS)	mg/L	16	8.0	7	6.5	<5	6.8	9	5.2	7	6.8	36	6.0	17	6.5	5	7.2	18	9.0	-	-
9.	Electric Conductivity (EC)	µS/cm	110	50	88	60	96	50	106	60	114	50	124	50	122	60	119	60	88	50	-	-
10.	Ammonia (NH_3)	mg/L	0.38	0.02	0.22	0.01	0.27	0.01	2.77	0.01	0.27	0.08	0.33	0.06	0.31	0.44	0.36	0.24	0.92	0.18	-	-
11.	Nitrate (NO_3)	mg/L	1.77	1.3	1.77	1.1	1.77	1.2	1.77	1.3	1.77	1.2	2.21	1.1	1.77	0.8	1.33	0.6	2.66	0.9	-	-
12.	Coliform (total)	CFU/ 100mL	340	<1.8*	390	2.0	280	<1.8*	240	<1.8*	200	<1.8*	190	<1.8*	1110	4.0	1260	9.3	1370	2.0	≤ 5000	≤ 50000

[24] Ministry of Environment, Forest, and Climate Change. (2023). *Bangladesh Environment Conservation Rules, 2023 (Schedule-2)*. The People's Republic of Bangladesh.

[25] d - Water usable for fisheries

[26] f - Water usable for irrigation

S/N	Parameters	Unit	Concentration																Bangladesh Standard[24]	
			SW-1		SW-2		SW-3		SW-4		SW-5		SW-6		SW-7		SW-8		SW-9		d[25]	f[26]
			Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet		
13.	Chloride (Cl^-)	mg/L	7	1.89	6	1.22	7	3.18	7	2.15	8	2.38	8	19.7	6	8.71	8	1.60	2	6.16	-	-

Source: Study Team, 2025

7.1.3.2.1 Interpretation of Surface Water Monitoring Results

Surface water quality monitoring was carried out at nine locations (SW-1 to SW-9) during both the dry and wet season to assess the baseline conditions of the Haor Region. The results are summarized below.

Temperature

During the dry season, water temperature ranged between 20.2°C and 22.8°C, while in the wet season it increased to 25.3–25.6°C. This rise of approximately 3–5°C in the wet season is attributable to higher ambient temperatures, increased solar radiation, and monsoonal inflow into the Haor system. Such seasonal fluctuations are typical for the region and indicate normal thermal conditions. Although there is no specific Bangladesh standard for surface water temperature, all observed values fall within the expected natural range for freshwater ecosystems.

Turbidity

Turbidity values varied considerably across the nine sampling sites, ranging from 1.28 to 27.40 NTU during the dry season and from 1.2 to 23.0 NTU in the wet season. The differences reflect localized influences such as soil erosion, sediment suspension, and minor anthropogenic activities. Interestingly, the wet season did not show a marked increase at all sites, likely due to sediment settling within the flooded Haor basin. While there is no specific numerical limit set by Bangladesh for surface water turbidity, the observed values are typical for natural freshwater bodies and do not indicate pollution concerns.

pH

The surface water pH ranged from 6.87 to 7.18 in the dry season and decreased slightly to 5.98–6.20 in the wet season. This mild acidic shift is likely caused by rainfall dilution and the input of naturally occurring organic acids from decomposing vegetation and surrounding soils. Despite the slight reduction in pH, all measurements remain within the Bangladesh standard of 6.0–9.0 and the IFC guideline of 6.5–8.5, indicating that the water maintains neutral to slightly acidic conditions suitable for aquatic life.

Dissolved Oxygen

DO concentrations ranged from 5.23 to 6.28 mg/L during the dry season and increased to 6.2–6.6 mg/L in the wet season. The higher levels in the wet season are a result of improved aeration, higher water turnover, and dilution of organic matter. Throughout both seasons, DO remained above the Bangladesh minimum standard of 5 mg/L, confirming that the Haor's surface waters provide sufficient oxygen to support aquatic organisms and maintain ecological balance.

Biochemical Oxygen Demand

BOD_5 values were low in both seasons, ranging from 1.0–4.5 mg/L in the dry season and decreasing further to 0.24–0.4 mg/L in the wet season. The marked reduction in the wet season reflects dilution of organic matter and increased dispersion in the flooded Haor system. These low BOD_5 levels indicate minimal organic pollution, remaining well below the Bangladesh standards of ≤6 mg/L for the dry season and ≤12 mg/L for the wet season.

Chemical Oxygen Demand

COD concentrations ranged from 21–38 mg/L during the dry season and dropped significantly to 0.6–1.4 mg/L in the wet season. The decline is consistent with the BOD trend and demonstrates a lower presence of oxidizable organic and inorganic substances during periods of high water flow. Both dry and wet season values are well below the Bangladesh limits of 50 mg/L and 100 mg/L, respectively, confirming that the water remains clean and free from chemical stress.

Total Dissolved Solids

TDS levels ranged from 69–111 mg/L in the dry season and dropped to 30 mg/L in the wet season. The reduction during the monsoon reflects strong dilution by rainfall and inflowing waters. These low concentrations indicate freshwater with minimal dissolved mineral content, far below the Bangladesh standard of 1000 mg/L, highlighting excellent water quality in both seasons.

Total Suspended Solids

TSS concentrations varied from 5.0 to 36 mg/L in the dry season and 5.2–9.0 mg/L in the wet season. While seasonal rainfall can introduce suspended sediments, the widespread inundation in the Haor allows settling of particles, resulting in moderate values even during the wet season. These levels are environmentally acceptable for freshwater systems, and no national standard for TSS is specified.

Electrical Conductivity

EC measurements ranged from 88–124 µS/cm in the dry season and decreased to 50–60 µS/cm in the wet season. The reduction during the monsoon reflects lower concentrations of dissolved ions due to dilution. Such values are typical of low-mineral freshwater systems and indicate minimal influence from saline sources or anthropogenic ionic inputs. There is no fixed Bangladesh standard for EC, and all observed values are within normal environmental ranges.

Ammonia

Ammonia concentrations were between 0.22–2.77 mg/L in the dry season and 0.01–0.44 mg/L in the wet season. Higher levels during the dry season are likely caused by accumulation of organic matter and reduced water flow, whereas dilution and increased microbial processing lower concentrations in the wet season. The slightly elevated dry-season value at SW-9 suggests localized input from agriculture or organic waste, but overall, ammonia levels remain low and environmentally safe, with no national limit exceeded.

Nitrate

Nitrate ranged from 1.33–2.66 mg/L in the dry season and decreased to 0.6–1.3 mg/L in the wet season. The seasonal reduction is primarily due to dilution from rainfall and uptake by aquatic vegetation. Concentrations in both seasons are low, indicating minimal nutrient enrichment and negligible risk of eutrophication in the Haor surface waters.

Total Coliform

Total coliform counts ranged from 190–1370 CFU/100mL in the dry season and dropped sharply to 2–9.3 CFU/100mL in the wet season. The decrease in the wet season is likely the result of dilution and natural disinfection due to sunlight and water movement. Both seasons recorded values far below the Bangladesh limit of ≤5000 CFU/100mL, confirming low microbial contamination and good hygienic quality.

Chloride

Chloride concentrations ranged from 2–8 mg/L in the dry season and 1.22–19.7 mg/L in the wet season. The slightly elevated wet-season value at SW-6 may reflect local runoff, but overall, chloride levels remain very low, indicating minimal saline intrusion and excellent freshwater conditions. No specific Bangladesh standard is defined, but all observed concentrations are environmentally safe.

Comparison of dry and wet season data shows clear seasonal patterns. The dry season exhibits slightly higher concentrations for most parameters due to lower water volume, reduced flow, and accumulation of organic and inorganic substances. The wet season demonstrates substantial dilution, higher dissolved oxygen, and reduced BOD, COD, TDS, ammonia, and nitrate levels, reflecting improved

water quality. All parameters comply with Bangladesh standards, confirming that surface water in the Haor Region remains clean, ecologically healthy, and suitable for aquatic life throughout the year.

7.1.4 Groundwater Quality

Primary monitoring of groundwater quality is considered important in order to understand the probable impacts of the proposed project activities on the sub-surface aquifers.

7.1.4.1 Groundwater Sampling Locations

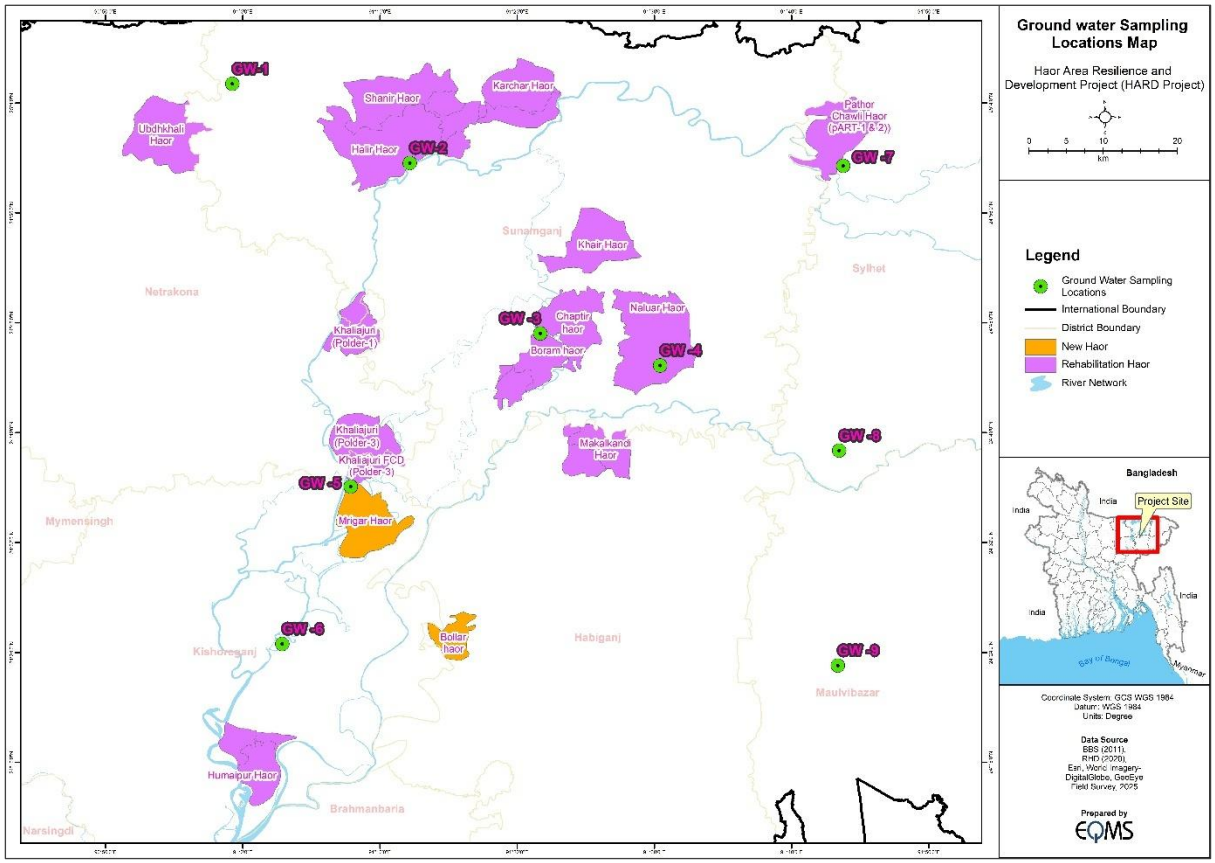
In order to establish the groundwater quality baseline in the study area, nine (9) groundwater samples were collected during the study period. The groundwater sampling has been conducted from tube wells in proximity to the proposed project area. The details of the groundwater sampling locations are presented in Table 7-10 and Figure 7-1.

Table 7-10: Groundwater sampling locations

Sampling Locations	Coordinates	Monitoring Date	Location Description
GW-1	25°05’24.00”N 90°59’14.90”E	24 May 2025	Gurmar Haor
GW-2	24°59’38.22”N 91°12’10.57”E	25 May 2025	Halir Haor
GW-3	24°47’13.70”N 91°21’41.20”E	26 May 2025	Chaptir Haor
GW-4	24°44’53.90”N 91°30’25.30”E	27 May 2025	Naluar Haor
GW-5	24°36’04.80”N 91°07’52.30”E	28 May 2025	Mrigar Haor
GW-6	24°24’37.90”N 91°02’52.80”E	29 May 2025	Kazir Kola Boro Haor
GW-7	24°59’26.00”N 91°43’45.60”E	30 May 2025	Pathor Chauli Haor
GW-8	24°38’42.10”N 91°43’28.20”E	31 May 2025	Muktarpur Haor
GW-9	24°23’03.23”N 91°43’22.43”E	1 Jun 2025	Hail Haor

Source: Study Team, 2025

Figure 7-11: Monitoring location map



Source: Study Team, 2025

7.1.4.2 Groundwater Monitoring Results

The analyzed results for groundwater are presented in Table 7-11.

Table 7-11: Groundwater analysis results

Parameters	Unit	Groundwater Quality									Bangladesh Standard 24	WHO Standards[27]
		GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	GW-9		
Temperature	°C	25.6	24.3	25.5	23.6	26.1	25.7	24.8	26.4	23.9	20-30	-
Turbidity	NTU	2.74	0.32	0.83	1.99	0.38	0.71	**22.0**	**5.11**	**17.20**	5	-
Total Hardness	mg/L	90	162	44	26	20	24	32	60	28	500	-
pH	-	6.89	7.11	7.07	6.92	7.18	7.04	6.97	6.52	7.04	6.5 - 8.5	6.5 - 8.5
TDS	ppm	113	93	124	111	177	152	175	148	140	1,000	-
EC	µS/cm	178	155	207	189	267	259	302	291	275	-	-
Sulfate (SO_4)	mg/L	<7	<7	<7	15	<7	<7	<7	<7	<7	250	-
Chloride (Cl^-)	mg/L	11	90	10	8	26	23	18	5	9	250	-
Arsenic (AS)	mg/L	0.016	0.005	0.035	0.002	0.009	0.029	0.002	**0.069**	**0.069**	0.05	-
Iron	mg/L	0.17	0.18	0.39	0.22	0.21	0.33	**3.95**	0.38	**4.81**	0.3-1.0	-
Manganese (Mn)	mg/L	0.10	0.9	0.11	0.11	0.10	0.10	0.11	0.12	0.14	0.4	-
Nitrate (NO_3)	mg/L	25.45	2.98	3.54	1.33	3.67	26.78	1.77	13.72	24.35	45	50
Phosphate (PO_4)	mg/L	4.70	0.21	0.10	26.00	1.21	5.30	0.72	4.50	0.10	-	-
Fluoride (F)	mg/L	0.4	0.74	**2.05**	0.07	0.83	0.96	0.14	0.24	0.59	1.0	1.5
Total Coliform (TC)	n/100	0	0	0	0	0	0	0	0	0	0	-
Fecal Coliform (FC)	n/100	0	0	0	0	0	0	0	0	0	0	-

Source: Study Team, 2025

[27] World Health Organization. (2017). *Guidelines for Drinking-water Quality: Fourth Edition incorporating the First Addendum*. Geneva. License: CC BY-NC-SA 3.0 IGO.

7.1.4.2.1 Interpretation of Groundwater Monitoring Results

The groundwater monitoring results indicate that, overall, the water quality is suitable for drinking in most locations, with temperature, pH, total dissolved solids, electrical conductivity, and total hardness all within the acceptable limits set by both Bangladesh standards and WHO guidelines, which indicates that the overall chemical environment of the aquifer is stable and suitable for drinking purposes.

Some parameters, however, exceeded guideline values, indicating localized water quality concerns. Turbidity was high at GW-7, GW-8, and GW-9, likely due to suspended sediments or natural soil particles, which could affect the aesthetic quality of water and may require simple filtration before use. Arsenic levels at GW-8 and GW-9 were above the Bangladesh standard, which is consistent with known contamination in certain aquifers and poses a serious health risk if consumed over time. Iron concentrations at GW-7 and GW-9 were significantly higher than permissible limits, possibly due to natural leaching from iron-rich soils or rocks, and could cause taste, staining, or operational issues in water supply systems. Manganese at GW-2 exceeded the standard, which may similarly result from natural mineral content in the aquifer. Fluoride at GW-3 was above the recommended limit, indicating potential for dental or skeletal effects with prolonged use. Elevated phosphate at GW-4, GW-5, and GW-6 suggests anthropogenic influence, such as runoff from fertilizers or detergents, and could contribute to nutrient enrichment.

Nitrate, chloride, and sulfate concentrations were within acceptable limits at all sites, suggesting limited contamination from agricultural or domestic wastewater. Microbiological analysis showed no total or fecal coliforms, indicating good sanitary conditions and protection of the aquifers from direct microbial pollution.

In summary, while most groundwater quality parameters are satisfactory, the exceedances of arsenic, iron, fluoride, manganese, turbidity, and phosphate at specific locations highlight the need for targeted interventions. Measures such as arsenic-safe water supply alternatives, iron and manganese removal, defluoridation where necessary, and regular monitoring can help ensure safe and reliable drinking water for affected communities.

7.1.5 Soil Quality

The soil quality of the study area is assessed through primary monitoring. As part of this study, soil quality was monitored in nine (9) locations - at the proposed project area.

A soil sampling procedure was followed by the AECL to ensure the quality of soil sample collection. The sample was stored in a plastic jar, sealed, and sent to the laboratory for pollution analysis. The detail of the soil sampling location is presented in Table 7-12. Primary soil monitoring also includes analysis of heavy metals with the objective of establishing baseline values for such contaminants (if present in the soil).

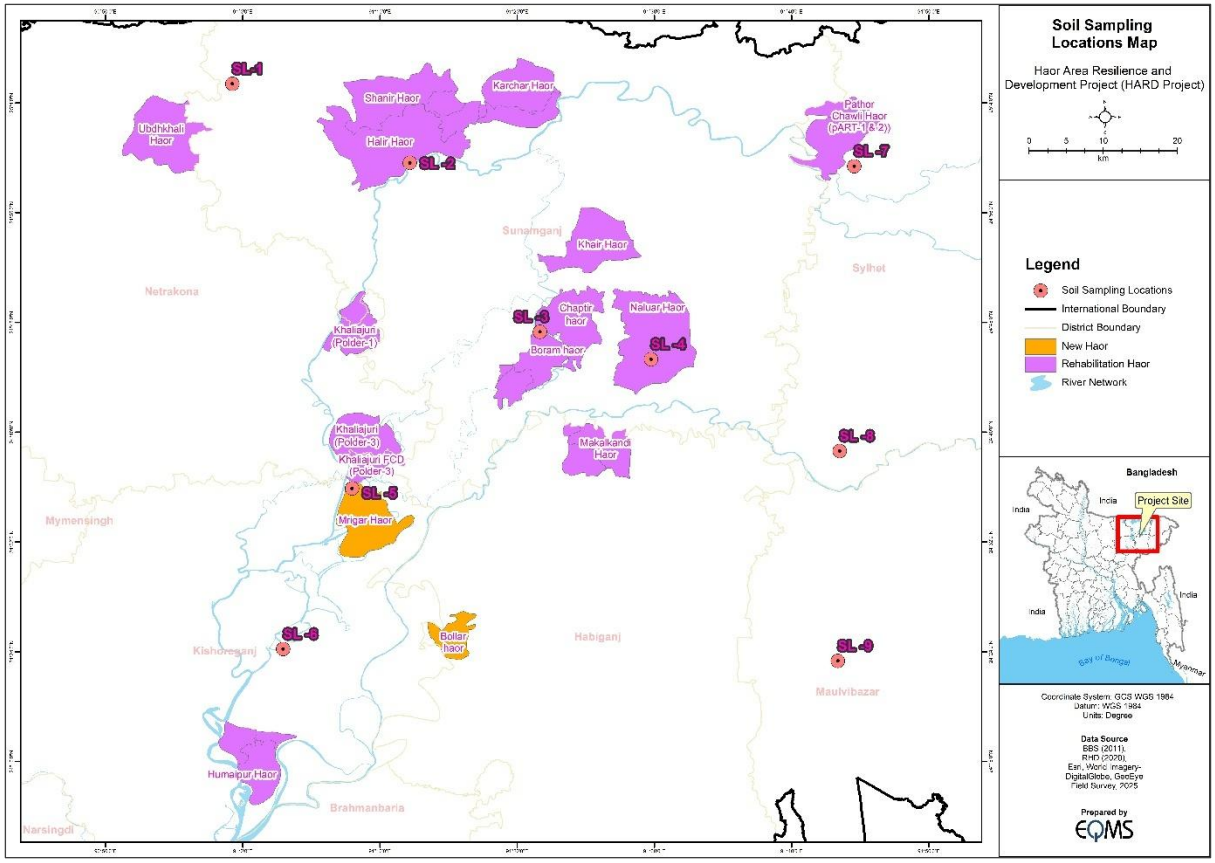
Table 7-12: Soil sampling locations

Sampling Locations	Coordinates	Monitoring Date	Location Description
SL-1	25°05’23.76”N 90°59’14.47”E	24 May 2025	Gurmar Haor
SL-2	24°59’37.75”N 91°12’10.76”E	25 May 2025	Halir Haor
SL-3	24°47’19.20”N 91°21’39.50”E	26 May 2025	Chaptir Haor
SL-4	24°45’19.20”N 91°29’45.50”E	27 May 2025	Naluar Haor
SL-5	24°35’54.40”N 91°07’58.30”E	28 May 2025	Mrigar Haor
SL-6	24°24’12.10”N 91°02’56.80”E	29 May 2025	Kazir Kola Boro Haor
SL-7	24°59’23.20”N 91°44’33.70”E	30 May 2025	Pathor Chauli Haor

Sampling Locations	Coordinates	Monitoring Date	Location Description
SL -8	24°38'38.08"N 91°43'30.08"E	31 May 2025	Muktarpur Haor
SL -9	24°23'20.40"N 91°43'22.42"E	1 Jun 2025	Hail Haor

Source: Study Team, 2025

Figure 7-12: Monitoring location map



Source: Study Team, 2025

7.1.5.1 Result Analysis

The analysis result of the soil sample is given in Table 7-13.

Table 7-13: Analysis result of soil sample

Parameters		Unit	SL-1	SL-2	SL-3	SL-4	SL-5	SL-6	SL-7	SL-8	SL-9
pH		-	5.5	6.2	5.6	5.8	6.2	5.9	6.3	6.4	5.7
Soil Texture	Type	-	Sandy Loam	Loamy Sandy	Loam	Loam	Sandy Loam	Loamy Sandy	Loam	Loam	Loamy Sandy
	Sand	%	48.82	80.98	43.80	37.73	56.73	81.66	35.21	40.69	80.59
	Silt	%	23.67	15.10	43.00	42.94	28.28	14.55	38.93	37.23	10.64
	Clay	%	27.51	3.93	13.20	19.33	14.99	3.79	25.86	22.08	8.77
TOC		mg/kg	40868	30210	20034	48016	15817	11081	17256	17980	15919
Total N		%	0.16	0.13	0.12	0.21	0.10	0.11	0.09	0.07	0.07
Total P		mg/kg	1670	2280	1711	3.37	3.29	1517	774	3.82	3.78

Parameters	Unit	SL-1	SL-2	SL-3	SL-4	SL-5	SL-6	SL-7	SL-8	SL-9
Total K	mg/kg	757	710	403	305	890	1066	156	160	206

Source: Study Team, 2025

Soil pH is an important factor controlling nutrient availability and plant growth. The soils in the study area showed pH values ranging from 5.5 to 6.4, which indicates that the soils are slightly acidic in nature. This acidity may influence the solubility of nutrients, particularly phosphorus and certain micronutrients, though it also falls within the tolerable range for many crops that prefer mildly acidic conditions.

The texture of the soil varies across the sampling sites and is classified as sandy loam, loamy sand, and loam. Sand content was highest in SL-2 and SL-6, suggesting lower water and nutrient retention in these soils, while loam-dominated sites such as SL-3 and SL-4 have higher proportions of silt and clay, providing better structure and fertility potential.

The organic carbon content ranged between 11,081 mg/kg and 48,016 mg/kg, with the highest value recorded at SL-4, indicating a good presence of organic matter and potential for supporting soil microbial activity. Total nitrogen concentrations varied between 0.07% and 0.21%, with higher values generally corresponding to soils with elevated organic carbon.

Phosphorus concentrations in most samples ranged between 774 mg/kg and 2,280 mg/kg, though some samples reported values as low as 3.29–3.82 mg/kg, which suggests inconsistencies or possible localized nutrient deficiency. Potassium concentrations varied from 156 mg/kg to 1,066 mg/kg, with SL-6 showing the highest level. The variation in potassium values points to uneven distribution, where some soils are well-supplied and others would require supplementation for sustainable crop production.

The analysis indicates that soils in the study area are generally slightly acidic with variable fertility potential. Sites with higher organic carbon and nitrogen, such as SL-1 and SL-4, are better suited for supporting healthy crop yields, while soils with low phosphorus and potassium, particularly SL-7 to SL-9, require soil amendments to improve productivity.

7.1.6 River Bottom Sediment Quality

The river bottom sediment quality of the study area is assessed through primary monitoring. As part of this study, river bottom sediment quality was monitored in nine (9) locations - at the proposed project area.

A river bottom sediment sampling procedure was followed by the AECL to ensure the quality of river bottom sediment sample collection. The sample was stored in a plastic jar, sealed, and sent to the laboratory for analysis. The detail of the river bottom sediment sampling location is presented in Table 7-14. Primary river bottom sediment monitoring also includes analysis of heavy metals with the objective of establishing baseline values for such contaminants (if present in the river bottom sediment).

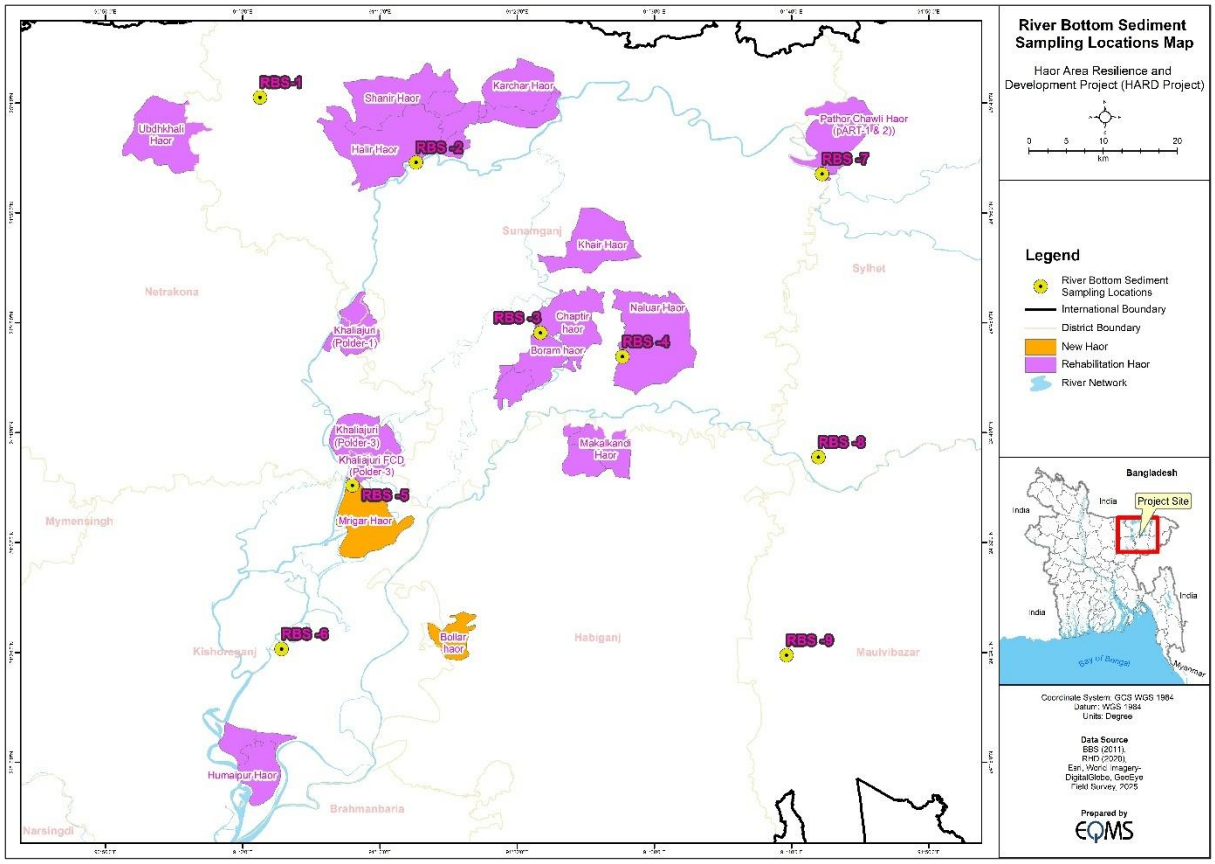
Table 7-14: River Bottom Sediment Sampling Locations

Sampling Locations	Coordinates	Monitoring Date		Location Description
		Dry Season	Wet Season	
RBS-1	25°04’24.43”N 91°01’15.49”E	24 May 2025	28 Aug 2025	Gurmar Haor
RBS-2	24°59’40.48”N 91°12’37.82”E	25 May 2025	27 Aug 2025	Halir Haor
RBS-3	24°47’16.60”N 91°21’41.90”E	26 May 2025	26 Aug 2025	Chaptir Haor

Sampling Locations	Coordinates	Monitoring Date		Location Description
		Dry Season	Wet Season	
RBS-4	24°45'32.30"N 91°27'40.40"E	27 May 2025	30 Aug 2025	Naluar Haor
RBS-5	24°36'10.60"N 91°07'59.80"E	28 May 2025	21 Aug 2025	Mrigar Haor
RBS-6	24°24'15.20"N 91°02'49.40"E	29 May 2025	20 Aug 2025	Kazir Kola Boro Haor
RBS-7	24°58'50.50"N 91°42'13.30"E	30 May 2025	22 Aug 2025	Pathor Chauli Haor
RBS-8	24°38'13.45"N 91°41'57.56"E	31 May 2025	23 Aug 2025	Muktarpur Haor
RBS-9	24°23'48.12"N 91°39'37.69"E	1 Jun 2025	24 Aug 2025	Hail Haor

Source: Study Team, 2025

Figure 7-13: Monitoring location map



Source: Study Team, 2025

7.1.6.1 Result Analysis

The analysis result of the river bottom sediment samples is given in Table 7-15.

Table 7-15: Analysis result of river bottom sediment samples

Parameters	Unit	Concentration																	
		RBS-1		RBS-2		RBS-3		RBS-4		RBS-5		RBS-6		RBS-7		RBS-8		RBS-9	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Temperature	°C	24.8	24.7	25.0	25.2	25.2	25.0	24.7	24.8	25.1	25.1	24.7	24.7	25.3	24.8	25.2	25.3	24.7	25.0
Sulfide	mg/kg	<0.05	<1.0	<0.05	<1.0	<0.05	<1.0	<0.05	<1.0	<0.05	<1.0	<0.05	<1.0	<0.05	<1.0	<0.05	<1.0	<0.05	<1.0
Organic Matter	%	0.52	3.023	0.72	1.838	1.65	2.522	1.86	3.283	1.14	2.783	0.62	1.685	0.56	2.588	0.62	5.988	0.41	5.926
Mercury (Hg)	mg/kg	0.56	<0.001	0.22	<0.001	0.28	<0.001	0.52	<0.001	1.02	<0.001	0.90	<0.001	0.97	<0.001	0.66	<0.001	0.35	<0.001
Cadmium (Cd)	ppm	0.30	<0.001	0.48	<0.001	0.48	<0.001	0.37	<0.001	0.17	<0.001	0.15	<0.001	0.65	<0.001	0.03	<0.001	0.61	<0.001
Lead (Pb)	ppm	20.03	7.29	32.26	4.15	16.70	5.99	20.03	22.2	17.81	10.2	17.81	3.07	25.59	7.44	22.26	6.92	6.68	7.50
Organic Phosphorus	mg/kg	2253	<0.002	3254	<0.002	2884	<0.002	2717	<0.002	1899	<0.002	1938	<0.002	2179	<0.002	1785	<0.002	241	59267
Nitrogen (N)	%	0.03	0.13	0.04	ND	0.09	ND	0.10	0.74	0.06	0.56	0.04	ND	0.03	ND	0.03	0.58	0.02	0.46
Chromium (Cr^{6+})	ppm	51.95	12.1	61.27	12.7	43.66	13.5	45.61	179	55.87	15.4	50.98	12.6	56.85	16.7	52.93	10.6	28.18	8.94
Arsenic (As)	mg/kg	2.32	2.69	4.75	2.57	1.38	4.53	2.19	23.7	3.06	1.96	1.11	3.41	1.68	1.51	1.11	0.73	1.68	1.00
Copper (Cu)	ppm	1.67	11.9	1.84	13.0	1.72	11.3	1.82	17.9	1.94	20.8	2.10	11.2	2.08	12.5	1.37	12.0	0.27	30.0
Zinc (Zn)	ppm	2.04	28.7	1.60	33.6	4.71	34.9	5.61	34.8	1.66	38.3	0.57	31.3	0.84	31.1	0.59	34.9	0.54	35.8
Fluorine (F)	mg/kg	<0.5	5.06	0.88	6.50	0.93	10.7	0.95	2.69	1.06	4.80	0.94	6.51	1.15	3.75	1.03	6.38	1.47	<0.5
Sodium (Na)	mg/kg	302	77.8	119	105	155	94.5	227	170	131	159	122	122	150	113	169	93.3	81.6	58.8
Potassium (K)	meq/100g soil	0.19	1.77	0.28	2.14	0.54	1.83	0.55	4.57	0.25	2.15	0.33	2.55	0.19	2.69	0.17	1.71	0.10	1.49
Chlorine (Cl)	mg/kg	48.7	639	2.27	22.4	10.3	17.6	4.06	39.0	6.48	29.4	1.23	30.6	4.42	32.1	7.93	50.8	1.89	11.7
Calcium (Ca)	meq/100g soil	4.69	5.27	10.27	3.75	6.55	1.41	5.99	2.83	2.78	2.8	3.64	4.97	5.06	2.62	2.39	3.29	0.54	102.61
Magnesium (Mg)	meq/100g soil	1.83	2.31	2.31	15.65	1.09	6.92	1.03	5.14	1.24	7.64	1.14	23.01	2.62	8.87	2.80	7.19	0.92	12.20

Source: Study Team, 2025

The analysis of river bottom sediment samples, as presented in Table 7-15, provides insight into the physical, chemical, and heavy metal characteristics of the sediments across nine locations.

Temperature

Soil temperatures at the nine sampling sites ranged from 24.7–25.3°C across both dry and wet seasons, showing minimal seasonal variation. The stable temperature reflects the buffering effect of soil and sediment on ambient temperature fluctuations, as well as uniform seasonal conditions in the Haor Region. While there is no specific Bangladesh standard for soil temperature, these values are typical for agricultural and wetland soils.

Sulfide

Sulfide concentrations were below detection limits (<0.05 mg/kg in the dry season and <1.0 mg/kg in the wet season) across all sites. The slight increase in the wet season may be attributed to anaerobic conditions in waterlogged soils, which can promote limited microbial reduction of sulfur compounds. All observed values are well below levels of environmental concern, indicating minimal sulfide accumulation in sediments.

Organic Matter

Organic matter content increased in the wet season, ranging from 0.41–1.86% in the dry season to 1.685–5.988% in the wet season. The increase is due to seasonal deposition of plant debris, leaf litter, and other organic inputs during monsoon flooding. Higher organic matter enhances soil fertility but may also influence nutrient cycling and redox conditions. The values are typical for floodplain soils and suggest that sediments are a significant reservoir of organic carbon.

Mercury

Mercury concentrations were relatively high in the dry season, ranging from 0.22–1.02 mg/kg, but dropped below detection limits (<0.001 mg/kg) in the wet season. The decrease is likely due to dilution or redistribution of surface sediments during flooding, reducing localized accumulation. Although dry-season values are elevated, wet-season values indicate minimal mercury mobility and a low risk of contamination under normal hydrological conditions.

Cadmium

Cadmium levels varied from 0.03–0.65 mg/kg in the dry season and fell below detection limits (<0.001 mg/kg) in the wet season. Seasonal reduction is likely due to dilution, sediment deposition, and leaching during monsoon inflows. The dry-season concentrations are moderate but not unusual for floodplain soils, while wet-season levels indicate minimal risk of heavy metal toxicity.

Lead

Lead concentrations ranged from 6.68–32.26 mg/kg in the dry season and 3.07–22.2 mg/kg in the wet season. While there is a slight decrease during the wet season, some sites still retain moderate Pb levels, reflecting either historical deposition, local anthropogenic sources, or natural geogenic contributions. Compared with the common reference guideline of 50 mg/kg for agricultural soils, all sites are below critical levels, although site-specific monitoring may be warranted.

Organic Phosphorus

Organic phosphorus content was very high in the dry season, ranging from 241–3254 mg/kg, but decreased to near-undetectable levels (<0.002 mg/kg) at most sites in the wet season. The sharp seasonal reduction likely results from dilution, sediment redistribution, and microbial mineralization during monsoon flooding. Elevated dry-season values suggest nutrient-rich sediments capable of supporting aquatic productivity during low-water periods.

Nitrogen

Nitrogen levels ranged from 0.02–0.10% in the dry season and increased in the wet season to 0.13–0.74% at sites where nitrogen was detectable. The wet-season increase is linked to accumulation of organic residues, plant litter, and flood-deposited nutrients. Nitrogen enrichment during monsoon can enhance sediment fertility and influence nutrient cycling but remains within safe limits for natural soils.

Chromium

Chromium (hexavalent) concentrations ranged from 28.18–61.27 mg/kg in the dry season and from 8.94–179 mg/kg in the wet season, showing considerable site-specific increases, particularly at SW-4 (179 mg/kg). The elevated wet-season concentrations may result from sediment redistribution and concentration in low-lying areas, possibly influenced by natural geogenic sources. Some wet-season readings approach or exceed typical guideline limits (50 mg/kg), indicating potential environmental concern at certain sites.

Arsenic

Arsenic ranged from 1.11–4.75 mg/kg in the dry season and 0.73–23.7 mg/kg in the wet season. The notable increase at specific sites during the wet season (e.g., 23.7 mg/kg) is likely due to monsoonal redistribution of As-rich sediments from upstream or local geogenic sources. Most other sites remain within moderate levels, but the high wet-season value may require monitoring for ecological risk.

Copper

Copper concentrations were low in the dry season (0.27–2.10 mg/kg) but increased significantly in the wet season (11.2–30.0 mg/kg), likely due to floodwater deposition, sediment mobilization, or anthropogenic inputs. The increase suggests seasonal accumulation of copper in topsoil, which could influence microbial activity and plant uptake, though levels remain below severe contamination thresholds.

Zinc

Zinc content ranged from 0.54–5.61 mg/kg in the dry season and increased to 28.7–38.3 mg/kg in the wet season. The rise is consistent with sediment redistribution and deposition during flooding, highlighting the sediments as a significant reservoir of micronutrients. Seasonal variation is pronounced but still generally below levels associated with toxicity for soils.

Fluoride

Fluoride concentrations were low in the dry season (0.88–1.47 mg/kg) but increased at some sites during the wet season (2.69–10.7 mg/kg), likely due to sediment-bound fluoride being redistributed during monsoon flooding. Most sites remain within safe natural levels, although a few locations with higher wet-season values may require monitoring to prevent accumulation in crops or groundwater.

Sodium

Sodium content decreased during the wet season at most sites, from 81.6–302 mg/kg in the dry season to 58.8–170 mg/kg in the wet season, reflecting dilution and leaching from floodwaters. Seasonal variation indicates natural mobility of sodium in the Haor sediments, and observed values are within the typical range for freshwater-influenced soils.

Potassium

Potassium concentrations were low in the dry season (0.10–0.55 meq/100g) but increased during the wet season (1.49–4.57 meq/100g), likely due to nutrient-rich floodwater deposition and organic matter contribution. This seasonal enrichment enhances soil fertility and reflects the dynamic nutrient cycling in the Haor sediments.

Chloride

Chloride levels ranged from 1.23–48.7 mg/kg in the dry season and increased dramatically in the wet season (11.7–639 mg/kg), primarily due to floodwater deposition and possible runoff inputs. The seasonal rise is site-specific, with some areas showing very high wet-season chloride, which may have implications for salinity-sensitive crops or soil chemistry.

Calcium

Calcium ranged from 0.54–10.27 meq/100g in the dry season and 1.41–102.61 meq/100g in the wet season, showing substantial enrichment at certain sites, likely due to deposition of riverine or flood sediments. Seasonal variation highlights the contribution of monsoon waters to soil base saturation and fertility.

Magnesium

Magnesium concentrations varied from 1.03–2.80 meq/100g in the dry season and 2.31–23.01 meq/100g in the wet season, reflecting sediment deposition and mineral inputs during floods. Seasonal enrichment increases cation availability in sediments but may also affect soil structure and water retention in high-Mg areas.

Overall, the river bottom sediments in the Haor Region exhibit clear seasonal variations. During the dry season, most heavy metals (Hg, Cd, Pb, Cr6+, As, Cu, Zn) and nutrients (organic matter, nitrogen, phosphorus) show moderate accumulation, while wet season flooding leads to dilution, redistribution, and localized enrichment at certain sites. Organic matter and nutrient content increase in the wet season due to deposition of plant residues and floodborne sediments, enhancing sediment fertility. Heavy metals generally decrease in the wet season, though some elements like Cr, Cu, Zn, and Cl show site-specific enrichment, reflecting sediment transport and localized inputs. Overall, the sediments remain within safe limits for most parameters, supporting ecological functions, nutrient cycling, and aquatic productivity, but certain hotspots may require monitoring for metals and salts.

7.2 Biological Environment

7.2.1 Terrestrial Ecosystem

7.2.1.1 Habitat

Terrestrial habitat of the haor based ecosystem includes agriculture land, homestead plantation, and roadside plantations (Appendix E-5). These habitats are largely modified in nature, having been shaped and altered over time by human activities. Despite these modifications, they continue to retain some original ecological functions and characteristics, supporting both biodiversity and local livelihoods.

7.2.1.1.1 Homestead Vegetation

A characteristic feature of the homestead landscape in the haor region is the presence of diverse plant and fruiting tree species that create a green panoramic view and contribute to local livelihoods. Across all haor study areas, similar patterns of homestead vegetation were observed, reflecting a consistent land use practice throughout the region. Common species include Hijol (*Barringtonia acutangular*), Koroch (*Dalbergia reniformis*), Jarul (*Lagerstroemia speciosa*), Coconut (*Cocos nucifera*), Jackfruit (*Artocarpus heterophyllus*), Mango (*Mangifera indica*), Guava (*Psidium guajava*), Papaya (*Carica papaya*), Lemon (*Citrus sp.*), Java Plum (*Syzygium cumini*), Areca palm (*Areca catechu*), Banana (*Musa sp.*), Raintree (*Samanea saman*), etc. This vegetation not only enhances the aesthetic and ecological value of the homestead environment but also provides essential habitats and food sources for a variety of wildlife species. Birds, herpetofauna (amphibians and reptiles), and small mammals were frequently observed in and around homestead plantations during the survey. Such vegetation thus plays an important role in maintaining biodiversity within the otherwise modified terrestrial ecosystem of the haor region.

7.2.1.1.2 Agricultural Lands

Agricultural habitats represent the most dominant habitat type across all haor study areas, where similar land-use patterns and practices were observed. These lands are primarily used for paddy cultivation, with water sourced from groundwater, rivers, and larger water bodies. During the dry season, Boro paddy is extensively cultivated in areas with access to irrigation, and the Boro–Fallow–Fallow pattern is the most common cropping sequence throughout the study area. In addition to paddy, farmers also cultivate crops such as chili, onion, pumpkin, and tomato. Although highly modified, agricultural lands provide seasonal foraging and roosting habitats for various bird species, while post-harvest fields support grazing, soil enrichment, and ecosystem connectivity within the haor landscape.

7.2.1.1.3 Roadside Vegetation

Roadside plantations are a common habitat across all haor study areas, providing a suitable living environment for a variety of plant and animal species. Vegetation planted along roadsides often creates localized microclimates that differ from surrounding agricultural or settlement areas, offering unique conditions for certain species to thrive. Common floral species recorded include Areca Palm (*Areca catechu*), Mango (*Mangifera indica*), Eucalyptus (*Eucalyptus* sp.), and Raintree (*Samanea saman*), among others. Much of the roadside vegetation consists of non-native species, primarily planted for fuel, timber, shade, and aesthetic purposes. Due to the high degree of human intervention in species selection and management, roadside plantations are classified as a Modified Habitat. Despite being planted, roadside vegetations support biodiversity by providing perching, nesting, and foraging habitats for birds, small mammals, and herpetofauna, while also contributing to microclimatic regulation and landscape connectivity within the haor region.

7.2.1.2 Terrestrial Flora

The quadrat sampling method was used for assessing the vegetation structure in the study area. The sampling plot size was considered 10 m x 10 m for trees, 5 m x 5 m for shrubs and 1 m x 1 m for herbs. All the trees, herbs and shrubs within the study plots were counted and their taxonomic identification were recorded. Habitat-wise direct observations were also employed to document the floral species present in the study area.

During the dry-season baseline survey, a total of 39 terrestrial floral species belonging to 19 families were recorded, while in the wet season, 44 terrestrial floral species representing 24 families were documented from the study area. The dominant families were Fabaceae (7 species), Myrtaceae (3 species), and Arecaceae (3 species). Fruit-bearing trees were the most common group, followed by timber, medicinal, and ornamental species.

Common species such as Mango (*Mangifera indica*), Jackfruit (*Artocarpus heterophyllus*), Guava (*Psidium guajava*), Coconut (*Cocos nucifera*), and Mahogany (*Swietenia mahagoni*) were present in almost all haor areas. In contrast, ornamental species like Krisnachura (*Delonix regia*) and Debdaru (*Polyalthia longifolia*) were more site-specific.

Species richness was highest in Gurmar, Halir, and Chaptir Haors (n = 42 species each), while the lowest diversity (n = 40 species each) was observed in Naluar and Mrigar Haors. The number of floral species recorded in the dry and wet seasons across all sampling haor areas is presented in Appendix D-1. Some photographs of tree species observed in the study area are presented in Appendix E-1.

7.2.1.3 Terrestrial Fauna

For terrestrial fauna (amphibians, reptiles, birds, and mammals), transect line surveys (1000 m × 100 m) were conducted. All faunal surveys were carried out simultaneously. In addition to transect surveys, Visual Encounter Surveys (VES) and opportunistic surveys were also used to document terrestrial fauna species. Focus Group Discussions (FGDs) were conducted with local communities to gather traditional ecological knowledge regarding wildlife, while Key Informant Interviews (KIIs) were held with Forest

Department officials, wildlife experts, and representatives from conservation NGOs to obtain information on species presence in the study area.

7.2.1.3.1 Herpetofauna

The baseline survey conducted as part of this project recorded a total of 15 herpetofaunal species. During the dry season, 12 species were observed in the study area, while the wet season survey documented 10 species of amphibians and reptiles. Among these, eight species are amphibians, and seven are reptiles. The most widespread species is the Asian Common Toad (*Duttaphrynus melanostictus*), found in all haor study area. Conversely, the least widespread species is the Common Tree Frog (*Polypedates leucomystax*), found only in five haors. Regarding species diversity, Gurmar Haor and Mrigar Haor support the highest number of species, each hosting all 10 species, while Chaptir Haor has the lowest, with 8 species.

According to the IUCN Red List of Threatened Species of Bangladesh (2015), all 15 species are classified as Least Concern (LC) nationally. Globally, according to the IUCN Red List (Version 2024-2), most species (11) are LC, while four species the Asmat's Cricket Frog (*Fejervarya asmati*), Checkered Keelback (*Xenochrophis piscator*), Common Garden Lizard (*Calotes versicolor*), and Bronze Grass Skink (*Eutropis macularia*) are Not Evaluated (NE), and Peacock Soft-shelled Turtle (*Nilssonia hurum*) is Endangered (EN) globally. A list of all recorded herpetofauna species by haor areas are provided in Appendix D-4, and a photo plate of some observed herpetofauna species are shown in Appendix E-3.

7.2.1.3.2 Avifauna

The study recorded a total of 61 bird species from 27 families. Of these, 43 species from 21 families were observed during the dry season, while 59 species representing 27 families were documented across different haor areas in the wet season. Notable species found in all haors areas include the Great Cormorant (*Phalacrocorax carbo*), Grey Heron (*Ardea cinerea*), Great White Egret (*Ardea alba*), Barn Swallow (*Hirundo rustica*), Indian Spot-billed Duck (*Anas poecilorhyncha*), and Common Kingfisher (*Alcedo atthis*), showing their wide distribution. On the other hand, species like the Common Iora (*Aegithina tiphia*), Striated Grassbird (*Megalurus palustris*), and Paddyfield Pipit (*Anthus rufulus*) were recorded in fewer haors, indicating a more limited presence. Gurmar Haor and Mrigar Haor hosted the highest number of species (n = 41 each), whereas Chaptir and Pathor Chauli had slightly lower (n = 39 each) species richness.

According to the IUCN Red List of Threatened Species of Bangladesh (2015), all 61 species are considered Least Concern (LC) nationally. On the other hand, as per Global IUCN Red List Status (Version 2024-2), the majority of species are also listed as LC, except for the Oriental Darter (*Anhinga melanogaster*), which is categorized as Near Threatened (NT). A complete list of all avian species recorded during the dry and wet seasons is provided in Appendix D-2, and. a Photoplate of some observed bird species are shown in Appendix E-2.

Migratory Winter Birds: All study haor areas serve as important foraging grounds for migratory winter birds. A total of 20 migratory winter bird species are expected to occur in the haor study area as per secondary data source[28] (Appendix D-3). These species belong to a diverse range of families, including Scolopacidae, Anatidae, Charadriidae, Rallidae, Phalacrocoracidae, Podicipedidae, Anhingidae, Laridae, Threskiornithidae, Pandionidae, Accipitridae, and Motacillidae.

Most of the recorded species, such as the Common Sandpiper (*Actitis hypoleucos*), Common Teal (*Anas crecca*), and Great Cormorant (*Phalacrocorax carbo*), are classified as Least Concern (LC) on both the national and global IUCN Red List. However, the Grey-headed Lapwing (*Vanellus cinereus*) is listed as Near Threatened (NT), indicating its relatively higher conservation concern.

[28] https://ebird.org/

7.2.1.3.3 Terrestrial Mammal

During the baseline biodiversity survey, a total of twelve mammal species representing seven families were recorded from the study area. Of these, eight species were observed during the dry season and eight during the wet season survey. The most widespread species, found in all study haors, include the Indian Flying Fox (*Pteropus giganteus*), Indian Pipistrelle (*Pipistrellus coromandra*), Lesser and Greater Bandicoot Rats (*Bandicota bengalensis* and *Bandicota indica*), Common House Rat (*Rattus rattus*), Asian House Shrew (*Suncus murinus*), and Small Indian Mongoose (*Herpestes auropunctatus*). The least widespread species was the Golden Jackal (*Canis aureus*), recorded in only six haors. Secondary data sources suggested that the Bengal Fox (*Vulpes bengalensis*), Fishing Cat (*Prionailurus viverrinus*), and Eurasian Otter (*Lutra lutra*) may also occur in the study area[29].

According to the IUCN Red List of Threatened Species of Bangladesh (2015), all species are classified as Least Concern (LC), and the Global IUCN Red List of Threatened Species (Version 2024-2), all species are also listed as LC. Among the species identified from secondary sources, the Bengal Fox (*Vulpes bengalensis*) is categorized as Vulnerable (VU), the Fishing Cat (*Prionailurus viverrinus*) as Endangered (EN), and the Eurasian Otter (*Lutra lutra*) as Critically Endangered (CR) according to the IUCN Red List of Threatened Species of Bangladesh (2015). A complete list of all terrestrial mammal species recorded during the dry and wet seasons is presented in Appendix D-5.

7.2.2 Aquatic Ecosystem

7.2.2.1 Habitat

The aquatic ecosystems of the haor areas, located in the floodplain region of north-eastern Bangladesh, are both diverse and ecologically significant. These areas form an extensive wetland ecosystem that spreads across the landscape. The haor ecosystems support a wide range of habitat types, which are home to diverse wildlife, including birds, amphibians, reptiles, mammals, insects, mollusks, and freshwater fish. The classification of these habitat types is based on field observations, ecological preferences, and species occurrence. Each habitat plays a vital role in maintaining the region's biodiversity and supporting local livelihoods. Photographs of different types of aquatic habitats within the project study area are presented in Appendix E-6.

7.2.2.1.1 Waterbodies

These include beels, ponds, flooded lowlands, ditches, and seasonal wetlands. They serve as critical aquatic habitats for fish, mollusks, crabs, amphibians, and waterbirds. Beels in haor areas retain water during the dry season, offering refuge for aquatic fauna and supporting wintering and resident bird populations. Aquatic plants in these waterbodies also provide food and breeding grounds for invertebrates and amphibians.

7.2.2.1.2 Rivers and Streams

Rivers flowing through the haor areas act as vital ecological corridors, facilitating the movement and dispersal of aquatic organisms, including fish. These essential watercourses support a diverse array of life by serving as critical breeding habitats for freshwater fish, mollusks, and waterbirds. They are also integral to the ecosystem's health, as they are responsible for crucial processes like nutrient cycling and sediment transport, which in turn enhances the fertility of surrounding wetlands and croplands.

These river and streams are not only sustaining aquatic and riparian biodiversity but also enhance connectivity among the haors. This connectivity is vital for the movement of species, which helps to

[29] IUCN Bangladesh. 2015. Red List of Bangladesh Volume 2: Mammals. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. xvi+232.

maintain genetic diversity and supports the overall resilience and ecological balance of the entire wetland ecosystem.

7.2.2.1.3 Hijal-Koroch Vegetation and Swamp Forest Patches

Small patches of swamp forest, dominated by Hijal (*Barringtonia acutangula*) and Koroch (*Pongamia pinnata*), are found in low-lying wetland areas. These act as nesting and roosting sites for birds like herons, cuckoos, and support amphibians and aquatic insects during the monsoon. They also contribute to flood mitigation and water retention.

7.2.2.2 Marshy Vegetation

Patches of marsh vegetation, particularly Hogla (*Typha* spp.) and Nol (*Phragmites* spp.), offer essential cover for wetland birds, breeding amphibians, and invertebrates. These zones are also harvested by locals for mat weaving and fuel, making them economically significant as well.

Each habitat type in haor plays a crucial ecological role in sustaining local biodiversity and supporting traditional land use practices. Understanding these habitats and their interdependencies is essential for conservation planning, ecological research, and sustainable resource management in the region.

7.2.2.3 Aquatic Flora

Aquatic flora plays a vital role in maintaining the ecological balance of Haor ecosystems by supporting primary productivity, providing food and shelter for aquatic fauna, stabilizing soil and sediment, and improving water quality. The Haor wetlands are rich in diverse aquatic plant species that contribute significantly to the ecological integrity and livelihoods of surrounding communities. The baseline survey conducted as part of this study recorded a total of 37 aquatic floral species of 18 families. During the dry season, 23 species were documented in the study area, while in the wet season, 31 species were recorded. Major species recorded in the project area include Water fern (*Azolla filiculoides*), Common water hyacinth (*Eichhornia crassipes),* Water spinach (*Ipomoea aquatica*), Pink morning glory (*Ipomoea carnea*), Red Water Lily (*Nymphaea rubra*), Blue Lotus (*Nymphaea nouchali*), Dwarf Copperleaf (*Alternantha sessilis*), Sedges (*Cyperus sp*.), Helencha (*Enhydra fluctuens*), Narrowleaf Cattail (*Typha angustata*), Alligator Weed (*Alternanthera philoxeroides*), Water Lettuce (*Pistia stratiotes*), Taro (*Colocasia esculenta*), Asian Watergrass (*Hygroryza aristata*), Water Primrose (*Jussiaea repens*), Greater Duckweed (*Spirodela polyrhiza*), Torpedo Grass (*Panicum repens*) and Water Chestnut (*Eleocharis sp*.), among others, which together form the foundation of the aquatic ecosystem. A complete list of aquatic flora is shown in Appendix D-10. Some pictures of Aquatic Macrophyte of the study area are presented in Appendix E-7.

7.2.2.4 Fisheries Resources

The prime objective of the fisheries study is to examine and evaluate the overall fisheries status in the study area of Gurmar, Halir, Chaptir, Naluar, Mrigar, Kazir Kola Boro, Pathor Chauli, Muktarpur, and Hail haor. The study involved FGD and consultation with local communities (Appendix B-4) and Key Informant Interviews (KII) with the Upazila Govt. Officials (Appendix B-3) to gather comprehensive information on fish diversity, abundance, and management practices. Some photos of fishing activities in the study area are presented in Appendix C-11.

Fisheries in the surveyed haors are carried out using a variety of traditional and modern methods, including angling, thela jal, current jal, ber jal, and different types of bamboo traps. To document species diversity and abundance, a boat-to-boat survey (Appendix C-10) was conducted across all haors, complemented by visits to local fish markets (Appendix C-9) to record capture species. This approach provided reliable information on the fisheries resources and their utilization within the haor ecosystem.

The fisheries survey conducted across the haors documented a total of 56 fish species. During the dry season, 27 species were recorded (Appendix D-6). During this season, Kazir Kola Boro, Hail, and Halir

Haors exhibited the highest fish diversity, while haors such as Mriga, Pathor Chauli, Muktarpur Chaptir, Naluar, and Gurmar showed lower species richness. In the wet season, a total of 51 fish and shrimp species were recorded across the surveyed haor areas representing a diverse range of families including Siluridae, Notopteridae, Channidae, Cyprinidae, Mastacembelidae, Bagridae, Nandidae, Palaemonidae, Schilbeidae, Osphronemidae, Ambassidae, and others. During wet season, Gurmar Haor, Halir Haor, Mrigar Haor, and Hail Haor exhibited the highest species diversity with 50-51 species each, while Chaptir Haor and Pathor Chauli Haor recorded relatively lower diversity with 40–42 species. According to the IUCN Red List of Threatened Species of Bangladesh (2015), 8 species are Endangered (EN), 5 species are Vulnerable (VU), 7 species are Near Threatened (NT), 1 species is Data Deficient (DD), 4 species are Not Evaluated (NE), and 31 species are Least Concern (LC) nationally. According to the Global IUCN Red List of Threatened Species (Version 2024-2), 1 species are Vulnerable (VU), 4 species are Near Threatened (NT), 8 species are Not Evaluated (NE), and the remaining 43 species are Least Concern (LC).

7.2.2.5 Plankton and Benthos Profile

For the qualitative study, plankton was collected by plankton net (No. 20 silk bottling cloth, mesh size: 45 µm) at predefined nine (9) sample collection points (Table 7-16 and Figure 7-14). After collection, they were preserved in 3% formalin and a few drops of Glycerin and Lugol's solution. After adding preservatives, they were brought to the laboratory for species identification and numerical abundance. Pictorial views of plankton sample collection are shown in Appendix C-7.

Benthos samples were collected by Ekman bottom grab sampler from predefined Nine (9) selected points of study area haor (Table 7-16 and Figure 7-14), and sediment from the sampler was taken into plastic bucket and mixed with water. Then the mixed water passed through a 0.5 mm mesh-sized hand-sieve to remove the waste particles, and the separated macro-benthos with other residue were preserved in labeled plastic containers with 10% buffered formalin and transferred to the laboratory for further analysis. Organisms were sorted and enumerated under major taxa. An electric microscope was also used to identify benthos. Pictorial presentation of benthos sampling is given in Appendix C-8.

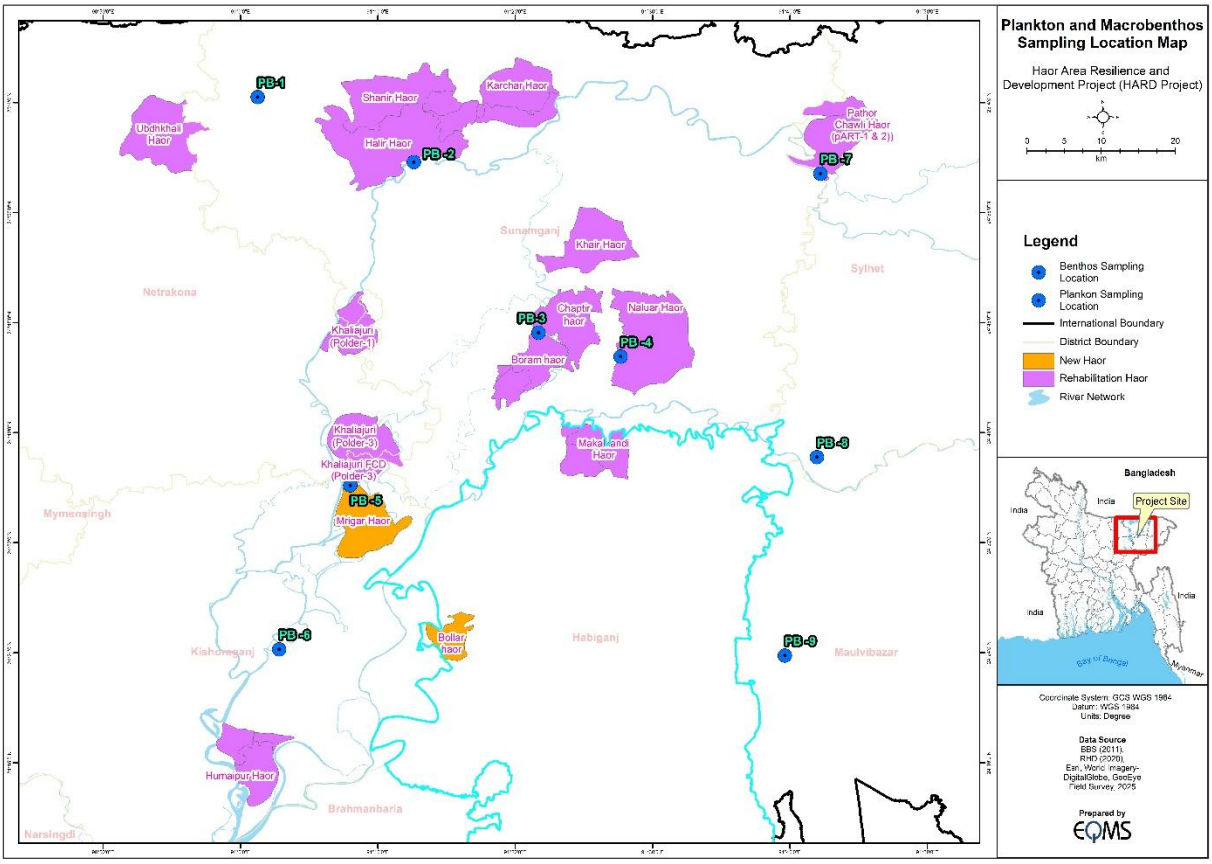
Table 7-16: Sampling points for plankton and benthos survey

S/N	Sample Point	Sample Location	Sample Code	Co-ordinates	Date	
					Dry	Wet
1	Gurmar Haor	Dharmapasha, Sunamganj	PB1	25°04'24.43"N 91°01'15.49"E	24.05.25	28.08.25
2	Halir Haor	Moddhyanagar, Tahirpur, Sunamganj	PB2	24°59'40.48"N 91°12'37.82"E	25.05.25	27.08.25
3	Chaptir Haor	Jamalganj, Sunamganj	PB3	24°47'15.50"N 91°21'46.60"E	26.05.25	26.08.25
4	Naluar Haor	Bishwamvarpur, Tahirpur, Sunamganj	PB4	24°45'32.90"N 91°27'45.50"E	27.05.25	30.08.25
5	Mrigar Haor	Derai, Kishoreganj	PB5	24°36'12.10"N 91°07'56.60"E	28.05.25	21.08.25
6	Kazir Kola Boro Haor	Jagannathpur, Kishoreganj	PB6	24°24'22.90"N 91°02'52.20"E	29.05.25	20.08.25
7	Pathor Chauli Haor	Companiganj, Sylhet	PB7	24°58’50.50”N 91°42’13.30”E	30.05.25	22.08.25

S/N	Sample Point	Sample Location	Sample Code	Co-ordinates	Date	
					Dry	Wet
8	Muktarpur Haor	Mithamoin, Austogram, Sylhet	PB8	24°38'13.45"N 91°41'57.56"E	31.05.25	23.08.25
9	Hail Haor	Companiganj, Moulvibazar Sadar	PB9	24°23'48.12"N 91°39'37.69"E	01.06.25	24.08.25

Source: JICA Survey Team, 2025

Figure 7-14: Map Showing Plankton and Macrobenthos Sampling Locations



Source: JICA Survey Team, 2025

7.2.2.5.1 Phytoplankton

The baseline survey recorded a total of 23 phytoplankton species from the study haor. During dry season, 17 phytoplankton species belonging to five major groups: Cyanobacteriaceae, Chlorophyceae, Diatomaceae, Euglenaceae, and Dinophyceae were recorded, while in the wet season, a total of 13 species were recorded, belonging to four major groups: Bacillariophyta, Chlorophyta, Euglenophyta, and Pyrrophyta. Bacillariophyta dominated the community, with species like *Melosira* sp., *Synedra* sp., *and Navicula* sp., showing high abundance in Gurmar, Halir, and Naluar Haors. Chlorophyta species, including *Microspora* sp., *Clostrium* sp., and *Ulothrix* sp., were more abundant in Kazir Kola Boro and Muktarpur Haors. Lesser numbers of Euglenophyta (*Euglena* sp.) and Pyrrophyta (*Ceratium* sp.) were observed across most haors. The variation in species composition and density indicates differences in water quality, nutrient availability, and ecological conditions among the haors, reflecting a diverse and productive aquatic ecosystem. A list phytoplankton found in sample location of the study area during study period shown in Appendix D-7.

7.2.2.5.2 Zooplankton

This study identified a total of 30 zooplankton species from the sampled haor areas. During the dry season, 25 species belonging to five major groups (Protozoa, Rotifera, Copepoda, Ostracoda, and Cladocera) were recorded across the nine surveyed haors, with Kazir Kola Boro Haor exhibiting the highest species richness. In contrast, 19 zooplankton species representing three major groups (Copepoda, Rotifera, and Cladocera) were recorded during the wet season. Copepods, including Diaptomus sp. and Cyclops sp., were widely distributed and particularly abundant in Kazir Kola Boro and Muktarpur Haors. A list of zooplankton found in sample location of the study area during study period shown in Appendix D-8.

7.2.2.5.3 Benthos

The baseline survey recorded a total of 23 benthic macroinvertebrate species from the study haor. During the dry season, 19 species representing five major groups (Platyhelminthes, Nematoda, Annelida, Arthropoda, and Mollusca) were identified, with Annelida consistently dominant, underscoring their ecological role in sediment and nutrient cycling. Kazir Kola Boro Haor exhibited the highest benthic diversity, while Naluar and Gurmar Haors showed the lowest. In the wet season, 13 benthic macroinvertebrate species were recorded across the nine surveyed haors, belonging to the same major groups as in the dry season. Among gastropods, Pila globosa was the most abundant and widely distributed species, with particularly high densities in Muktarpur, Pathor Chauli, and Kazir Kola Boro Haors. Other gastropods, such as Melania sp. and Thiara sp. (correction assumed from “rabic asp.”), showed patchy distributions across the haors. In the present study, macrobenthos abundance varied between 400 and 44 individuals per square meter (indv/m²), reflecting differences in sediment type, water quality, and habitat conditions across the haors. This highlights the ecological importance of these wetlands in supporting benthic biodiversity. A list of benthic species found in the sample location of the study area shown in Appendix D-9.

7.2.3 Haor Specific Wildlife Diversity

7.2.3.1 Wildlife Compositions of Gurmar Haor

Gurmar Haor, situated in Tahirpur Upazila of Sunamganj District, is one of the richest freshwater wetlands in Bangladesh, known for its high biodiversity. The faunal composition of this haor is described as follows.

7.2.3.1.1 Mammals

A total of eleven terrestrial mammal species were recorded in Gurmar Haor. These include two species of bats, one carnivore, four rodent species, and one insectivore. Notable species include the Indian Flying Fox (*Pteropus giganteus*) and the Golden Jackal (*Canis aureus*), indicating the presence of both arboreal and terrestrial habitats. All recorded species are classified as Least Concern (LC) at both national and global levels. The mammalian fauna of Gurmar Haor reflects a relatively stable ecosystem with common and adaptable species. A comprehensive list of mammals found in Gurmar Haor is provided in Appendix D-5.

7.2.3.1.2 Avifauna

Gurmar Haor supports a high diversity of avifauna, with records of more than 50 bird species across dry and wet seasons. The assemblage includes waterbirds, waders, raptors, passerines, and wetland-dependent species. Notable species include the Great Cormorant (*Phalacrocorax carbo*), Lesser Whistling Duck (*Dendrocygna javanica*), Asian Openbill (*Anastomus oscitans*), and various herons and egrets. One Near Threatened (NT) species, the Oriental Darter (*Anhinga melanogaster*), was recorded during the wet season. The dominance of waterbirds during the wet season highlights Gurmar Haor’s importance as a feeding and roosting habitat. A comprehensive list of avifauna of Gurmar Haor is given in Appendix D-2.

7.2.3.1.3 Herpetofauna

Gurmar Haor supports a diverse assemblage of herpetofauna, comprising both amphibians and reptiles. Recorded amphibians include the Asian Common Toad (*Duttaphrynus melanostictus*), Skipper Frog (*Euphlyctis cyanophlyctis*), Indian Bullfrog (*Hoplobatrachus tigerinus*), and Common Tree Frog (*Polypedates leucomystax*), all observed in both dry and wet seasons. Reptiles such as the Banded Krait (*Bungarus fasciatus*), Checkered Keelback (*Xenochrophis piscator*), and Common House Gecko (*Hemidactylus frenatus*) were also recorded. All species are classified as Least Concern (LC) at the national level, indicating a stable herpetofaunal community. A comprehensive list of herpetofauna of Gurmar Haor is given in Appendix D-4.

7.2.3.2 Wildlife Compositions of Halir Haor

The Halir Haor is situated in Jamalganj upazilla of Sunamganj district, considered the plenty of freshwater wetland in Bangladesh, is renowned for its high biodiversity and its faunal composition are described as follows.

7.2.3.2.1 Mammals

Halir Haor supports 10 terrestrial mammal species, primarily consisting of bats, rodents, and small carnivores across both wet and dry seasons. The Golden Jackal was not recorded in this haor. Species such as the Indian Pipistrelle (*Pipistrellus coromandra*), Bandicoot Rats, and Small Indian Mongoose (*Herpestes auropunctatus*) are common. All observed species fall under the Least Concern category, suggesting no immediate conservation concern for mammals in Halir Haor. A comprehensive list of mammals found in Halir Haor is provided in Appendix D-5.

7.2.3.2.2 Avifauna

Halir Haor supports a moderate diversity of bird species, during both wet and dry seasons. Commonly observed species include Long-tailed Shrike (*Lanius schach*), Barn Swallow (*Hirundo rustica*), Asian Palm Swift (*Cypsiurus balasiensis*), and several passerines. Waterbird presence was relatively lower compared to Gurmar Haor. All recorded species are categorized as Least Concern (LC), indicating no immediate conservation concern within this haor. A comprehensive list of avifauna of Halir Haor is given in Appendix D-2.

7.2.3.2.3 Herpetofauna

A total of five amphibian species were documented in Halir Haor during field surveys conducted in both the wet and dry seasons. Species such as the Asian Common Toad, Skipper Frog, and Asmat's Cricket Frog (*Fejervarya asmati*) were commonly observed. Reptile records were limited, with fewer species detected compared to other haors. All recorded species are categorized as Least Concern, suggesting no immediate conservation concerns. A comprehensive list of herpetofauna of Halir Haor is given in Appendix D-4.

7.2.3.3 Wildlife Compositions of Chaptir Haor

The Chaptir Haor is situated in Derai upazilla of Sunamganj district, considered the plenty of freshwater wetland in Bangladesh, is renowned for its high biodiversity and its faunal composition are described as follows.

7.2.3.3.1 Mammals

A total of 10 mammal species were documented in Chaptir Haor harbors, including bats, rodents, insectivores, and carnivores. The presence of the Golden Jackal indicates suitable foraging and shelter habitats. Rodent species such as *Bandicota bengalensis, Bandicota indica*, and *Rattus rattus* were widely recorded, reflecting the wetland–agricultural interface. All species are listed as Least Concern nationally and globally. A comprehensive list of mammals of Chaptir Haor is given in Appendix D-5.

7.2.3.3.2 Avifauna

Chaptir Haor supports a rich assemblage of birds, including waterfowl, waders, raptors, and songbirds. Species such as Great White Egret (*Ardea alba*), Indian Pond Heron (*Ardeola grayii*), Little Cormorant (*Microcarbo niger*), and Common Snipe (*Gallinago gallinago*) were frequently observed. Seasonal variation is pronounced, with significantly higher species richness during the wet season. All species recorded from this haor fall under the Least Concern category. A comprehensive list of avifauna of Chaptir Haor is given in Appendix D-2.

7.2.3.3.3 Herpetofauna

Chaptir Haor supports a mixed community of amphibians and reptiles. Amphibian species such as the Indian Bullfrog, Ornate Microhylid Frog (*Microhyla ornata*), and Asian Common Toad were recorded during both seasons. Reptiles including the Checkered Keelback and Common Garden Lizard (*Calotes versicolor*) were also observed. Species richness increased notably during the wet season, reflecting favorable breeding and foraging conditions. All species are listed as Least Concern. A comprehensive list of herpetofauna of Chaptir Haor is given in Appendix D-4.

7.2.3.4 Wildlife Compositions of Naluar Haor

The Naluar Haor is situated in Jagannathpur upazilla of Sunamganj district, considered the plenty of freshwater wetland in Bangladesh, is renowned for its high biodiversity and its faunal composition are described as follows.

7.2.3.4.1 Mammals

A total of 10 terrestrial mammal species were recorded from Naluar Haor as part of the baseline study conducted across the wet and dry seasons. The assemblage includes fruit bats, insectivorous bats, rodents, shrews, and the Golden Jackal. The diversity suggests a mosaic of open wetland edges, human settlements, and vegetation cover. All species recorded are categorized as Least Concern, indicating a stable mammalian community. A comprehensive list of mammals found in Naluar Haor is provided in Appendix D-5.

7.2.3.4.2 Avifauna

A total of 54 bird species were recorded as part of baseline study conducted across wet and dry season. The avifauna includes herons, egrets, ducks, raptors, cuckoos, kingfishers, and passerines. Species such as the Black Kite (*Milvus migrans*), Brahminy Kite (*Haliastur indus*), and Common Kingfisher (*Alcedo atthis*) indicate a well-functioning wetland ecosystem. No nationally or globally threatened bird species were recorded. A comprehensive list of avifauna found in Naluar Haor is provided in Appendix D-2.

7.2.3.4.3 Herpetofauna

A total of 10 herpetofauna species were recorded from Naluar Haor during the wet and dry seasons of the field study year. Among the amphibians, common species included the Asian Common Toad, Skipper Frog, Indian Bullfrog, and Asmat's Cricket Frog, which were widespread during both seasons. Reptiles, including the Common Garden Lizard and Common House Gecko, were also present. The dominance of amphibians indicates the availability of shallow water bodies and moist habitats in the area. All recorded species are classified as Least Concern. A comprehensive list of herpetofauna documented in Naluar Haor is provided in Appendix D-4.

7.2.3.5 Wildlife Compositions of Mrigar Haor

The Mrigar haor is situated in Itna upazilla of Kishoreganj district, considered the rich of freshwater wetland in Bangladesh, is abundance for its high biodiversity and its faunal composition are described as follows.

7.2.3.5.1 Mammals

Mrigar Haor supports nine mammal species, dominated by rodents, bats, and small carnivores. The Golden Jackal was not observed in this haor. Species such as the Indian Flying Fox and Small Indian Mongoose are indicative of tree cover and small prey availability. All species are listed as Least Concern, suggesting no threatened mammal species currently present. A comprehensive list of mammals found in Mrigar Haor is provided in Appendix D-5.

7.2.3.5.2 Avifauna

Bird diversity in Mrigar Haor was moderate, with observations dominated by passerines and wetland-edge species. Species such as Barn Swallow, Dusky Warbler (*Phylloscopus fuscatus*), Asian Palm Swift, and Red-vented Bulbul (*Pycnonotus cafer*) were common. Waterbirds were less abundant compared to larger haors. All recorded species are classified as Least Concern. A comprehensive list of avifauna found in Mrigar Haor during both season of the year is provided in Appendix D-2.

7.2.3.5.3 Herpetofauna

Mrigar Haor supports a total of 10 herpetofauna, dominated by amphibians. The Asian Common Toad, Skipper Frog, and Indian Bullfrog were commonly recorded in both seasons. Reptile species such as the Common Garden Lizard were also observed. The absence of rare or threatened species suggests a community composed primarily of common and adaptable taxa, all listed as Least Concern. A comprehensive list of herpetofauna found in Mrigar Haor is provided in Appendix D-4.

7.2.3.6 Wildlife Compositions of Kazir Kola Boro Haor

Detailed ecological findings of Kazir Kola Boro Haor, derived from field surveys, are presented here. The haor is situated in Mithamoin Upazila of Kishoreganj District and is a significant freshwater wetland in Bangladesh, known for its rich biodiversity. The faunal composition is described as follows.

7.2.3.6.1 Mammals

Kazir Kola Boro Haor supports a total of 10 mammal species, including the Golden Jackal, bats, rodents, shrews, and mongooses as per baseline biodiversity study. The presence of both predators and prey species suggests a functional trophic structure. Rodent species were abundant and widespread. All recorded species are categorized as Least Concern at both national and global levels. A comprehensive list of mammals found in Kazir Kola Boro Haor is provided in Appendix D-5.

7.2.3.6.2 Avifauna

Kazir Kola Boro Haor supports a notable diversity of wetland birds, during both wet and dry season of the years. Common species include Little Egret (*Egretta garzetta*), Intermediate Egret (*Ardea intermedia*), Asian Openbill, and Common Greenshank (*Tringa nebularia*). The presence of migratory waders and ducks highlights the haor's importance as a seasonal foraging habitat. All species recorded are of Least Concern. A comprehensive list of avifauna found in Kazir Kola Boro Haor is provided in Appendix D-2.

7.2.3.6.3 Herpetofauna

Kazir Kola Boro Haor supports a total of five amphibian species, including the Asian Common Toad, Skipper Frog, Indian Bullfrog, and Ornate Microhylid Frog. The haor also supports four reptile species, such as the Common Garden Lizard and the Bronze Grass Skink (Eutropis macularia). Species richness was notably higher during the wet season, reflecting enhanced breeding activity. All recorded species fall under the Least Concern category. A comprehensive list of herpetofauna documented in Kazir Kola Boro Haor is provided in Appendix D-4.

7.2.3.7 Wildlife Compositions of Pathor Chauli Haor

The Pathor Chauli Haor is situated in Companiganj upazilla of Sylhet district, considered the plenty of freshwater wetland in Bangladesh, is renowned for its high biodiversity and its faunal composition are described as follows.

7.2.3.7.1 Mammals

Pathor Chauli Haor supports a total of nine terrestrial mammal species, as recorded in our baseline study conducted during both the dry and wet seasons. The mammalian fauna includes bats, rodents, insectivores, and the Golden Jackal. This composition reflects a mosaic of wetland margins, agricultural lands, and homestead vegetation. No nationally or globally threatened mammal species were recorded, and all documented species fall under the Least Concern category. A comprehensive list of mammals recorded from Pathor Chauli Haor is provided in Appendix D-5.

7.2.3.7.2 Avifauna

Pathor Chauli Haor recorded high bird species richness, including waterbirds, raptors, and passerines. Species such as Oriental Darter (*Anhinga melanogaster*), Grey-headed Lapwing (*Vanellus cinereus*), Little Pratincole (*Glareola lactea*), and Common Hoopoe (*Upupa epops*) were observed. The presence of the Near Threatened Oriental Darter emphasizes the conservation value of this haor. Seasonal flooding significantly enhances habitat suitability for water-dependent birds. A comprehensive list of avifauna found in Pathor Chauli Haor during both wet and dry season is provided in Appendix D-2.

7.2.3.7.3 Herpetofauna

Pathor Chauli Haor supports a comparatively rich herpetofaunal community. Amphibians such as the Indian Bullfrog, Asmat's Cricket Frog, and Common Tree Frog were recorded. Reptiles including the Checkered Keelback, Common Garden Lizard, and Bronze Grass Skink were also observed. Seasonal flooding appears to play a key role in maintaining amphibian diversity. All species recorded are classified as Least Concern. A comprehensive list of herpetofauna found in Pathor Chauli Haor is provided in Appendix D-4.

7.2.3.8 Wildlife Compositions of Muktarpur Haor

The Muktarpur Haor is situated in Balagonj and Osmaninagar Upazilas of Sylhet district considered the rich of freshwater wetland in Bangladesh, is renowned for its high biodiversity and its faunal composition are described as follows.

7.2.3.8.1 Mammals

A total of nine mammal species were recorded from Muktarpur Haor. These include common bats, rodents, the Small Indian Mongoose, and the Golden Jackal. The consistent presence of generalist species indicates adaptability to seasonal flooding and human-modified landscapes. All species are classified as Least Concern, suggesting low conservation risk. A comprehensive list of mammals found in Muktarpur Haor is provided in Appendix D-5.

7.2.3.8.2 Avifauna

Muktarpur Haor supports a diverse assemblage of birds, during both dry and wet season of the year. Frequently recorded species include Great Cormorant, Grey Heron (*Ardea cinerea*), Asian Koel (*Eudynamys scolopaceus*), Black Drongo (*Dicrurus macrocercus*), and various starlings and mynas. All species recorded are listed as Least Concern, indicating stable avian populations. A comprehensive list of avifauna found in Muktarpur Haor is provided in Appendix D-2.

7.2.3.8.3 Herpetofauna

Muktarpur Haor recorded a diverse assemblage of amphibians, with consistent records of the Asian Common Toad, Skipper Frog, Indian Bullfrog, and Ornate Microhylid Frog across both seasons.

Reptiles such as the Common House Gecko and Common Garden Lizard were also present. The availability of wetland margins and homestead vegetation supports a stable herpetofaunal community. All species are listed as Least Concern. A comprehensive list of herpetofauna found in Muktarpur Haor is provided in Appendix D-4.

7.2.3.9 Wildlife Compositions of Hail Haor

Located in Moulvibazar Sadar and Sreemangal upazilas of Moulvibazar District, Hail Haor is regarded as one of the most biologically rich freshwater wetlands in Bangladesh and is renowned for its high biodiversity. Its faunal composition is presented below.

7.2.3.9.1 Mammals

Hail Haor supports a total of 10 terrestrial mammal species across dry and wet season of the year as per our baseline study. The Golden Jackal was not recorded in this haor, while bats, rodents, shrews, and mongooses were commonly observed. The dominance of small mammals reflects typical wetland-associated terrestrial fauna. All recorded species are listed as Least Concern nationally and globally. A comprehensive list of mammalian species recorded in Hail Haor is presented in Appendix D-5.

7.2.3.9.2 Avifauna

Hail Haor exhibits high avifaunal diversity, with records of numerous waterbirds, waders, and terrestrial birds. Species such as Lesser Whistling Duck, Indian Spot-billed Duck (*Anas poecilorhyncha*), Common Snipe, Asian Openbill, and Grey-headed Lapwing were common during the wet season. The haor serves as an important seasonal habitat for residents and migratory birds. One Near Threatened species, the Oriental Darter, was also recorded. A comprehensive list of avifauna species recorded in Hail Haor is presented in Appendix D-2.

7.2.3.9.3 Herpetofauna

Hail Haor supports a notable diversity of herpetofauna, during the dry and wet season of the year. Amphibians including the Asian Common Toad, Skipper Frog, Indian Bullfrog, and Asmat's Cricket Frog were widespread. Reptile species such as the Checkered Keelback, Common Garden Lizard, and Common House Gecko were also recorded. The dominance of amphibians highlights the importance of Hail Haor as a breeding and foraging habitat. All species recorded are classified as Least Concern. A comprehensive list of herpetofauna species recorded in Hail Haor is presented in Appendix D-4.

CHAPTER 8

Impact Assessment and Evaluation

8 IMPACT ASSESSMENT AND EVALUATION

This chapter details the inferences drawn from the environmental impact assessment of the proposed Haor Area Resilience and Development (HARD) Project. It describes the overall impact of the project activities and underscores the areas of concern which need mitigation measures.

Assessment of potential impacts is based on activities that will be involved in the implementation of the project, nature and extent of the proposed activities, and present environmental setting of the project area. The impacts due to the project activities across different phases have been identified and assessed. The project activities will have impacts on the physical, social, and ecological environment in two distinct phases:

- Construction phase, which may be regarded as temporary or short-term.
- Operation phase, which would have long-term effects.

The identification of likely impacts during construction and operation phases has been carried out based on likely activities having their impact on the environment and socio-economic parameters. The critical areas of environmental concern for which the impacts and their predictions are taken into consideration are listed below.

- Ambient air quality
- Ambient noise
- Land and soil
- Water quality
- Hydrology and drainage
- Terrestrial and aquatic ecology
- Socio-economic aspect.

The details of the activities and their impacts have been worked out in the following sections.

8.1 Impact Identification

The potential impacts have been identified through a systematic process whereby the activities (both planned and unplanned) associated with the project have been considered with respect to their potential to interact with environmental and social resources or receptors.

8.1.1 Impacts on Physical Environment

8.1.1.1 Air Pollution

8.1.1.1.1 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 be a particle size range between 2.5 to 10 µm[30].

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

8.1.1.1.1.1 Impact from Dust Emissions during Construction Phase

Sources

Dust emissions during the construction phase may result from:

- Earthworks, excavation, and grading activities.
- Movement of vehicles over unpaved roads and construction areas.
- Handling, loading, and storage of soil, sand, and aggregates.
- Wind erosion from exposed surfaces and stockpiles.

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.[30]

The human receptors that would likely be exposed to increased dust levels from the development and 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[30]. From the review of the land use within and surrounding the project site, the above-mentioned receptors would include staff and workers within the project area and the local community.

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.

Dust particles released during earthworks and civil works can contribute to poor air quality, leading to respiratory issues and other health problems for the residents. The air may be polluted due to dust arisen from unpaved road, sand/earth stockpile by wind. Dust is 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 areas. Excessive dust can reduce visibility, creating hazards for motorists and pedestrians.

In consideration of the aforementioned influencing factor, the magnitude/severity of impacts of dust generated from construction and earthworks during the project construction phase is moderate.

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 civil works 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/sand and other materials shall be stored in specifically designated areas and shall 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.
- Wherever reasonable and practicable, re-vegetate exposed ground as soon as possible to stabilize surfaces and minimize re-entrainment of dust.
- During development and construction, the access road shall be regularly maintained to keep it clean, and free from mud and slurry. Regularly cleaning the nearby roads and streets to minimize dust accumulation and prevent its dispersion.
- Enforcing speed limits on dust roads to prevent dust entrainment into the atmosphere. Speed restrictions on vehicles entering and leaving the site.
- Educating the public about the potential health hazards of dust pollution and encouraging their cooperation in adopting preventive measures like keeping windows closed, using air purifiers, and wearing protective masks.
- A grievance register must be kept on site during construction so that grievances can be recorded and then dealt with accordingly.
- The periodic monitoring of the ambient air quality will be conducted in design methodology.

8.1.1.1.1.2 Impact from Dust Emissions during Operation Phase

Sources

Dust emissions during the operation phase will primarily arise from:

- Vehicular movement over road shoulders, unpaved access routes, and service roads.
- Soil erosion and wind action over exposed roadside surfaces.
- Resuspension of deposited dust due to the continuous movement of vehicles, particularly during dry seasons.
- Material loading and unloading activities near the road corridor, such as sand, soil, or aggregates.

Receptors

Dust levels typically decline with distance from the source, depending on wind speed, atmospheric stability, terrain, and vegetation. Human receptors most likely to be exposed include:

- Residents, shopkeepers, and pedestrians located adjacent to the road alignment.
- Sensitive receptors such as schools, healthcare facilities, and markets situated within 200 m of unpaved sections or access routes.
- Roadside vendors and transport workers (drivers, helpers, rickshaw pullers, etc.) who spend prolonged hours near traffic and dust-prone areas.

Impacts

During the operation phase, vehicular movement over unpaved road shoulders and access routes may generate fugitive dust emissions, particularly in dry and windy conditions. This dust can contribute to localized air quality degradation and pose health risks such as respiratory irritation, coughing, eye and throat discomfort, and aggravation of asthma or other pre-existing conditions. Continuous deposition of dust on houses, shops, crops, and roadside vegetation may create nuisance impacts, reducing visibility and causing soiling of surfaces. Dust particles suspended in the air can also impair visibility for motorists and pedestrians, creating road safety hazards. However, compared to the pre-project situation, the paving of main road sections will substantially reduce dust resuspension, limiting impacts mainly to unpaved shoulders and access routes. Considering these factors, the severity of dust-related impacts during the operation phase is assessed as low to moderate.

Mitigation Measures

To minimize dust emissions and related impacts during the operation and maintenance phase, the following measures are recommended.

- Regularly maintain and, where feasible, pave road shoulders and access routes to reduce dust generation.
- Apply periodic water spraying or dust suppressants on unpaved sections, especially during dry seasons.
- Enforce vehicle speed limits along unpaved routes to minimize dust entrainment.
- Establish and maintain roadside vegetation cover to stabilize exposed soils and reduce wind erosion.
- Carry out regular cleaning of paved road surfaces to prevent dust accumulation.
- Store construction or maintenance materials (sand, soil, aggregates) in designated areas, covered with tarpaulin or other protective materials.
- Monitor dust levels at sensitive receptor locations to ensure compliance with national ambient air quality standards.

8.1.1.1.2 Impacts due to Increased Vehicular Emissions

8.1.1.1.2.1 Impact from Vehicular Emissions during Construction Phase

Diesel-powered vehicles and equipment used on site and vehicles accessing the development and 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.

Sources

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

- Exhaust emissions from construction machinery, trucks, and other heavy-duty vehicles operating on-site.
- Increased traffic movement for transporting construction materials, equipment, and workers.
- Idling and congestion near material storage yards, loading/unloading points, and site access roads.

Receptors

Air pollutant concentrations from construction vehicles will diminish with distance from the source, depending on meteorological conditions, terrain, and vegetation. Likely receptors include:

- Construction workers and site staff directly exposed to on-site vehicle activity.
- Local communities, shopkeepers, and pedestrians living or working near the project boundary.
- Sensitive receptors such as schools, healthcare facilities, and marketplaces within 200 m of the construction access routes or project site.
- Flora and fauna in the immediate vicinity of the construction site and access roads may be affected. Vegetation may experience deposition of particulate matter, while local wildlife could be exposed to pollutants or disturbed by vehicle movement and noise.

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.[31]

Such emissions may arise in the construction areas and where diesel-fueled equipment and generator sets will be used. Emissions may 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 any road diversions could also lead to increased vehicular emissions.

In consideration of the aforementioned influencing factor, the magnitude/severity of impacts of emissions during the project construction phase is moderate.

Mitigation Measures

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

- Follow the approved Environmental Management and Monitoring Plan throughout the construction activities.
- All equipment and machinery used at the land development site and construction worksites should be maintained and operated in such a manner that they will not give rise to smoke emissions and will comply with the regulation.
- 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 NO_2, PM_{10}, and SO_2.
- No waste shall be burnt on or around the project site.
- The periodic monitoring of the ambient air quality shall be conducted in design methodology.

8.1.1.1.2.2 Impact from Vehicular Emissions during Operation Phase

Sources

Vehicular emissions during the operation phase will primarily arise from:

- Increased traffic volumes due to improved road connectivity.
- Exhaust emissions from gasoline and diesel engines, including carbon monoxide (CO), nitrogen oxides (NOx), sulfur oxides (SOx), hydrocarbons (HC), and particulate matter (PM).
- Secondary emissions such as tire and brake wear particles.
- Occasional idling and congestion near intersections, market centers, or bus stops along the road corridor.

Receptors

Air pollutant concentrations generally decrease with distance from the emission source, influenced by factors such as wind speed and direction, air stability, terrain, and vegetation cover. Human receptors most likely to be exposed include:

- Residents, shopkeepers, and pedestrians living or working adjacent to the road corridor.
- Sensitive receptors such as schools, healthcare facilities, and markets located within 200 m of the road alignment.

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

- Roadside vendors and transport workers (drivers, helpers, rickshaw pullers, etc.) who spend long hours near traffic sources.

Impacts

During the operation phase, improved road connectivity will attract higher traffic volumes, leading to an increase in vehicular emissions such as carbon monoxide (CO), nitrogen oxides (NOx), sulfur oxides (SOx), hydrocarbons (HC), and particulate matter (PM). These pollutants can contribute to localized air quality degradation and pose health risks for nearby residents, roadside vendors, pedestrians, and other sensitive receptors, including schools and healthcare facilities situated close to the corridor. Prolonged exposure may aggravate respiratory illnesses, cause irritation of the eyes and throat, and increase the risk of chronic cardiovascular and pulmonary conditions. Vehicular exhaust also releases greenhouse gases like carbon dioxide, contributing to climate change, while soot and black carbon may stain roadside buildings and vegetation, creating nuisance impacts. On the other hand, paving of roads will reduce the resuspension of dust that was previously generated by traffic over unpaved surfaces, lowering particulate emissions from that source. Considering these counterbalancing effects, the overall severity of impacts from vehicular emissions during the operation phase is assessed as moderate.

Mitigation Measures

To avoid, minimize, and limit the magnitude of emissions during the operation and maintenance phase, the following measures are recommended.

- Promote smooth traffic flow by reducing congestion through proper signage, speed management, and junction improvements.
- Enforce vehicle emission standards and periodic inspection and maintenance programs. Encourage the use of cleaner fuels and low-emission vehicles.
- Develop green belts along the road corridor to act as natural filters for vehicular pollutants.
- Conduct awareness campaigns for drivers and operators on vehicle maintenance, avoiding idling, and adopting fuel-efficient practices.
- Carry out periodic ambient air quality monitoring at sensitive receptor locations along the road corridor.
- Where feasible, promote the use of public transport, non-motorized transport, and ride-sharing to reduce vehicle numbers.
- Ensure regular maintenance of paved surfaces to minimize secondary dust emissions and prevent pothole-related congestion.

8.1.1.2 Water Quality

8.1.1.2.1 Impact on Surface Water

8.1.1.2.1.1 Impact on Surface Water from Construction Activities

Sources

Potential sources of surface water impacts during the project construction phase include:

- Accidental spillage or leakage of construction materials, fuels, lubricants, oils, and solvents from machinery and storage areas.
- Runoff from construction sites carrying soil, sediments, and construction debris.
- Discharge of untreated domestic wastewater from construction camps, including greywater, kitchen waste, and sewage.
- Stormwater runoff washing away loose materials, including cement, sand, and aggregates, into nearby water bodies.

Receptors

Surface water bodies located downstream or adjacent to the construction site are the primary receptors. These include:

- Rivers, canals, and streams in or near the project corridor.
- Wetlands and ponds that may receive runoff or spillage.
- Aquatic ecosystems and associated flora and fauna that rely on these water bodies for habitat and sustenance.
- Communities that depend on surface water for domestic or irrigation purposes.

Impacts

During construction, accidental spillage of fuels, lubricants, and chemicals can introduce toxic substances into surface water, resulting in water pollution and contamination of aquatic habitats. Runoff from exposed soil, earthworks, and stockpiles can increase sedimentation, turbidity, and suspended solids in water bodies, which can reduce light penetration, disrupt aquatic ecosystems, and smother fish eggs or benthic organisms. Untreated domestic wastewater from construction camps may introduce nutrients, pathogens, and organic matter, leading to eutrophication, unpleasant odors, and potential health risks for downstream users. These impacts may degrade water quality, affecting both ecological integrity and the suitability of water for human uses. The overall magnitude of these impacts is assessed as moderate, depending on the proximity of water bodies and the volume of construction activity.

Mitigation Measures

Mitigation measures for surface water quality include the following.

- Store fuels, lubricants, and chemicals in designated, bunded areas to prevent accidental spillage.
- Provide spill kits at key locations and train personnel on emergency response.
- Implement sediment and erosion control measures, including silt fences, check dams, and sedimentation ponds.
- Treat or safely dispose of domestic wastewater from construction camps, including greywater and sewage, before discharge.
- Cover stockpiles of soil, sand, and aggregates to reduce runoff and prevent sediment from entering water bodies.
- Schedule construction activities to minimize exposed soil during rainy periods.
- Conduct regular monitoring of nearby surface water quality to detect and address contamination promptly.
- Educate construction workers and contractors on best practices to prevent pollution of water bodies.

8.1.1.2.1.2 Impact on Surface Water from Operation Activities

During the operation phase, no significant impacts on surface water quality are expected. With construction completed, there will be no ongoing spillage of fuels, lubricants, or construction materials, and proper road drainage systems will prevent sediment-laden runoff from entering nearby water bodies. Domestic wastewater from construction camps will no longer be present, and routine road use under normal conditions does not release pollutants in concentrations likely to affect surface water quality. Properly maintained drainage and sediment traps along the road corridor will ensure that runoff is managed and treated before it reaches sensitive aquatic receptors.

8.1.1.2.2 Impact on Groundwater

8.1.1.2.2.1 Impact of Groundwater from 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.
- Unplanned events such as accidental spills and overflow of the stormwater drainage system and ancillary facilities due to major rainfall events.

Sources

Potential sources of groundwater impacts during construction may include:

- Infiltration of wastewater, oils, fuels, and other chemicals from construction machinery, camps, or material storage areas.
- Accidental spills of lubricants, diesel, or cement slurry that may seep into the soil and reach shallow aquifers.
- Improper handling or disposal of solid waste and hazardous materials.

Receptors

- Local communities rely on shallow tube wells or dug wells for drinking, domestic use, and irrigation.
- Groundwater-dependent ecosystems in and around the haor area.

Impacts

During construction, contamination of shallow groundwater may occur if fuels, oils, or construction chemicals infiltrate the soil. Increased sedimentation from excavation and earthworks may also alter the natural recharge patterns of aquifers. These impacts are generally localized but could temporarily affect water quality and availability for nearby communities and agriculture. Considering the potential sources, the sensitivity of groundwater resources, and the exposure of human and ecological receptors, the magnitude/severity of impacts is considered moderate.

Mitigation Measures

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

- Store fuels, oils, and chemicals in designated areas with proper containment to prevent seepage.
- Treat wastewater from construction camps before discharge and avoid direct infiltration into the soil.
- Implement proper solid waste management to prevent leaching contaminants into the groundwater.
- Conduct regular monitoring of groundwater quality near construction sites to detect any contamination early.
- Schedule excavation and material handling away from sensitive recharge zones where feasible.

8.1.1.2.2.2 Impact on Groundwater from Operation Activities

During the operation phase, no impacts on groundwater are expected. Project activities will be limited to routine operations and maintenance, which do not involve the use or disposal of substances that could contaminate aquifers. Groundwater quality and availability are expected to remain unaffected throughout the operational period.

8.1.1.3 Soil Contamination

8.1.1.3.1 Impact on Soil Quality during Construction Phase

Sources

Potential sources of soil contamination and degradation during the construction phase include:

- Accidental spillage or leakage of fuels, lubricants, and other chemicals from construction machinery and storage areas.
- Disposal of dredged spoils, construction debris, and liquid waste from construction camps.
- Compaction and disturbance of soil due to movement of heavy vehicles, machinery, and equipment.

Receptors

Soil within the project area and its immediate surroundings are the primary receptors. Sensitive receptors include:

- Agricultural land or cultivated areas adjacent to the project site.
- Local vegetation along the road corridor.
- Soil in environmentally sensitive zones or near drainage channels that could be exposed to contamination.

Impacts

During construction, accidental spillage of fuels, lubricants, and other chemicals, as well as the improper handling or disposal of dredged spoils and liquid waste, may lead to contamination of the soil. Such contamination can alter soil properties, reduce fertility, and affect vegetation growth. Compaction from heavy machinery may reduce soil porosity, affecting drainage and aeration, and can further degrade soil quality. The overall magnitude of impacts on soil quality during construction is assessed as moderate.

Mitigation Measures

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

- Store fuels, lubricants, and chemicals in designated bunded areas to prevent spillage.
- Provide spill kits and train personnel on immediate response to chemical spills.
- Dispose of dredged spoils and construction waste at approved locations following environmental guidelines.
- Limit heavy machinery movement to designated areas and avoid unnecessary soil compaction.
- Rehabilitate and re-vegetate disturbed areas after construction to restore soil properties.
- Monitor soil quality periodically in sensitive areas to detect and address contamination promptly.

8.1.1.3.2 Impact on Soil Quality during Operation Phase

During the operation and maintenance phase, no significant impacts on soil quality are expected. Construction-related sources of contamination are no longer present, and routine road use does not release pollutants in concentrations sufficient to degrade soil. Proper maintenance and drainage measures will help preserve soil stability and prevent erosion.

8.1.1.4 Wastes

8.1.1.4.1 Impact due to Waste Generation

8.1.1.4.1.1 Impacts due to Waste Generation during Construction Phase

Sources

The main type of waste likely to be generated during development and construction activities is the construction debris resulting from the excavations, dredged soil/sand, and civil works. Other waste that will be generated include waste food and packaging materials littered by workers.

Some of the waste streams include the following.

- Hazardous waste such as fuel and oil spills, residual or spilled chemicals, solvents, adhesives, light bulbs, and batteries.
- Non-hazardous wastes such as food and canteen waste, scrap metal waste, wastepaper, wood, and cardboard packaging.
- Construction debris such as excavated soil, concrete, timber, metal, and packaging materials.

Receptors

- Land and soil within and surrounding the project site.
- Local communities near labor camps and construction sites.
- Water bodies in the vicinity, which could be affected by improper waste disposal or runoff.

Impacts

During the construction phase, the project is expected to generate significant quantities of construction debris, including excavated soil, concrete, timber, metal, and packaging materials, as well as domestic waste from labor camps such as food scraps, plastics, and other general refuse. If not properly managed, this waste could lead to localized soil contamination, obstruct drainage channels, and increase the risk of runoff entering nearby water bodies, potentially affecting water quality. Improper disposal may also create nuisance conditions and pose health and safety risks to workers and local communities. Considering the sources and sensitivity of the surrounding environment, the magnitude/severity of impacts is considered moderate.

Mitigation Measures

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

- Implement a comprehensive solid waste management plan for construction activities and labor camps.
- Segregate waste at source into biodegradable, non-biodegradable, and hazardous categories.
- Store hazardous materials, including chemicals and fuels, in securely labeled and bunded areas; limit on-site storage to minimize risk.
- Collect, transport, and dispose of construction debris and domestic waste regularly at approved facilities.
- Reuse or recycle construction debris wherever feasible to reduce landfill disposal.
- Clearly demarcate all storage and handling areas, ensuring proper labeling and security for hazardous materials.
- Train and instruct workers to prevent littering and random disposal of waste on-site.
- Remove all construction debris and level the site to its original condition upon completion of development activities.
- Monitor waste management practices regularly to ensure compliance with national regulations and the project EMP.

8.1.1.4.1.2 Impacts due to Waste Generation during Operation Phase

During the operation phase, no significant impacts from waste generation are expected, as project activities do not produce substantial waste beyond routine maintenance.

8.1.1.5 Noise and Vibration

8.1.1.5.1 Impacts from Noise Emissions

8.1.1.5.1.1 Impact from Noise during Construction Phase

Source

Noise will be generated from the following sources during the construction activities.

- Operation and movement of heavy vehicles such as lorries, crane lorries for transportation of equipment and materials.
- Bulldozers, excavators, cranes, and compaction equipment generate significant noise as they perform tasks like grading, excavation, and land clearing.
- 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.
- The loading and unloading of construction materials, including steel, concrete, and other heavy items, can produce noise.

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:

- Construction workers and staff on-site.
- Local communities and residents near the project area.
- Sensitive receptors such as schools, health facilities, and mosques located between 100 m to 380 m from the construction work site.
- Fauna within and around the project site.

Impacts

Noise can lead to annoyance due to interference with communication or disturbance to receptors involved in leisure activities, as well as sleep disturbance[32]. The effects of noise may vary with the individual receptor and are dependent on many factors such as the activity that the receptor is engaged in, as well as the duration of noise exposure.

For receptors located within a short distance of the construction worksites, noise levels experienced by the receptors will be dominated by the nearest noise source. Noise levels at close proximity to the project boundary were therefore calculated assuming one of the noisiest single items of equipment (i.e., jack hammer) operating continuously very close to the worksite boundary. Noise specifications for each construction equipment/vehicle were taken from the British Standard BS 5228-1:2009+A1:2014[33]. Where a range of sound power levels was presented, a higher value was taken to remain consistent with a conservative approach. The identified development and construction equipment/vehicles and the assumed noise specifications are presented in Table 8-1.

[32] World Health Organization. (1999). *Guidelines for Community Noise*. https://apps.who.int/iris/handle/10665/66217

[33] British Standards Institution. (2014). *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*. BS 5228-1:2009+A1:2014. The British Standards Institution.

Table 8-1: Typical development and construction equipment/vehicle and associated noise specifications

S/N	Equipment/Vehicle	Activity Equivalent Continuous Sound Pressure Level at 10 m
1	Tracked loaders	87
2	Tracked excavators	86
3	Dozers	86
4	Dump truck	92
5	Crane	82
6	Jack hammer	95
7	Tracked crane	81
8	Concrete mixer	76
9	Water pump	81
10	Pile Driver	106

Source: British Standards Institution, 2014 [33]

Noise levels due to the construction equipment within the project boundary are predicted to exceed the guideline value for workers and staff within the project boundary and adjacent local residence.

During construction, noise levels are expected to increase temporarily due to machinery operation and vehicle movement. Elevated noise can cause discomfort, annoyance, and temporary hearing issues for workers and nearby residents. Considering the intensity of activities and proximity of receptors, the magnitude/severity of impacts is considered moderate.

Mitigation Measures

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

- Throughout the construction period, the schedule of the noisiest construction activities 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 to be turned off when not in use.
- Workers to be trained in noise reduction behaviors such as reducing the drop height of materials. Daily toolbox briefings should include remainders on the need to implement noise reduction behaviors, in particular during pilling activities.
- Employees working in high-noise areas should be provided with earplugs to protect their hearing and ensure their safety.
- Instead of hoardings, erect acoustic barriers along the boundary between the construction area. Where practicable, acoustic barriers shall be at 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 number 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 will 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, 2025.

8.1.1.5.1.2 Impact of Noise during Operation Phase

Sources

Potential sources of noise and vibration during the operation phase include:

- Increased traffic volumes along the completed road corridor.
- Engine noise, honking, and braking from vehicles, particularly commercial vehicles.
- Low-level vibrations generated by moving vehicles, especially on uneven road surfaces or at high speeds.

Receptors

The primary receptors for noise and vibration during operation include:

- Nearby residential settlements, shops, and community areas located along or adjacent to the road.
- Sensitive receptors such as schools, healthcare facilities, and places of worship within 200 m of the road alignment.
- Wildlife and sensitive habitats near the road corridor, including local vegetation and fauna that may be disturbed by noise and vibrations.

Impacts

During operation, the completed road is expected to attract higher traffic volumes, resulting in persistent noise and low-level vibrations. Nearby residents and communities may experience annoyance, sleep disturbance, and reduced quality of life due to increased ambient noise levels. Sensitive receptors such as schools and hospitals may face interruptions in their normal functioning. Noise and vibrations may also disturb local wildlife, potentially causing changes in behavior, avoidance of habitat, or disruption of feeding and breeding activities. Although modern road design and paving reduce vibrations compared to unpaved roads, the cumulative impact of continuous traffic noise may still be significant for receptors located very close to the road corridor. Overall, the impact of noise during the operation phase is assessed as moderate.

Mitigation Measures

To minimize noise and vibration impacts during operation:

- Enforce speed limits, particularly near residential areas, schools, and sensitive habitats.
- Implement roadside noise barriers or green belts where feasible to reduce noise propagation.
- Use well-maintained, low-noise road surfaces to limit vehicle-generated vibrations.
- Regulate and monitor heavy-duty vehicle movements during night hours to reduce disturbance.
- Encourage public awareness campaigns on minimizing honking and unnecessary vehicle noise.
- Periodically monitor ambient noise levels at sensitive receptor locations to ensure compliance with national standards.

8.1.1.5.2 Impacts due to Vibration

8.1.1.5.2.1 Impact due to Vibration during Construction Phase

Sources

Noise will be generated from the following sources during the construction activities.

- Operation of heavy construction machinery, including bulldozers, excavators, and compactors.
- Movement of heavy construction vehicles on-site and along access roads.

Receptors

In general, vibration propagated through the ground during earthworks is attenuated within a short distance from the source. Formula from empirical studies generally consider a distance of approximately 110 m from the vibration source[34]. Human receptors that may be exposed to vibration impacts from the project, therefore, include those who would be within 110 m of the project construction work area boundary and comprise the plant staff and workers, as well as personnel temporarily residing within the exclusive use areas.

Impacts

Vibration can lead to annoyance due to sleep disturbance. Low levels of perceptible vibration may also cause disturbance and can cause concern about structural damage to nearby buildings. Guidance on the effect of vibration levels to human receptors was published by the British Standard Institute and is presented in Table 8-2.

Table 8-2: Guidance on effects of vibration levels

Vibration Level ($mm.s^{-1}$)	Effects
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1.0	It is likely that vibration of this level in residential environments will cause complaints but can be tolerated if prior warning and explanation have been given to residents.
10.0	Vibration is likely to be intolerable for any more than very brief exposure to this level.

Source: British Standards Institution, 2014 [34]

Vibration levels are expected to attenuate within 110 m of the construction work area. During construction, vibration may occur due to heavy machinery and vehicle movement. These effects are generally localized and temporary but could cause minor structural disturbances to nearby buildings and discomfort to workers. Considering the localized nature of vibrations and the sensitivity of receptors, the magnitude/severity of impacts is considered low to moderate.

Mitigation Measures

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

[34] British Standards Institution. (2014). *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*. BS 5228-1:2009+A1:2014. The British Standards Institution.

- Maintain and operate machinery in accordance with manufacturer guidelines to minimize vibration.
- Restrict operation of heavy equipment near sensitive structures.
- Schedule high-vibration activities to minimize exposure to nearby communities and workers.
- Monitor vibration levels near sensitive structures periodically during construction.

8.1.1.5.2.2 Impact due to Vibration during Operation Phase

Sources

During the operation phase, vibration is expected to arise from:

- Movement of vehicles along the completed road.
- Engine operations, braking, and acceleration of vehicles on uneven surfaces or at high speeds.
- Occasional construction or maintenance vehicles during routine road upkeep.

Receptors

The main receptors for vibration impacts include:

- Nearby residential buildings, commercial structures, and community facilities along the road corridor.
- Sensitive facilities such as schools, hospitals, and places of worship within 200 m of the road alignment.
- Wildlife and sensitive habitats adjacent to the road that could be affected by repeated low-level vibrations.

Impacts

During operation, low-level vibrations generated by continuous vehicular movement may affect buildings and structures close to the road, causing minor structural stress or nuisance effects. For residents, persistent vibrations may result in discomfort or disturbance, particularly in structures not designed to withstand frequent vibrations. Sensitive receptors such as hospitals or laboratories may experience minor interference with sensitive equipment. Wildlife in nearby habitats may also be affected by vibrations, potentially altering behavior or causing avoidance of areas close to the road. While the magnitude of vibration is expected to be low, receptors in close proximity to high-traffic sections may experience moderate impacts.

Mitigation Measures

To reduce vibration impacts during operation:

- Enforce speed limits, particularly for heavy-duty vehicles in sensitive zones.
- Ensure the road surface is regularly maintained and smooth to minimize vibrations.
- Designate alternative heavy vehicle routes where possible to divert traffic away from sensitive areas.
- Encourage the use of low-vibration vehicles for freight and public transport.
- Monitor vibration levels periodically near sensitive buildings and habitats to ensure impacts remain within acceptable limits.

8.1.1.6 Ground Subsidence

8.1.1.6.1 During Construction Phase

During construction, groundwater usage is expected to be very limited, and deep excavation or dewatering activities are not anticipated at a scale that could cause significant ground settlement. As a result, the likelihood of ground subsidence occurring during construction is minimal. The magnitude/severity of impacts is considered negligible.

8.1.1.6.2 During Operation Phase

During the operation phase, no activities involving substantial groundwater withdrawal, dewatering, or subsurface disturbance are planned. Therefore, no impact on ground subsidence are expected.

8.1.1.7 Offensive Odor

8.1.1.7.1 Impacts due to Odor during Construction Phase

Sources

Odor during the construction phase may originate from:

- Leakage or spillage of fuels, oils, and lubricants from machinery and equipment.
- Temporary construction workers' sanitation facilities, including toilets and waste disposal areas.
- Storage or handling of chemicals and construction materials with strong odors.

Receptors

The primary receptors for odor impacts include:

- Construction workers and site staff are directly exposed to emission sources.
- Nearby residents, shopkeepers, and pedestrians along the project corridor.
- Sensitive receptors such as schools, hospitals, and community facilities located within 200 m of construction sites or camps.

Impacts

During construction, temporary odors may be noticeable near machinery, storage areas, and worker camps. These odors can cause discomfort, annoyance, and reduced amenity for workers and nearby communities. Prolonged exposure to strong or persistent odors, particularly from fuel or chemical spills, may also cause mild health effects such as headaches, nausea, or irritation of the eyes and respiratory tract. The overall magnitude of odor impacts during construction is considered low to moderate, as odors are generally localized, temporary, and dissipate rapidly with proper site management.

Mitigation Measures

To minimize odor impacts during construction:

- Ensure proper storage of fuels, oils, and chemicals in designated bunded areas.
- Maintain sanitation facilities in construction camps, with regular cleaning and safe waste disposal.
- Immediately clean up accidental spills of fuels or chemicals and dispose of contaminated materials appropriately.
- Cover or enclose odorous materials and chemicals to reduce emissions.
- Educate construction workers on proper handling practices to minimize odor release.
- Monitor areas with higher potential odor generation and respond promptly to complaints or issues.

8.1.1.7.2 Impacts due to Odor during Operation Phase

During the operation and maintenance phase of the HARD Project, no odor-generating activities are anticipated. Therefore, no odor-related impacts are expected.

8.1.1.8 Bottom Sediment

8.1.1.8.1 Impacts on Bottom Sediment during Construction Phase

Sources

Potential disturbances to bottom sediments during construction may arise from:

- Excavation, dredging, and filling activities in or near water bodies.
- Construction of bridges, culverts, or embankments affecting the riverbed or pond bed.
- Runoff carrying sediments from exposed soil and stockpiles into adjacent water bodies.
- Movement of construction machinery in shallow water areas.

Receptors

The primary receptors for sediment disturbance include:

- Rivers, canals, ponds, and wetlands located within or downstream of the construction site.
- Aquatic flora and fauna, including benthic organisms, fish, and amphibians, which rely on stable sediment conditions.
- Water users dependent on these water bodies for irrigation, fishing, or domestic purposes.

Impacts

During construction, dredging, excavation, and filling may disturb the bottom sediment profile of water bodies, resulting in resuspension of sediments and increased turbidity. Elevated turbidity can reduce light penetration, affecting aquatic plant growth and photosynthesis, while suspended sediments may smother benthic organisms and fish eggs. Sediment resuspension can also transport adsorbed pollutants such as nutrients, heavy metals, or hydrocarbons, further degrading water quality. These disturbances are generally localized and temporary but can affect aquatic ecosystems and water usability in the immediate vicinity of construction activities. Overall, the impact on bottom sediments during the construction phase is assessed as moderate.

Mitigation Measures

To minimize impacts on bottom sediments during construction:

- Restrict dredging and excavation activities to defined, minimal areas and avoid sensitive habitats where possible.
- Implement silt curtains, sediment traps, or cofferdams to contain disturbed sediments.
- Schedule in-water works during low-flow or dry seasons to reduce sediment mobilization.
- Cover or stabilize exposed soil and stockpiles to prevent erosion and runoff into water bodies.
- Monitor turbidity and sedimentation levels during construction to ensure compliance with water quality standards.
- Rehabilitate disturbed aquatic habitats after construction, including replanting of aquatic vegetation where feasible.

8.1.1.8.2 Impacts on Bottom Sediment during Operation Phase

During the operation and maintenance phase, no significant activities involving dredging, excavation, or sediment disturbance are planned. Hence, no impacts on bottom sediment are expected.

8.1.2 Impacts on Natural Resources

8.1.2.1 Protected Areas and Eco-sensitive Zones

Although Bangladesh has fifty-seven (57) Protected Areas (PAs) managed by the Forest Department, the immediate HARD Project study area does not include any designated PA under national regulations. The nearest PA is Rema-Kalenga Wildlife Sanctuary, located approximately 53 km from Mrigar Haor. In addition, the study area does not contain any Ecologically Critical Area (ECA), Ramsar Site, or Important Bird and Biodiversity Area (IBA). The nearest ECA is Tanguar Haor, which is about 2 km from the study area (Shanir Haor). Discussions with the relevant upazila fisheries officer revealed that some haor areas contain fish sanctuaries, which provide refuge for brood fish, juveniles, and other aquatic species during the dry season. Fishing is banned in these sanctuaries during the dry season, but no such restrictions are applied in the monsoon or wet season.

8.1.2.1.1 Impacts on Protected Areas and Eco-sensitive Zones during Construction Phase

Sources

The sources of impact during the construction phase include construction of rural roads, embankments, and protective structures. Construction of bridges, culverts, and ghats, along with fish-related infrastructure also contribute as impact sources. Restoration and development of beels, excavation of fish sanctuaries and nurseries, and the re-excavation of khals, river dredging, and disposal of excavated spoil are additional sources. Wetland edge filling, tree cutting, and vegetation clearance further alter natural habitats. Installation of irrigation inlets, outlets, and drainage systems, as well as construction of rural markets and growth centers near aquatic areas, represent additional impact sources. Finally, the use of heavy machinery, transportation of materials, and establishment of temporary worker camps near haors serve as further sources of potential impacts.

Receptors

During the construction phase, the primary receptors include protected areas (PAs), fish sanctuaries, aquatic habitats, and eco-sensitive zones such as Tanguar Haor ECA and Ramsar sites; migratory and resident birds in IBAs; and wetland fauna, including amphibians, reptiles, and small mammals.

Impacts

Considering the sources of impact and the absence of any protected areas or eco-sensitive zones such as Ecologically Critical Areas (ECAs), Ramsar Sites, or Important Bird and Biodiversity Areas (IBAs) within the study area, no impacts are anticipated on the mentioned receptors during the construction phase of the project. However, due to the presence of fish sanctuaries, the following impacts may occur on fisheries resources.

- Aquatic habitat disturbance from excavation, embankment construction, and soil reshaping, may cause turbidity, sedimentation, and impacts on brood fish.
- Water contamination from accidental spillage of fuel, cement, or construction materials may harm the fish health.
- Noise and vibration impact from machinery, potentially stressing or displacing aquatic species.
- Pollution risk from fuel, oil spills, or waste discharge affecting sanctuary water quality.

Considering the sensitivity and location of the protected and eco-sensitive zones, impacts on these areas during the construction phase are expected in some extent.

Mitigation Measures

- Avoid selecting sanctuary areas for any kind of construction intervention.
- Install silt traps, sedimentation ponds, or barriers to minimize turbidity and sediment runoff to fish sanctuaries.
- Store fuel, cement, and construction materials in secure, bunded areas away from water bodies.
- Implement spill prevention and emergency response procedures (spill kits on-site).
- Prohibit washing of equipment or disposal of construction residues in or near water bodies.

With the implementation of appropriate mitigation measures, the significance of the impact is expected to be reduced to Insignificant.

8.1.2.1.2 Impacts on Protected Areas and Eco-sensitive Zones during Operation Phase/ Post-construction

Source

Routine maintenance of roads, bridges, culverts, protective walls, ghats, growth centers, and beel/khal systems. Desilting, re-excavation, and minor repairs. Community use of infrastructure and fisheries resources, including CAIGA activities.

Receptor

During the operation phase, the primary receptors include fish sanctuaries, Tanguar Haor ECA, Ramsar sites, and IBAs; as well as fish, amphibians, reptiles, and migratory and resident birds.

Impacts

Considering the sources of impact and the absence of any protected areas or eco-sensitive zones such as Ecologically Critical Areas (ECAs), Ramsar Sites, or Important Bird and Biodiversity Areas (IBAs) within the study area, no impacts are anticipated on the mentioned receptors during the operation phase of the project. However, due to the presence of fish sanctuary, the following impacts may occur during operation phase of the project on fisheries resources of the fish sanctuary.

- Aquatic habitat disturbance from periodic desilting and re-excavation, potentially affecting brood fish and juvenile refuge areas.
- Accidental contamination from fuel, lubricants, or construction materials used during routine maintenance may harm fish and other aquatic resources.
- Easy and unregulated access to the haor area leading to overfishing near sanctuaries.

Considering the sensitivity and location of the protected and eco-sensitive zones, impacts on these areas during the operation phase are expected in some extent.

Mitigation Measures

- Schedule desilting and re-excavation outside sensitive breeding and dry-season periods and apply silt control measures to minimize habitat disturbance.
- Store fuel, lubricants, and construction materials in secure, bunded areas; implement spill-prevention protocols; and train workers on safe handling near water bodies.
- Strengthen community-based management and monitoring of sanctuary zones, enforce fishing restrictions, and raise awareness to prevent overfishing near sanctuaries.

With the implementation of appropriate mitigation measures, the significance of the impact is expected to be reduced to insignificant.

8.1.2.2 Biodiversity

8.1.2.2.1 Impacts on Terrestrial Ecosystems and Biota

The baseline survey recorded limited terrestrial fauna diversity in the project study area due to reduced natural vegetation, with notable presence of homestead vegetation, roadside trees, and seasonal wetlands. Notable trees that is found in the study area are Hijol (*Barringtonia acutangular*), Koroch (*Dalbergia reniformis*), Jarul (*Lagerstroemia speciosa*), Coconut (*Cocos nucifera*), Jackfruit (*Artocarpus heterophyllus*), Mango (*Mangifera indica*), Guava (*Psidium guajava*), Papaya (*Carica papaya*), Lemon (*Citrus sp.*), Java Plum (*Syzygium cumini*), Areca palm (*Areca catechu*), Banana (*Musa sp.*), Raintree (*Samanea saman*), etc. Key faunal groups include various bird species like Black Drongo (*Dicrurus macrocercus*), Common Myna (*Acridotheres tristis*), Spotted Dove (*Spilopelia chinensis*), reptiles like Bengal Monitor (*Varanus bengalensis*), House Gecko (*Hemidactylus frenatus*), Common Garden Lizard (*Calotes versicolor*), amphibians like Southeast Asian Toad (*Duttaphrynus melanostictus*), Indian Bullfrog (*Hoplobatrachus tigerinus*), and small mammals like Common House Rat (*Rattus rattus*),

House Shrew (*Suncus murinus*). The project site also contains beel wetlands, ponds, rivers, and khals, which provide habitat for various terrestrial and wetland-dependent wildlife.

The LGED activities road and bridge construction, protective embankments, growth centers, ghats, beel and khal development, and culture fisheries can affect terrestrial ecosystems and biota during pre-construction, construction, and operation phases.

8.1.2.2.1.1 Impacts During Construction Phase

Source

The main sources of impact during construction phase include construction of rural roads, embankments, and protective structures. Construction of bridges, culverts, and ghats, along with fish-related infrastructure also contributes as impact sources. Restoration and development of beels, excavation of fish sanctuaries and nurseries, and the re-excavation of khals, river dredging, and disposal of excavated spoil are additional sources. Wetland edge filling, tree cutting, and vegetation clearance further alter natural habitats. Installation of irrigation inlets, outlets, and drainage systems, as well as construction of rural markets and growth centers near aquatic areas, represent additional impact sources. Finally, the use of heavy machinery, transportation of materials, and establishment of temporary worker camps near haors serve as further sources of potential impacts.

Receptor

The primary receptors will include different types of vegetation (jackfruit, mango, coconut, banana, papaya, and raintree); roadside trees; and wetland-associated tree species (Hijol, Koroch, Jarul). Terrestrial faunas include common birds (Black Drongo, Common Myna, Spotted Dove), reptiles (Bengal Monitor, Garden Lizard), amphibians (Indian Bullfrog, Asian Toad), and small mammals (House Rat, Shrew). Wetland-dependent wildlife and migratory bird species around beels and khals are also important receptors.

Impacts

Construction-phase activities may have several potential impacts on the terrestrial ecosystem and its associated flora and fauna:

- Small-scale loss of vegetation from clearance activities, leading to reduced habitat and food availability.
- Disturbance to some nesting and roosting sites due to tree felling.
- Dust, emissions, and vibrations stressing terrestrial fauna and disrupting plant processes.
- Soil compaction and top-soil loss reducing vegetation regeneration potential.
- Habitat fragmentation and temporary barriers to animal movement.
- There are some mortality risk for less mobile and Least Concern (LC) reptiles and amphibians.
- Temporary displacement of birds and mammals from active habitats.
- Indirect disturbance of wetland-edge habitats affecting amphibians and migratory birds.

Considering the sensitivity of the surrounding ecosystems and their associated terrestrial flora and fauna, the level of impacts on these receptors during the construction phase is expected in some extent.

Mitigation Measures

- Minimize tree felling and implement compensatory plantations, and give special attention to Shanir Haor, as it is located near Tanguar Haor (a Ramsar and Ecologically Critical Area [ECA] site).
- Suppress dust (water spraying, covering stockpiles).
- Limit noisy activities to daylight hours and use noise barriers near bird habitats.
- Conserve and reuse topsoil for revegetation.

- Arrange awareness program for construction workers regarding importance of wildlife protection.

With the implementation of appropriate mitigation measures, the significance of the impact is expected to be reduced to insignificant.

8.1.2.2.1.2 Impacts during Operation Phase

Source

Routine maintenance of roads, bridges, culverts, protective walls, ghats, growth centers, and beel/khal systems. Desilting, re-excavation, and minor repairs. Community use of infrastructure and fisheries resources.

Receptor

The primary receptors for these activities are the terrestrial flora (Hijol, Koroch, Pulm), roadside plantations, homestead vegetation, riparian vegetation; terrestrial fauna: birds (resident and migratory), reptiles (monitor lizard, garden lizard), amphibians (bullfrog, toad), small mammals (house rat, shrew); Wetland-dependent species using riparian/embankment vegetation for shelter and foraging.

Impacts

- Increased tourism, community activities, and noise generation can stress resident and migratory birds and mammals, leading to their displacement from roadside foraging or nesting sites.
- Movement along roads, ghats, and embankments may disturb reptiles and amphibians using these habitats.
- Increased vehicle movement may increase road kills of wildlife.
- Routine clearance of embankment or roadside vegetation may reduce perching, nesting, and sheltering sites for birds and small mammals.
- Desilting and re-excavation can temporarily alter soil moisture and microhabitats near wetlands, affecting amphibians and reptiles.

Considering the sensitivity of the surrounding ecosystems and their associated terrestrial flora and fauna, the level of impacts on these receptors during the operation phase is evaluated as significant.

Mitigation Measures

- Maintain buffer strips along wetlands, beels, and riparian vegetation to protect sensitive habitats of birds and other wildlife.
- Schedule desilting, re-excavation, and other disruptive maintenance outside amphibian breeding periods and peak bird nesting/migratory seasons.
- Retain native trees along embankments and avoid complete clearance during routine maintenance.
- Limit human and vehicle movement to designated paths to reduce trampling and habitat disturbance.
- Implement vehicle speed limits to minimize wildlife road mortality.
- Educate communities and maintenance teams about wildlife-sensitive practices.

With the implementation of appropriate mitigation measures, the significance of the impact is expected to be reduced to insignificant.

8.1.2.2.2 Impacts on Fisheries and Aquatic Resources

The baseline survey recorded a diverse assemblage of fish and aquatic species in and around the project area, including 55 species of fish and shrimp. The aquatic ecosystems of the haor area also support 10 phytoplankton species, eight zooplankton species, and eight benthic macroinvertebrate

species. According to the IUCN Red List of Threatened Species of Bangladesh (2015), eight fish species are categorized as Endangered (EN). Major aquatic vegetation recorded in the project area includes Water fern (*Azolla filiculoides*), Common water hyacinth (*Eichhornia crassipes*), Water spinach (*Ipomoea aquatica*), Pink morning glory (*Ipomoea carnea*), Red water lily (*Nymphaea rubra*), Blue lotus (*Nymphaea nouchali*), Dwarf copperleaf (*Alternantha sessilis*), Sedges (*Cyperus* sp.), Helencha (*Enhydra fluctuens*), Narrowleaf cattail (*Typha angustata*), Alligator weed (*Alternanthera philoxeroides*), Water lettuce (*Pistia stratiotes*), Taro (*Colocasia esculenta*), Asian watergrass (*Hygroryza aristata*), Water primrose (*Jussiaea repens*), Greater duckweed (*Spirodela polyrhiza*), Torpedo grass (*Panicum repens*), and Water chestnut (*Eleocharis* sp.).

8.1.2.2.2.1 Impacts during Construction Phase

Source

The primary sources of impacts during the construction phase include removal of vegetation, wetland edge filling, tree cutting, site preparation, temporary access roads preparation and construction of labor camps, embankment raising, khal re-excavation, construction of bridges and culverts, revetments and other protective works, spoil disposal, use of heavy machinery, and transport activities.

Receptor

The primary receptors during the construction phase will include fish species (both juveniles and adults, including endangered species such as Baghair and Chitol); shrimp, crabs, and benthic macroinvertebrates (including polychaetes, mollusks, and crustaceans); aquatic plants that provide spawning and nursery grounds; migratory waterfowl utilizing shallow haors during winter; and local communities dependent on fishing.

Impacts

Construction-phase activities are expected to result in the following impacts.

- Temporary disturbance to fish and fish fry from embankment/polder works and canal excavation.
- Increased turbidity and sedimentation from dredging and spoil disposal, impairing fish feeding and respiration.
- Removal of aquatic vegetation may temporarily affect breeding habitats and bird nesting.
- Noise/vibration and boat traffic disrupting fish migration and waterbird feeding behavior.
- Localized mortality of benthic species due to excavation and spoil dumping.
- Accidental fuel/chemical spills polluting aquatic habitats.

Considering the sensitivity of the surrounding aquatic ecosystems and their associated flora and fauna, the significance of impacts on these receptors during the construction phase is expected in some extent.

Mitigation Measures

- Time major dredging/excavation works outside peak fish breeding (March–June) and migratory bird congregation (Nov–Feb), and give special attention to Shanir Haor, as it is located near Tanguar Haor (a Ramsar and Ecologically Critical Area [ECA] site).
- Implement silt curtains to minimize turbidity in adjacent beels.
- Dispose of dredged spoil in approved upland areas or use for community asset elevation (schools, homesteads).
- Restrict night-time noisy works near key bird habitats.
- Maintain spill response kits and emergency protocols for hazardous material handling.

With the implementation of appropriate mitigation measures, the significance of the impact is expected to be reduced to insignificant.

8.1.2.2.2.2 Impacts during Operation Phase/Post-construction

Source

Routine maintenance of roads, bridges, culverts, protective walls, ghats, growth centers, and beel/khal systems. Desilting, re-excavation, and minor repairs. Community use of infrastructure and fisheries resources, including CAIGA activities.

Receptor

The primary receptors for these activities are fish populations and spawning habitats in beels, khals, and wetlands; shrimp, benthic invertebrates, and plankton communities; wetland vegetation (including Hijol, Pulm, Nymphaea, sedges, and water hyacinth); migratory and resident waterbirds; and local communities dependent on fisheries, navigation, and agriculture.

Impacts

Operation-phase activities are expected to result in the following impacts on fisheries and aquatic resources.

- Altered hydrological flow and water connectivity affecting fish migration between beels and rivers.
- Reduction in nursery habitat availability due to prolonged water retention or premature drainage.
- There is some risk of aquatic fauna mortality from regulator mis-operation (fish entrapment).
- Minor disturbance to bird habitats from increased boat traffic and navigation activities.
- Introduction of agricultural pollutants from small-scale mechanized farming.

Considering the sensitivity of the surrounding aquatic ecosystems and their associated flora and fauna, impacts on these receptors during the operation phase are expected in some extent.

Mitigation Measures

- Implement fish-friendly gate operation schedules (partial opening, staggered drainage) in coordination with DoF and BWDB.
- Promote integrated pest management (IPM) and organic fertilizer use.
- Maintain and expand community-based wetland afforestation (Hijol, Pulm) to stabilize banks and provide fish/bird habitats.
- Regulate boat speeds and restrict night navigation in ecologically sensitive haor pockets.

With the implementation of appropriate mitigation measures, the significance of the impact is expected to be reduced to insignificant.

8.1.2.3 Hydrology

8.1.2.3.1 Impacts on Hydrology during Construction Phase

Source

- Land modification

Impacts

As construction works in haor areas are planned for the dry season, when water levels remain low and floodplain areas are not inundated, no significant impact on natural hydrological patterns is expected. Activities such as excavation, earth filling, and material transport will be confined to dry ground, thereby avoiding obstruction of flood flows or alteration of drainage networks. Only minor, localized disturbances such as temporary surface runoff changes or small waterlogging around borrow pits may occur, but these will be negligible and short-term.

Mitigation Measures

- Ensure all major earthworks are completed before the onset of the monsoon.
- Store construction materials above expected pre-monsoon water levels to prevent accidental flow obstruction.
- Rehabilitate borrow pits promptly to avoid creating localized waterlogging pockets.

8.1.2.3.2 Impacts on Hydrology during Operation Phase

Source

- Land modification

Impacts

Submerged roads, although intended to minimize disruption by allowing seasonal submergence, can still modify micro-hydrology. Changes in water velocity and flow direction may cause sediment accumulation in some pockets and erosion in others. This can gradually reshape the drainage network and affect the storage capacity of the basin. Inadequate provision of cross-drainage structures (culverts, regulators, sluice gates) further aggravates the problem by restricting fish migration routes and interrupting the hydrological connectivity between beels, khals, and the main haor basin.

Mitigation Measures

- The natural drainage pattern should be preserved.
- Align roads along natural ridges or higher ground to minimize interference with flood flow.
- Provide adequate cross-drainage structures (culverts, bridges, regulators) at regular intervals to maintain natural water movement and connectivity.

8.1.2.4 Topography/geology

8.1.2.4.1 Impacts on Topography/Geology during Construction Phase

Source

- Land modification

Impacts

The construction of submerged roads in haor areas modifies the natural topography through earth filling and embankment works. Although submerged roads are designed to remain underwater during the monsoon, the raised alignment still alters the otherwise flat basin-like terrain of the haor.

Mitigation Measures

- Save topsoil removed at the start of the project and use it for reclaiming disturbed areas upon completion of development and construction activities.
- Restrict earth cutting and filling to the minimum required level consistent with submerged road design standards.

8.1.2.4.2 Impacts on Topography/Geology during Operation Phase

No activities are identified during the operation phase that will affect the topography or geology of the area. Submersible roads generally maintain seasonal water flow, so long-term changes to topography are minimal, limited to minor embankment-induced modifications.

8.1.3 Impacts on Social Environment

The assessment of socio-economic impacts has been undertaken with respect to natural capital, human capital, social capital, economic capital, and physical capital to have a significant interaction with the activities linked to the project across its lifecycle. For assessment of impacts, the project lifecycle has

been divided into two phases – (i) construction phase (this includes the pre-construction phase also) and (ii) operation phase.

8.1.3.1 Land Acquisition and Resettlement

8.1.3.1.1 Loss of Land

8.1.3.1.1.1 Pre-construction/ Construction Phase

Sources

Haor Area Resilience and Development Project involve components such as rural infrastructure development including village protection walls construction, road improvement, bridge and culvert construction, protective structures, growth centers, local market and ghat development, rehabilitation and maintenance of roads. Village protection walls construction and other development may require land acquisition creating impact during pre-construction period. The resettled and rehabilitated HH numbers of the project area will be confirmed after the RAP.

Receptors

Titleholders and non-titleholders of land, sharecropper (if any village adjacent land is acquired which is cultivated by sharecropper). The number of affected households will be finalized during RAP preparation.

Impacts

- Due to the land acquisition, landowners will lose their land permanently. It may cover some portions of land adjacent to the homesteads with possibility of affecting some structures. Some cultivated lands may also be covered by land acquisition.
- Poor and vulnerable people who own the land or depend on the acquired land will be affected by land acquisition.
- Common property resources like graveyards and religious places may be affected due to land acquisition.

The resettlement and land acquisition activities may result in permanent loss of land, structures, and common property resources, along with effects on livelihoods.

Considering this, the impact is expected to be significant.

Mitigation Measures

- The project should aim to minimize land acquisition, avoid physical displacement, and prevent the takeover of productive land.
- When avoidance or minimization is not possible, a comprehensive Resettlement Action Plan (RAP) should be prepared, with provisions for cash compensation for acquired land.
- The land acquisition process should be done through the enforcement of Acquisition and Requisition of Immovable Property Act, 2017 (ARIPA), the landowner will be duly compensated as per the provisions mentioned in the Entitlement Matrix of Resettlement Action Plan.
- Stakeholder Engagement Plan and Grievance Redressal Mechanism should be implemented.
- It should be ensured that compensation is paid to the affected people before the commencement of any construction work.

With proper implementation of the mitigation measures, the impact will be reduced significantly.

8.1.3.1.1.2 Operation Phase

The acquisition will be completed prior to the construction phase. So, no impact will occur during the construction phase.

Mitigation Measures

There is no major impact that is anticipated during the operation phase and therefore no mitigation measure is suggested.

8.1.3.1.2 Loss of Structures

8.1.3.1.2.1 Pre-construction/ Construction Phase

Source

Land acquisition for village protection walls and other construction which has possibility of covering homestead, and other structures.

Receptors

Titleholders and non-titleholders of land, local people.

Impacts

Structure including homestead, shops or other structures may be affected due to the land acquisition for village protection walls construction (to be finalized during RAP). However, considering this, the impact is expected to be significant.

Mitigation Measures

- The project should aim to minimize impact on existing structures.
- When avoidance or minimization is not possible, a comprehensive Resettlement Action Plan (RAP) should be prepared, with provisions for cash compensation for structure on the acquired land.
- The land acquisition process should be done through the enforcement of Acquisition and Requisition of Immovable Property Act, 2017 (ARIPA), the landowner will be duly compensated as per the provisions mentioned in the Entitlement Matrix of Resettlement Action Plan.
- Stakeholder Engagement Plan and Grievance Redressal Mechanism should be implemented.
- It should be ensured that compensation is paid to the affected people before the commencement of any construction work.

With proper implementation of the mitigation measures, the impact will be reduced significantly.

8.1.3.1.2.2 Operation Phase

No impact is expected.

8.1.3.1.3 Sharecroppers

8.1.3.1.3.1 Pre-construction/ Construction Phase

Sources

Involuntary land acquisition for village protection walls construction may cover some agricultural lands with possibility of affecting sharecropper.

Receptors

Informal sharecroppers who previously used the affected land are the recipients of the impacts.

Impacts

Sharecroppers use the titleholders' land under an informal agreement to share the produce proportionately. If sharecroppers are affected, they will permanently lose access to the acquired land that they previously used to produce crops for living.

Therefore, some potential negative impacts on sharecroppers may be created.

Mitigation Measures

- A context-specific ILRP should be prepared.
- Implementation of ILRP should be ensured to minimize livelihood impacts.

With the proper implementation of mitigation measures, the negative impact will reduce.

8.1.3.1.3.2 Operation Phase

No impact is expected.

8.1.3.2 Vulnerable Groups

8.1.3.2.1 Pre-construction/ Construction Phase

Sources

Permanent impact of involuntary land acquisition and probable temporary restriction of economic activity during construction of structure, improvement of growth center/market, re-excavation of Khals may cause some impact on poor and vulnerable households, such as elderly and/or women-headed households, and households below the poverty line.

Receptors

Poor and vulnerable households who have any form of dependency on the acquired land or the temporarily affected areas like growth centers/market, khals may suffer from some impact. Such as, some vulnerable households may have dependency on laboring works during cultivation or harvesting period of crops in the acquired land, they may have some dependency fishing on the re-excavated khals which will be restricted during re-excavation.

Impacts

Since the land acquisition for the village protection works and other improvement activities may restrict locals access for temporary time, the impact on vulnerable households are not likely to be significant. However, in cases of any impact, the vulnerable households will lose works in the acquired land where they previously worked or were benefited by other means.

Considering this, the impact on poor and vulnerable people may be created to some extent.

Mitigation Measures

- Particular attention should be paid to the needs of the poor and vulnerable and adapt the engagement process accordingly.
- A context-specific ILRP should be prepared. It is necessary to ensure that women have a role in decision-making.
- Implementation of the ILRP should be ensured to minimize livelihood impacts.

With proper implementation of mitigation measures, the impact on poor people, including vulnerable people will be reduced.

8.1.3.2.2 Operation Phase

Sources

Improvements of roads, khals, village protection and other activities may create positive impact/opportunities on poor and vulnerable households, such as elderly and/or women-headed households, and households below the poverty line.

Receptors

Poor and vulnerable households who have dependency.

Impacts

Poor people including vulnerable households may be benefited by improved roads, khals and agriculture. While improved roads will increase for goods and other business-related transportation, khals and beel development will help them providing improved access to the fishery resources. Ecotourism may also provide some economic opportunities for poor people. Poor people/household members will also be benefited by alternative income generation activities/livelihood supports.

8.1.3.3 Ethnic Minorities/Indigenous People

8.1.3.3.1 Pre-construction/ Construction Phase

No indigenous/ethnic people live in the project affected area. No impact is expected.

8.1.3.3.2 Operation Phase

No impact will be expected on minority group and indigenous people during Operation phase.

8.1.3.4 Local Economy, Employment and Livelihood

8.1.3.4.1 Pre-construction/ Construction Phase

Sources

During the pre-construction phase, the local economy and livelihood may be impacted by land acquisition for the village protection walls and other project related activities in the lands to be acquired. During the construction phase, following sources may create impact.

- Waste generated from construction work may interrupt.
- Temporary restriction on access to the existing roads for local movement and goods transportation.
- Temporary restriction on access to the existing Khals/canals during re-excavation.
- Employment opportunities from construction work.
- Agricultural promotional activities.

Receptors

The individuals who previously owned or used the acquired land for agricultural and other economic purposes, who depends on the targeted roads for communication and goods transportation, who depend on the Khals/canals which are under the project coverage, who use road side as a grazing land for cattle, and who use khals for duck rearing will be the recipients of the impact. Others like local People, fishermen, local unskilled and semi-skilled workers, migrant workers, small businesses and traders, transport operators (auto-rickshaw/CNG drivers), etc. will be benefited.

Identified Impacts

Negative Impact

- Land acquisition in different places of the targeted haors, which may cover some agricultural land or land where different economic activities (e.g., shops) exist. Since the land acquisition will be initiated before the construction, the affected landowners and users (like sharecropper) will lose their access to cultivate or other uses. As a result, it will impact on their household income and livelihoods.
- Road improvement, bridge and culvert construction, protective structures, growth centers, local market and ghat development, rehabilitation and maintenance of roads may have impact during construction period. For example, village road improvements activities including construction culvert/regulators may affect adjacent land for the temporary periods, improvement of growth center and rural market will affect the business entities during the construction period.

- During the re-excavation of Khals, fishermen may face some impact for a short period of time although re-excavation is assumed to be planned in silted portion with less possibility of water and fish availability during the re-excavation.
- Some cattle owners/grazers may be affected who graze their cattle on the bank of khals, roadsides and other places where the interventions will be taken.
- During the construction of boat landing stations, fishing boat may face impact for fish landing or it may require additional time for them to transport the fish.
- Moreover, the people, including agricultural laborers and others who potentially earn from the crops produced from these lands (such as local vendors) or who were benefited by the economic activities on the acquired land will also be impacted to some extent.

Overall, some negative impact is expected on local economy, employment and livelihood.

Positive Impact

- Different types of preliminary studies and surveys may benefit some local people economically such as local transport owners and drivers, and other people based on their qualification and skill.
- During the construction phase, local skilled, semi-skilled and unskilled workforce may get employment opportunities during all kinds of construction works based on their capabilities. Local businesses entities like restaurants, grocery stores, and mobile banking services may be benefited near the labor camps.

However, considering the income and job opportunities during construction period, some positive impact is expected from the project.

Mitigation Measures

- Title and non-title vulnerable households should be identified during the RAP and a context-specific ILRP should be prepared.
- Implementation of ILRP should be ensured to minimize livelihood impacts.
- Project Affected Persons (PAPs) should be prioritized during any employment opportunities related to this project.
- Develop and enforce a construction waste management plan (segregation, collection, and safe disposal).
- Follow measures to avoid disturbance in adjacent lands.

With proper implementation of mitigation measures, the impact will be reduced.

8.1.3.4.2 Operation Phase

Sources

During the operation phase some impact, if the roads, drainage system of growth centers/markets are not maintained properly, it may create some negative impacts.

Receptors

Local people, working people who regularly travel by village roads, market-bound people, etc.

Identified Impacts

Negative Impact

- Poorly maintained roads may create impact causing interruption for travelling by local people, school children or market bound people, which will require additional time and money for travelling to the destination.

- Poorly maintained drainage systems and other systems in growth centers and markets may make the business inconvenient which can reduce business opportunities.

Considering this, some negative impact during operation phase is anticipated.

Positive Impact

- Strengthened and improved roads will better facilitate local communication and goods transportation.
- Improved rural roads will facilitate timely harvesting of crops and safe transportation protecting from floods, which contribute to increasing income and food security for the farmers and local people.
- Re-excavated Khals will connect beels with rivers and serve natural fish breeding contributing to increase fish population. It will ultimately increase income of local fishermen and nutritional gain of local people.
- Re-excavated khals will also be helpful for duck rearing.
- Improved growth center and local market will serve as a hub for the local economy and business, creating opportunities for trade, small enterprises, and employment, thereby enhancing livelihoods and community prosperity. It will particularly facilitate better marketing of agricultural and fishery products, enhance trade opportunities, and improving income for farmers and fishers.
- Improved boat landing stations/ghats will help facilitate the transportation fish and trade of goods, particularly agricultural and fishery products, enhance connectivity for local communities, and support livelihoods and economic activities along the waterway.
- Development of culture fisheries and beel an fish sanctuaries will support sustainable fish production, conserve aquatic biodiversity, and strengthen local livelihoods dependent on fisheries, while promoting long-term ecological balance and community-based resource management.
- Establishment of eco-tourism and knowledge center may attract tourists and other groups of people from neighboring and other regions which may create some economic opportunities for local people.

Considering this, the positive impact will be created to a significant extent.

Mitigation Measures

- Ensure proper maintenance of the roads, structures, and growth center.
- Enhance the capacity of local people for community-based resource management.

With proper implementation of mitigation measures, the negative impact will be reduced.

8.1.3.5 Land Use and Utilization of Local Source

8.1.3.5.1 Pre-construction/ Construction Phase

Sources

The acquisition of agricultural land will decrease the cultivable land in the project area.

Receptors

Title holders and non-title holders of the land that will be acquired.

Impacts

Negative Impact

Land will be acquired some targeted haors for some developments. It may cause reduction of the cultivable land in some areas.

Although the land acquisition will cause reduction of cultivable land, it will not significantly impact on the production or land use pattern since the land is mostly single cropped low-land or fallow land or near the homestead areas.

Positive Impact

Due to the increased accessibility to the agricultural land by improved roads, Khals (for irrigation) and other developments, diversified agricultural practices may be possible with potential change in cropping patterns in some areas.

However, considering the activities under the project, there will be some positive impact on the land use.

Mitigation Measures

- Provide fair compensation to the affected people.
- Prepare context specific ILRP and ensure proper implementation.
- Training and financial support for farmers to transition to alternative employment or modern agricultural techniques.

With the proper implementation of the mitigation measures, the negative impact will be reduced to a significant extent.

8.1.3.5.2 Operation Phase

No major impact is expected during operation phase of the project.

8.1.3.6 Water Use and Water Services

8.1.3.6.1 Pre-construction/ Construction Phase

There is no major impact on the water usage and water rights during pre-construction and constriction phase of the project.

8.1.3.6.2 Operation Phase

Sources

Retention of water and planned water management activities is expected to be source of many productive works for local farmers, fishermen and community in general.

Receptors

Local farmers, fishermen and the local community in general who depend on the water resources in multiple ways including farming, fishing, etc.

Positive Impacts

- Although no negative impact on water and water rights has been identified, there will be some positive impact on water and water rights of the locals.
- The re-excavation nof Khals, beels and water management structure will help manage water in a planned way to supplement irrigation during cultivation.
- The water retention in the Khals/canals and in the re-excavated khals will also facilitate natural fish breeding which helps increase in fish production and conserving local fishery species.
- Development of beel will help increase fish production and the conserved water which serve beel users groups and local people.

The proper management of water resources will help irrigation enhancing yield and natural fish breeding resulting in increased water resource-dependent livelihood options.

8.1.3.7 Existing Social Infrastructure and Services

8.1.3.7.1 Pre-construction/ Construction Phase

Sources

Repairing and improvement of roads.

Receptors

Local people including market bound people, students, healthcare service seekers, etc.

Identified Impacts

Although the improvement of roads is not expected to create any broader barriers to local social infrastructure, in some part, following impacts may be created based on the volume of works.

- Construction traffic, heavy vehicles/machineries (excavators, big truck), and excavation may damage local roads, culverts, or footpaths that connect people to schools, health centers and other community places.
- Temporary road blockages, diversions, or embankment may make it difficult for students, patients, and community members to reach schools, markets, or clinics.
- Water-based transport routes (boats) may also be disrupted due to construction near canals or rivers.
- Influx of construction workers can increase demand for local shops, healthcare services, and water/sanitation facilities, straining community resources.
- Poor waste disposal from camps may create sanitation hazards around social infrastructure.

Therefore, considering the nature of the activities, some impact will be created on social infrastructure, which is not expected to be significant.

Mitigation Measures

- Prepare proper plans to avoid schools, health centers, religious sites, and markets as much as possible.
- Provide temporary access routes, boat services if required in any place to ensure uninterrupted access to schools, clinics, and markets.
- Implement traffic management plan.

With proper implementation of mitigation measures, the impact will be mitigated.

8.1.3.7.2 Operation Phase

Sources

Increased access to the social infrastructure due to enhanced communication and navigation on the embankment and through the Khals/canals.

Receptors

Local people, school children, rickshaw/auto rickshaw drivers may be the receptors of some impacts during operation phase when the embankment enhance communication during dry season.

Identified Impacts

Negative Impact

Transportation and communication will increase substantially and that may cause some increased access social infrastructure during dry season. However, these impacts are not likely to be significant.

Positive Impact

Due to the development, access to the social infrastructure may increase which allows community people to enjoy more benefits.

Mitigation Measures

- Establish traffic management systems.
- Increase capacity of local social infrastructures.

With proper implementation of mitigation measures, the impact will be mitigated.

8.1.3.8 Social institutions such as social capital and local decision-making bodies

8.1.3.8.1 Pre-construction/ Construction Phase

Source

Activities such as land acquisition, re-excavation of Khals/canals, construction of village protection walls, eco-tourism development, etc. may be source of impact on local communities and decision-making institutions.

Receptors

Local people, activist groups, Union parishad, upazila parishad etc.

Identified Impacts

During the pre-construction phase, lad acquisition will be conducted in the targeted areas. This will have an impact on the local community particularly among the titleholders and non-titleholders of land. Support and guidance from relevant decision-making authorities including Union Parishad, local elites and other community leaders will be essential to ensure that the land acquisition process is conducted properly. Therefore, some pressure may be created on the local decision-making institutions, which is not expected to be significant.

Mitigation Measures

- The land acquisition process should be conducted through the enforcement of Acquisition and Requisition of Immovable Property Act, 2017 (ARIPA), the landowner will be duly compensated as per the provisions mentioned in the Entitlement Matrix of Resettlement Action Plan
- Coordinate with relevant institutions like Union Parishad, DC office, etc.
- Ensure participatory consultations with affected people.

8.1.3.8.2 Operation Phase

Sources

Operational activities during operation phase

Receptors

Members of community-based organizations such as Beel User Co-operative Association, market committees, and women's cooperatives will be receptors who will be involved in fisheries management, Compensatory Alternative Income-Generating Activities (CAIGA) and other operational activities.

Positive Impacts

At the grassroots level, community-based organizations such as Beel User Co-operative Association, market committees, and women's cooperatives will be directly involved in fisheries management, Compensatory Alternative Income-Generating Activities (CAIGA), and the operation and maintenance of rural infrastructure. It will benefit the members of the committees/groups in multiple ways like knowledge and capacity enhancement, practical experience, decision making skills and income opportunities.

Thus, the project will make many positive impacts among the locally formed bodies.

8.1.3.9 Unequal Distribution of Damage and Benefit

8.1.3.9.1 Pre-construction/ Construction Phase

Sources

The compensation and rehabilitation eligibility criteria primarily cover landowners, land users and directly affected laborers.

Receptors

Individuals and groups excluded from the compensation eligibility criteria, such as workers dependent on the affected land for their livelihoods.

Impacts

Individuals and groups excluded from the compensation eligibility criteria, such as workers dependent on the affected land for their livelihoods, may face economic displacement without financial support. Similarly, local vendors operating within the project area could experience income losses from the decreased trade with agricultural produce, growth centers, and roads during the construction period. On the other hand, some other local people, workers and business can experience benefits due to income opportunities during construction periods. However, this impact will not be significant.

Mitigation Measures

- Encourage contractors to prioritize hiring local workers, including unskilled labor, to ensure more equitable distribution of job opportunities.
- Conduct consultations with affected communities to identify vulnerable groups and ensure their concerns are addressed in compensation and employment strategies.
- Set up a transparent grievance redress system to allow affected individuals to voice concerns and seek fair resolution regarding compensation and employment.

With proper implementation of mitigation measures, the impact will be reduced significantly.

8.1.3.9.2 Operation Phase

No major impact is anticipated.

8.1.3.10 Conflicts of Interest within the Region

8.1.3.10.1 Pre-construction/ Construction Phase

Sources

The wave in job opportunities during the construction phase may create competition for employment between local communities and external workers.

Receptors

Local communities may feel excluded from employment opportunities, resulting in frustration and potential conflicts. External workers hired for specialized or skilled labor could become targets of local resentment.

Impacts

The increase in employment opportunities during construction may lead to competition between local workers and outsiders, creating potential social conflicts. Local communities might perceive the project as unfair if they feel marginalized in the hiring process. However, the impact will be insignificant considering the extent.

Mitigation Measures

- Ensure that contractors implement fair recruitment practices that prioritize local workers for unskilled or semi-skilled labor positions.
- Conduct regular consultations with local communities to understand their concerns regarding employment opportunities and ensure transparency in the hiring process.
- Establish a clear grievance redress system where local workers can raise concerns about employment opportunities and resolve issues amicably.

With proper implementation of mitigation measures, the impact will be mitigated.

8.1.3.10.2 Operation Phase

No impact is expected.

8.1.3.11 Cultural Heritage

8.1.3.11.1 Pre-construction/ Construction Phase

No historical/cultural/archaeological was found in the project area which would be affected by the project. Therefore, no impact is expected on cultural heritage due to the proposed project implementation.

8.1.3.11.2 Operation Phase

No impact is expected.

8.1.3.12 Landscape

8.1.3.12.1 Pre-construction/ Construction Phase

No significant impact will be expected as there is no scenic spot near the site.

8.1.3.12.2 Operation Phase

No significant impact will be expected as there is no scenic spot near the site.

8.1.3.13 Gender

8.1.3.13.1 Pre-construction/ Construction Phase

Sources

Labor migration during pre-construction/construction phase.

Receptors

Women community surrounding the construction areas.

Identified Impacts

Negative Impact

- Construction work will require workers of different levels to perform the work and other activities related to the project construction period. Many workers will migrate from outside to the construction areas. Therefore, chance of gender-based violence in that area may arise during the construction period.

Positive Impact

- There may be some positive impact that could also benefit women. Some unskilled or semi-skilled small-scale works may involve women such as some earthwork, cleaning, cooking/food supply for labors, etc. may help women.
- Such an income opportunity for women may increase their leadership and control over household decision.

Mitigation Measures

- Resident women should be closely informed about the days during which the works will occur in the areas they used to move or for other activities.
- EPC contractors should alert the labor and worker group for not being involved with such activity.
- Proper guidelines and training should be provided for the workers regarding GBV.
- The OHS manager and Social Safeguard specialist or any such designated person should be in charge of monitoring during the construction work.
- Onsite grievance box should be maintained.

With proper implementation of mitigation measures, the impact will be mitigated.

8.1.3.13.2 Operation Phase

Sources

Women's involvement in operational and maintenance activities and women's inclusion in different committees/groups.

Receptors

Female members of community-based organizations such as Beel User Co-operative Association (BUCA), market committees, and women's cooperatives will be receptors who will be involved in fisheries management, Compensatory Alternative Income-Generating Activities (CAIGA) and other operational activities.

Positive Impacts

Local women will be included in community-based organizations such as Beel User Co-operative Association (BUCA) and market committees. The women's cooperatives will also be directly involved in fisheries management, Compensatory Alternative Income-Generating Activities (CAIGA), and the

operation and maintenance of rural infrastructure. It will benefit the female members of the committees/groups in multiple ways like knowledge and capacity enhancement, practical experience, decision making skills and income opportunities.

Thus, the project will make many positive impacts among the local women.

8.1.3.14 Children's Rights

8.1.3.14.1 Pre-construction/ Construction Phase

Sources

During construction phase, temporary traffic may cause delay in movement on the roads or may restrict movement on the existing embankment that may affect children accessing to the educational institutions.

Receptors

School-going children will face some kind of impact that will arise from the proposed project.

Impacts

Probable impacts from the construction activity mainly cover for the school going children moving through the roads twice in a day will face some impacts due to the temporary traffic or restriction during construction phase.

Mitigation Measures

- Traffic personnel should be appointed at every potential crossing of school for commuting children.
- Safety signage should be placed properly so that school-going children can easily access the route.
- Proper consultation should be conducted with the schoolteacher and management committee.
- EPC contractors should alert the workers/drivers to avoid school time for construction work in those particular areas.
- Child labor at the construction site during the project implementation shall be strictly prohibited since both Bangladesh laws and JICA guidelines ban such practices.

With proper implementation of mitigation measures, the impact will be reduced significantly.

8.1.3.14.2 Operation Phase

Sources

Rural road development and support for women by income generating activities.

Receptors

Children of the areas

Positive Impacts

Children of the areas will be benefited in many ways by the positive impact of the project. For example, road development will allow them to have increased access to their educational institute/schools. The income support to the women will ultimately benefit their children by improving households' capacity to ensure more caring in need.

Thus, the project will benefit children in multiple ways.

8.1.3.15 Infectious Disease, such as HIV/AIDS

8.1.3.15.1 Construction Phase

Sources

The entire construction phase will require labor of unskilled, semi-skilled, skilled, and skilled nature. During Construction, in general, many migrant workers flow into the sites, who may have the possibility with HIV/AIDS, or any other infectious disease (like COVID, Dengue) and the disease can spread among local people.

Receptors

Infectious disease may spread among the local people as the bearer will route and communicate with the people from the locality. Close contact with infected person may spread the disease among people living in that community and the whole community will be impacted.

Impacts

People may suffer from the anonymous disease out of a sudden and then it may spread to the entire community if they do not have any idea regarding the infection. Human health may face health hazards if any disease spreads in that community. However, the impact is anticipated to some extent.

Mitigation Measures

- In order to minimize the impact, preventive measures against such diseases should be considered, and implemented by construction contractors.
- To provide surveillance for workers' health.
- Prevention of illness among workers by undertaking health awareness and education initiatives and by conducting immunization programs for workers.
- To provide treatment through standard case management in on-site and community health care facilities as necessary.
- Educating project personnel and area residents on risks, prevention, and available treatment.
- Promoting collaboration with local authorities to enhance access of workers' families and the community to public health services and promoting immunization as necessary.
- Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites.

With proper implementation of mitigation measures, the impact may be reduced significantly.

8.1.3.15.2 Operation Phase

No impact is expected.

8.1.3.16 Working Environment (Including Work Safety)

8.1.3.16.1 Construction Phase

Sources

- Operation of heavy equipment and transport like heavy truck and excavator.
- Lack of adequate personal protective equipment (PPE) and worker training.

Receptors

Construction workers, unskilled local workers, contractors and supervisors etc.

Impacts

Long hours of work, an unsafe working place/area which is not in favor of workers and lack of proper safety gears and equipment's provided for the workers may represent bad working conditions. Newly

recruited workers and unskilled workers, those who have not handled such work previously, may also fall under the risk of being injured from workplace incidents.

However, the impact is expected to be created to some extent.

Mitigation Measures

- Maintain general OHS guidelines at workplace.
- Areas that are under construction should be protected from trespassing.
- Emergency response measures like first aid and rescuing facilities for any accident should be available.
- Train the newly recruited and unskilled workers for managing any emergency situation/accident.

With proper implementation of mitigation measures, the impact will be reduced significantly.

8.1.3.16.2 Operation Phase

No impact is expected.

8.1.4 Others

8.1.4.1 Climate Change

8.1.4.1.1 During Construction Phase

The operation of construction machinery, trucks, and other vehicles will release greenhouse gases (GHGs), primarily carbon dioxide (CO2), with minor contributions of methane (CH4) and nitrous oxide (N2O). These emissions contribute incrementally to climate change, which can have transboundary effects by slightly influencing regional weather patterns, rainfall, and temperature beyond the immediate project area. However, due to the relatively limited scale of construction activities and vehicle numbers, the transboundary contribution to climate change during the construction phase is expected to be minor.

Mitigation Measures

- Ensure regular maintenance of construction vehicles and machinery to reduce fuel consumption and GHG emissions.
- Optimize machinery operation to avoid unnecessary idling or inefficient usage.
- Use low-emission fuels or energy-efficient machinery where feasible.
- Implement mitigation measures from the air quality management plan to indirectly reduce GHG emissions.
- Monitor GHG emissions from major construction activities periodically.

8.1.4.1.2 During Operation Phase

During the operation phase, submersible roads themselves have minimal direct GHG emissions. However, improved access may indirectly increase traffic volumes, especially in the dry season, leading to a slight rise in vehicle-related emissions. These incremental emissions may contribute marginally to transboundary climate impacts. At the same time, the climate-resilient road design helps maintain natural flood flow and reduces vulnerability to extreme weather, mitigating some broader climate risks. Overall, the impact on transboundary climate conditions during operation is considered low.

Mitigation Measures

- Promote regular maintenance of operational vehicles to reduce fuel consumption and emissions.
- Encourage the use of low-emission vehicles and fuel-efficient driving practices.
- Optimize traffic management to reduce congestion and associated emissions.

- Maintain climate-resilient features of the road to prevent damage from extreme weather and preserve natural hydrological flows.
- Periodically monitor vehicle-related GHG emissions in high-traffic sections to identify mitigation opportunities.

8.1.4.2 Accident

8.1.4.2.1 During Construction Phase

Operation of heavy vehicles and machinery may cause traffic accidents in and around the proposed project sites. Workers engaged in excavation, civil works, and material handling are also at risk of accidents and injuries. Improper traffic management, lack of safety measures, and high movement of vehicles and equipment can significantly increase the likelihood of accidents on-site and in adjacent areas.

Mitigation Measures

- Follow the Health and Safety Management Plan (HSMP) rules and regulations designated by contractors.
- Provide traffic signs, road markings, speed bumps, zebra crossings, guard rails, poles, and curb stones as required.
- Implement a proper traffic management plan to separate construction vehicles, machinery, and pedestrian movement.
- Train workers in safety procedures and ensure the use of personal protective equipment (PPE).
- Maintain emergency response measures and first-aid facilities on-site.
- Conduct regular safety audits and hazard monitoring.

8.1.4.2.2 During Operation Phase

During operation, the incidence of road accidents may increase with rising vehicle volumes on the completed road. High traffic density, mixed vehicle types, and pedestrian interactions near settlements, schools, and marketplaces can contribute to higher accident risks.

Mitigation Measures

- Enforce speed limits and traffic regulations along the road corridor.
- Install appropriate signage, road markings, pedestrian crossings, and traffic calming measures near sensitive areas.
- Maintain road surfaces to prevent accidents caused by potholes or road deterioration.
- Conduct public awareness campaigns on road safety and safe driving practices.
- Monitor accident records and implement corrective measures in high-risk zones.

8.2 Summary of Identified Impacts

The summary of the identified environmental and social impacts is shown in Table 8-3. The impacts in Pre-Construction Phase (PCP)/Construction Phase (CP), and Operation Phase (OP), respectively were classified as A to D for the items with ✓ in the scoping matrix table, in accordance with the following criteria.

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C: Extent of impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: No impact is expected.

N/A: Impact assessment is not conducted because the item was categorized as no effect in scoping phase.

Table 8-3: Summary of the identified impacts

S/N	Items of Impact	Evaluation in Scoping		Evaluation based on EIA		Identified Impacts
		PCP/ CP	OP	PCP/ CP	OP	
Pollution Measures						
1	Air pollution 【Common to all haors】	✓	✓	B-	B-	**Construction Phase:** • Emissions from construction machinery and vehicles. • Dust from aggregate production and transport routes. • Exhaust and particulates from diesel-powered earthmoving and excavation. • Localized air quality deterioration at construction sites. **Operation Phase:** • Improved connectivity may raise traffic volumes and emissions.
2	Water quality 【Common to all haors】	✓	-	B-	D	**Construction Phase:** • Accidental spillage of fuel, lubricants, solvents, and other construction materials may contaminate water. • Runoff from construction camps carrying domestic sewage and kitchen waste may pollute surface water. **Operation Phase:** • No impact is expected.
3	Soil contamination 【Common to all haors】	✓	-	B-	D	**Construction Phase:** • Accidental spillage of fuel, chemicals, and liquid waste may contaminate soil. • Improper disposal of dredged spoils may degrade soil quality. **Operation Phase:** • No impact is expected.

S/N	Items of Impact	Evaluation in Scoping		Evaluation based on EIA		Identified Impacts
		PCP/ CP	OP	PCP/ CP	OP	
4	Waste 【Common to all haors】	✓	-	B-	D	**Construction Phase:** • Generation of construction debris: excavated soil, concrete, timber, metal, and packaging materials. • Domestic waste from labor camps: food scraps, plastics, and general refuse. • Poor waste management may cause localized soil contamination. • Waste can obstruct drainage channels and increase runoff into nearby water bodies, affecting water quality. **Operation Phase:** • No impact is expected.
5	Noise and vibration 【Common to all haors】	✓	✓	B-	D	**Construction Phase:** • A temporary increase in noise and vibration levels is expected due to the operation of construction machinery and the movement of construction vehicles. **Operation Phase:** • Traffic may cause persistent noise and vibrations, affecting settlements and habitats.
6	Ground subsidence 【Common to all haors】	-	-	D	D	**Construction Phase:** • Groundwater use and excavation will be minimal, so the risk of ground subsidence is negligible. **Operation Phase:** • No impact is expected.
7	Offensive odor 【Common to all haors】	✓	-	B-	D	**Construction Phase:** • Temporary odors from fuel and oil leaks. • Odors from workers' sanitation facilities may cause local discomfort.

S/N	Items of Impact	Evaluation in Scoping		Evaluation based on EIA		Identified Impacts
		PCP/ CP	OP	PCP/ CP	OP	
						Operation Phase: • No odor-related impacts are expected.
8	Bottom sediment 【Common to all haors】	✓	-	B-	D	**Construction Phase:** • Bottom sediment disturbance from embankment construction, dredging, and excavation. • Increased turbidity reduces light penetration and affects aquatic plants and animals. • Suspended sediments may clog fish gills, smother benthic organisms, and lower dissolved oxygen. • Temporary degradation of aquatic habitats and disruption of fishing activities. **Operation Phase:** • No impacts on bottom sediment are expected.
Natural Environment						
9	Protected area and Eco-sensitive Zones 【Common to all haors】	-	-	D	D	**Construction Phase:** • As there are no protected or ecologically sensitive areas within the proposed project site or its area of influence, no impact on such areas is anticipated. **Operation Phase:** • As there are no protected or ecologically sensitive areas within the proposed project site or its area of influence, no impact on such areas is anticipated.
10	Biodiversiy 【Shanir Haor】	✓	✓	B-	B-	**Construction Phase:** • Although Shanir Haor is not part of a protected area, it is located near Tanguar Haor (a protected area) and may serve as a habitat for important species such as migratory birds that visit Tanguar Haor in winter. Therefore, there is a potential for impacts on these bird species. • Increased turbidity and sedimentation caused by runoff during construction may affect aquatic organisms and fish spawning and nursery grounds. • Aquatic habitat in the fish sanctuaries may be impacted by excavation, embankment

S/N	Items of Impact	Evaluation in Scoping		Evaluation based on EIA		Identified Impacts
		PCP/ CP	OP	PCP/ CP	OP	
						construction, and soil reshaping, leading to turbidity, sedimentation, and potential effects on brood fish, along with noise and vibration from machinery that could stress or displace aquatic species. **Operation Phase:** • The submerged road may alter water flow and sediment patterns, potentially impacting habitats for aquatic plants, plankton, benthic organisms, and fish spawning and breeding areas. On the other hand, the long-term impact on the movement of terrestrial wildlife is expected to be minimal. • Increased vessel traffic and navigation activities may disturb bird habitats. • The project area contains fish sanctuaries, and potential impacts on these sanctuaries and aquatic resources include habitat disturbance from desilting and re-excavation, which may affect brood fish and juvenile refuges.
	Biodiversity 【Other Haors】	✓	✓	B-	B-	**Construction Phase:** • Permanent vegetation removal, tree felling, soil compaction, and habitat fragmentation may reduce food, shelter, and movement corridors for birds, mammals, reptiles, and amphibians. • Noise, vibrations, dust, emissions, and human presence disrupt nesting, roosting, and foraging, while earth-moving activities pose direct mortality risks to less mobile species and indirectly affect wetland-edge habitats. • Runoff from the construction site may carry higher quantity of sediments, construction waste and hazardous parameters, polluting surface water, and impact the aquatic life. • Disturbance or loss of spawning and nursery grounds of fish from embankment/polder works and canal excavation. • Increased turbidity and sedimentation from dredging and spoil disposal, impairing fish feeding and respiration.

S/N	Items of Impact	Evaluation in Scoping		Evaluation based on EIA		Identified Impacts
		PCP/ CP	OP	PCP/ CP	OP	
						Operation Phase: • Increased tourism, community activities, and noise generation can stress resident and migratory birds and mammals, leading to their displacement from foraging or nesting sites. • Movement along roads, ghats, and embankments may disturb reptiles and amphibians using these habitats. Increased vehicle movement may increase road kills of wildlife. • Altered hydrological flow and water connectivity affecting fish migration between beels and rivers. • Reduction in nursery habitat availability due to prolonged water retention or premature drainage. • Risk of aquatic fauna mortality from regulator mis-operation (fish entrapment). • Potential disturbance to bird habitats from increased boat traffic and navigation activities.
11	Hydrology 【Common to all haors】	-	✓	D	B-	**Construction Phase:** • No significant impact on natural hydrological patterns is expected. Localized disturbances such as temporary surface runoff changes or small waterlogging around borrow pits may occur. **Operation Phase:** • Submerged roads, although intended to minimize disruption by allowing seasonal submergence, can still modify micro-hydrology. Changes in water velocity and flow direction may cause sediment accumulation in some pockets and erosion in others.
12	Topography/ geology 【Common to all haors】	✓	-	B-	D	**Construction Phase:** • Construction of submerged roads in haor areas modifies the natural topography through earth filling and embankment works. Although submerged roads are designed to remain underwater during the monsoon, the raised alignment still alters the otherwise flat basin-like terrain of the haor.

S/N	Items of Impact	Evaluation in Scoping		Evaluation based on EIA		Identified Impacts
		PCP/ CP	OP	PCP/ CP	OP	
						Operation Phase: • No impact is anticipated.
Social Environment						
13	Land acquisition and resettlement 【Common to all haors】	✓	-	A-	D	**During Construction:** • Construction village protection walls and some other works may may require land acquisition, potentially impacting the livelihoods of the people who own or use the affected land. **Operation and Maintenance:** • There is no additional land acquisition.
14	Poor people 【Common to all haors】	✓	✓	B+/-	B+	**Before/During Construction:** • The poor people who worked in the acquired land may be affected. The construction of the embankment is expected to create job and commercial opportunities for local residents, including vulnerable groups. **Operation and Maintenance:** • Poor people/household members will be benefited by alternative income generation activities/livelihood supports. Road's development will allow timely crop harvesting with increased agricultural work opportunities for poor people. Fishery development and other activities will also benefit them in multiple ways.
15	Ethnic minorities/ indigenous people 【Common to all haors】	✓	✓	D	D	**Construction Phase:** • No impact is expected, as no indigenous/ethnic people have been identified. **Operation Phase:** • No impact is expected.

S/N	Items of Impact	Evaluation in Scoping		Evaluation based on EIA		Identified Impacts
		PCP/ CP	OP	PCP/ CP	OP	
16	Local Economy, Employment and Livelihood 【Common to all haors】	✓	✓	B+/-	A+	**During Construction:** • Project-Affected Households (PAHs) who earn income from the acquired land or land where other development will take place, may lose their source of income either permanently or temporarily. • Some affected household and local people will get employment in construction related activities. **Operation and Maintenance:** • Implementation of the project will help harvesting crops timely, enhancing fishing activities, and creating opportunities for economic activities by other interventions. Therefore, it will improve the livelihood of the local people.
17	Land use and utilization of local resources 【Common to all haors】	✓	-	B-	B+	**Construction Phase:** • Reduction of agriculture land may result in a shift in agricultural practices of some people. Moreover, improve farming capacities may facilitate cropping diversification with dynamics cropping pattern. **Operation Phase:** • Diversified cropping pattern.
18	Water use 【Common to all haors】	✓	-	D	B+	**During Construction:** • Surface water from nearby rivers or groundwater will be used during the construction phase. **Operation and Maintenance:** • Re-excavation of Khals and beel development will support irrigation for agricultural production.

S/N	Items of Impact	Evaluation in Scoping		Evaluation based on EIA		Identified Impacts
		PCP/ CP	OP	PCP/ CP	OP	
19	Existing social infrastructure and services 【Common to all haors】	-	-	D	B+	**Before/During Construction:** • Impact on social infrastructure/service will be limited and/or negligible. **Operation and Maintenance:** • Access to social infrastructure may increase due to improved roads and connectivity.
20	Local communities and local decision-making bodies 【Common to all haors】	✓	✓	B-	B+	**Before/During Construction:** • Social institutions and local decision-making institutions of the project area may be impacted. **Operation and Maintenance:** • Positive impact will be made on locally formed groups (like BUG) who will be involved in operational activities.
21	Uneven Distribution of Damage and Benefit 【Common to all haors】	✓	-	B-	D	**Before/During Construction:** • Only landowners and affected laborers will be eligible for compensation and rehabilitation. **Operation and Maintenance:** • No impact is expected.
22	Conflicts of interest within the region 【Common to all haors】	✓	-	B-	D	**Before/During Construction:** • Due to an increase in employment opportunities during construction, construction workers may experience some conflicts between local communities. **Operation and Maintenance:** • No impact is expected.
23	Cultural heritages	✓	✓	D	D	**Before/During Construction:** • No impact is expected

S/N	Items of Impact	Evaluation in Scoping		Evaluation based on EIA		Identified Impacts
		PCP/ CP	OP	PCP/ CP	OP	
	【Common to all haors】					**Operation and Maintenance:** • No impact is expected
24	Land scape 【Common to all haors】	✓	-	D	D	**Before/During Construction:** • No impact is expected **Operation and Maintenance:** • No impact is expected
25	Gender 【Common to all haors】	✓	✓	B+/-	B+	**During Construction:** • There will be some impact due to chance of gender-based violence. Some unskilled or semi-skilled small-scale works may involve women such as some earthwork, cleaning, cooking/food supply for labors, etc. may help women. **Operation and Maintenance:** • Positive impact will be taken place as women will also be included in operational activities and other promotional activities.
26	Children's rights 【Common to all haors】	✓	✓	B-	B+	**Construction Phase:** • The construction activity may create some impact school-going children who travel on the roads twice a day. **Operation Phase:** • Children will be benefited by improved access to schools and reduced risk by flood protection. The support to female household members will also bring some benefits to the children.
27	Infectious diseases such as HIV/AIDS	✓	-	B-	D	**During Construction:** • Influx of workers may increase the risk of infectious diseases.

S/N	Items of Impact	Evaluation in Scoping		Evaluation based on EIA		Identified Impacts
		PCP/ CP	OP	PCP/ CP	OP	
	【Common to all haors】					**Operation and Maintenance:** • No impact is expected.
28	Working environment (work safety) 【Common to all haors】	✓	-	B-	D	**During Construction:** • There would be the possibility to accidents and incidents occurring during construction works for the implementation of the project. **Operation and Maintenance:** • No impact is expected.
Others						
29	Transboundary impacts and climate change 【Common to all haors】	✓	✓	B-	B-	**Construction Phase:** • Construction machinery, diesel equipment, and transport vehicles will emit greenhouse gases, mainly CO_2, contributing to climate change. Sources include engines of earthmoving machinery, generators, and material transport trucks. **Operation Phase:** • Minimal direct greenhouse gas emissions from submersible roads. • Slight increase in emissions due to higher vehicle use in the dry season. • Positive impact on climate resilience by preserving natural flood flow and reducing vulnerability to extreme weather.
30	Accident 【Common to all haors】	✓	✓	B-	D	**Construction Phase:** • Construction and road accidents in and around the project site may occur as a result of ongoing construction activities, posing potential safety risks to workers and the local community. **Operation Phase:** • Increased vehicle volume may raise the risk of road accidents. However, it will have minor impact.

8.3 Evaluation of Impacts

All positive and negative impacts on environmental and social components due to the construction and operation activities have been discussed in Section 8.1. Also, the proposed mitigation measures and residual impacts have been discussed elaborately. The evaluation of impact has been made in this section considering without mitigation measures and with mitigation measures and rated in A, B, C, and D. The definition of the rating is the same as depicted in Section 8.2.

Some impact ratings considered during the scoping stage have been changed after a detailed assessment in Section 8.1. The evaluation of environmental impacts is expressed in the context of physical, natural, and social environment and other points of view as assessed during the scoping stage. The evaluation matrix after detailed assessment considering without mitigation and with mitigation along with scoping is presented in Table 8-4.

Table 8-4: Evaluation matrix of environmental and social impact

	Items of Impact		Evaluation in Scoping		Evaluation based on EIA			
			PCP/ CP	OP	PCP/CP		OP	
					Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Pollution Measures	1.	Air pollution	✓	✓	B-	D	B-	D
	2.	Water quality	✓	-	B-	D	D	D
	3.	Soil contamination	✓	-	B-	D	D	D
	4.	Wastes	✓	-	B-	D	D	D
	5.	Noise/vibration	✓	✓	B-	D	D	D
	6.	Ground subsidence	-	-	D	D	D	D
	7.	Offensive odor	✓	-	B-	D	D	D
	8.	Bottom sediment	✓	-	B-	D	D	D
Natural Environment	9.	Protected areas	-	-	D	D	D	D
	10.	Biodiversity	✓	✓	B-	D	B-	D
	11.	Hydrology	-	✓	D	D	B-	D
	12.	Topography/ geology	✓	-	B-	D	D	D
Social Environment	13.	Land acquisition and resettlement	✓	-	A-	D	D	D
	14.	Poor people	✓	✓	B+/-	D	B+	B+
	15.	Ethnic minorities/ indigenous people	✓	✓	D	D	D	D
	16.	Livelihood	✓	✓	B+/-	B+	A+	A+
	17.	Land use and utilization of local resources	✓	-	B-	D	B+	B+
	18.	Water use	✓	-	D	D	B+	B+
	19.	Existing social infrastructure and services	-	-	D	D	B+	B+

	Items of Impact		Evaluation in Scoping		Evaluation based on EIA			
			PCP/ CP	OP	PCP/CP		OP	
					Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
	20.	Local communities and local decision-making bodies	✓	✓	B-	D	B+	B+
	21.	Uneven distribution of damage and benefits	✓	-	B-	D	D	D
	22.	Conflicts of interest within the region	✓	-	B-	D	D	D
	23.	Cultural heritages	✓	✓	D	D	D	D
	24.	Land scape	✓	-	D	D	D	D
	25.	Gender	✓	✓	B+/-	B+	B+	B+
	26.	Children's rights	✓	✓	B-	D	B+	B+
	27.	Infectious diseases such as HIV/AIDS	✓	-	B-	D	D	D
	28.	Working environment (work safety)	✓	-	B-	D	D	D
Others	29.	Transboundary impacts and climate change	✓	✓	B-	D	B-	D
	30.	Accident	✓	✓	B-	D	D	D

Note:

- A = Significant positive/negative impact is expected; B = Positive/negative impact is expected to some extent; C = Extent of impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses); and D: No impact is expected.
- The scoping items are referred from JICA guidelines.

'+' and '-' signs indicate positive and negative impacts, respectively.

During the construction and operation phases, comprehensive mitigation measures, as detailed in Section 8.1, will be effectively implemented. Consequently, during the construction phase, one significant impact and twenty-two moderate or less significant impacts are anticipated to be fully mitigated and reduced to a negligible level. During the operation phase, no significant adverse impacts are expected, and all moderate or less-than-significant negative impacts are projected to be mitigated to a negligible level through the implementation of appropriate mitigation measures. In addition, seven impacts during the operation phase are assessed to be positive.

CHAPTER 9

Public Consultation and Disclosure

9 PUBLIC CONSULTATION AND DISCLOSURE

9.1 Introduction

Public consultation and disclosure are core components of the broader stakeholder engagement process. They ensure that people who may be affected by the project, as well as those with an interest in its outcomes, are provided with clear, accessible, and timely information and are given meaningful opportunities to express their views and concerns. This two-way dialogue is essential for building trust, improving project design, and securing social acceptance of the project.

According to the JICA Guidelines for Environmental and Social Considerations (2022), consultation involves listening to and incorporating the perspectives of affected and interested parties, while disclosure ensures that relevant project information is shared in a transparent and accessible manner. Together, these processes safeguard the rights of stakeholders to be informed and to participate in

In the EIA process, consultation and disclosure are carried out from the earliest stages of project preparation and continue throughout implementation and operation. They provide opportunities for stakeholders, particularly disadvantaged or vulnerable groups, to understand potential impacts, suggest mitigation measures, and influence decision-making. Effective public consultation also enhances accountability, strengthens the Environmental and Social Management Plan (ESMP), and contributes to the long-term sustainability of the project.

To ensure meaningful participation, the consultation process must be inclusive, culturally appropriate, and responsive to the communication and accessibility requirements of different stakeholder groups. Disclosure of information should be proactive, timely, and provided in formats that are clear and easily understood. In alignment with these principles, this EIA has undertaken a comprehensive stakeholder mapping exercise and has adopted appropriate consultation tools and communication strategies to facilitate culturally appropriate, accessible, and inclusive engagement with all relevant stakeholders, including disadvantaged and vulnerable groups.

9.2 Scope and Specific Objectives

The overall scope of stakeholder consultation and disclosure is to ensure that affected and interested stakeholders, as well as relevant authorities, are meaningfully involved in the EIA process. This provides an opportunity to identify issues, concerns, and opportunities related to the proposed Project and to integrate stakeholder perspectives into project planning and decision-making. The specific objectives of the consultation and disclosure process are to:

- Ensure that relevant issues, including those identified by sectoral agencies, public bodies, local communities, affected groups, and other interested stakeholders, are adequately considered.
- Confirm inclusiveness by engaging vulnerable groups through culturally appropriate and accessible consultation approaches.
- Facilitate transparent and effective information flows between the project proponent and stakeholders to enhance mutual understanding of the project and its implications.
- Identify key environmental and social characteristics, potential impacts, and opportunities for mitigation and enhancement measures.
- Confirm that the magnitude and significance of potential environmental and social impacts are appropriately assessed and addressed.
- Strengthen the acceptability, quality, and practicality of the proposed mitigation, management, and monitoring measures.

9.3 Identification of Stakeholders

Stakeholder identification is one of the most important processes throughout the project life cycle. It involves documenting relevant information regarding stakeholders' interests in the project, their level of influence, independence, and the potential impacts they may experience. Stakeholders vary in terms of the degree of interest, influence, and control they have over the project. Those who have a direct impact on, or are directly impacted by, the project are considered Primary Stakeholders, while those with indirect influence or who are indirectly affected are considered Secondary Stakeholders.

Accurate identification and classification of stakeholders is a prerequisite for effective public consultation and disclosure, as it ensures that all relevant groups are recognized and engaged through appropriate methods. By clearly mapping out stakeholders, the consultation process can be designed to capture diverse perspectives, address concerns, and facilitate culturally appropriate communication strategies. For this study, stakeholder identification was carried out by EQMS in consultation with LGED, and NK, providing the foundation for structured and inclusive engagement throughout the ESIA process. Keeping in mind the nature of the project and its setting, the stakeholders have been identified and listed in Table 9-1.

Table 9-1: Identification of stakeholders

S/N	Stakeholder Group/ Category	Key Stakeholders	Description of the Stakeholder Profile
Primary Stakeholders			
1	Project Affected Persons (PAPs)	• Impacted Landowners • Impacted Land Users	• Landowners are individuals or entities who hold legal ownership rights to land that will be acquired for the project. • Individuals or groups who utilize land for residential, agricultural, commercial, or other livelihood purposes, but do not hold formal ownership rights to the land. Impacted land users may include tenants, sharecroppers, leaseholders, encroachers and others whose access and use of land are affected by the project.
2	Community	• Households • Farmers, Fishermen, livestock grazers, other livelihood groups • Women and children • Individuals residing in or around the project area	• As primary stakeholders, communities may experience both positive and negative impacts, including changes in land use, access to natural resources, employment opportunities, livelihoods, local infrastructure, community health and safety, and environmental quality.

S/N	Stakeholder Group/ Category	Key Stakeholders	Description of the Stakeholder Profile
3	Vulnerable Households	• Poor households • Elderly-headed households • Women-headed households • Households headed by persons with disabilities	• As primary stakeholders, vulnerable households face a higher risk of disproportionate impacts from the project due to their limited coping capacity.
4	Institutional Stakeholders	• Department of Environment (DoE) • Deputy Commissioner's (DC) Office • UNO (Upazila Nirbahi Officer) Office • Local Union Parishad Office • Other Regulatory Authorities	• This stakeholder group comprises regulatory authorities at the national, district, upazila, and union levels that are responsible for issuing permits, licenses, and approvals relevant to the Project.
5	Project Authority	• LGED	• This stakeholder is responsible for the whole project's implementation
6	Other Primary Stakeholders	• EPC contractor	• The EPC contractor is directly responsible for construction activities and therefore plays a critical role in ensuring compliance with environmental, social, health, and safety requirements.
7	Project Financing Agencies/ Institutions	• Financers and Investors	• As primary stakeholders, they play a decisive role in project approval, oversight, and implementation, with a strong interest in ensuring that the project complies with national laws, international safeguard standards, and good international industry practice (GIIP).
Secondary Stakeholders			
8	Institutional Stakeholders	• Department of Agriculture • Department of Fisheries • Forest Department	• As secondary stakeholders, these institutions are not directly impacted by the project but hold mandates related to natural resource

S/N	Stakeholder Group/ Category	Key Stakeholders	Description of the Stakeholder Profile
		• Department of Bangladesh Haor and Wetland Development	management, environmental protection, and community development or livelihood in the project area.
9	Other Secondary Stakeholders	• Local NGOs • Civil Societies • Printed and Electronic Media	• These stakeholders play an important role in shaping public opinion, raising community concerns, and facilitating dialogue between affected people and project authorities.

9.4 Stakeholder Mapping

Stakeholder mapping is the process of analyzing the relative level of influence that different individuals and groups have over the project, as well as the degree of interest they have in the project and the extent to which they may be affected by it. It helps to determine the nature and intensity of engagement required for each group.

The purpose of stakeholder mapping is to examine the profile of identified stakeholders and the nature of their stakes in the project, understand each group's specific issues, concerns, and expectations related to the project, and assess their level of influence on project outcomes and decision-making.

9.5 Approach and Methodology for Stakeholder Mapping and Analysis

The stakeholder mapping and analysis for this Project has been carried out using an influence and interest framework, consistent with international good practice. This approach allows for identifying the degree of power or influence that stakeholders hold over project decisions, alongside the level of interest they have in, or the extent to which they may be affected by, the Project.

- Influence refers to the ability of a stakeholder to affect decisions, outcomes, or the overall direction of the Project. Stakeholders with high influence often include regulatory agencies, financing institutions, and contractors, as they can shape compliance, funding, or implementation processes.
- Interest/Impact refers to the degree to which stakeholders are affected by the Project, either positively or negatively. This includes project-affected communities, landowners, land users, and vulnerable groups whose livelihoods, environment, or well-being may be directly impacted.

Stakeholders were plotted on an influence and interest matrix to guide the intensity and type of engagement required:

- High (High Influence, High Interest): Stakeholders with both strong influence and high interest in the project. They require close and continuous engagement, as they are powerful actors and are directly affected.
- Medium (High Influence, Low Interest or Low Influence, High Interest): Stakeholders with high influence but low interest should be kept satisfied through targeted engagement, as they can significantly affect project outcomes despite limited interest. Stakeholders with low influence but high interest should be kept informed and consulted, as they are directly affected but have limited ability to shape decisions.

- Low (Low Influence, Low Interest): Stakeholders with minimal influence and low interest. Engagement with this group is generally limited to periodic information disclosure to maintain transparency and accountability.

The following section provides brief profiles of the various stakeholders in the project as discussed in the previous sub-section along with their degree of influence. The details are provided in Table 9-2.

Table 9-2: List of identified key project stakeholders

Stakeholders	Category of stakeholder	Brief profile	Overall stake on the project	Basis of the Rating
Project Management				
Project Authority	Primary	LGED is the primary project proponent	High	• Primary project proponent, therefore high interest. • Responsible for all the project risks and impact liabilities. • Responsible for the construction and operation of this project, high influence.
Project Financiers	Primary	Financiers at the corporate and project level for the project. Include Japan International Cooperation Agency.	High	• Engagement is limited at the corporate management level. • Key participants in the decision-making process. • Compliance with funding agencies' safeguards/operation policies and guidelines. • High interest due to their investment in the project, as well as high influence because of their compliance and safeguard requirements.
EPC contractor	Primary	Construct to deliver a functioning facility or asset to their clients	Medium	• Carry out the detailed engineering design of the project. • Procure all the equipment and materials necessary. • Carry out the construction works in accordance with the agreed scope of works and in accordance with the Contract.

Stakeholders	Category of stakeholder	Brief profile	Overall stake on the project	Basis of the Rating
				• Their interest in the project is high due to contractual obligations and performance requirements, their influence is considered low, as they are bound to comply with the terms and conditions set by the project authority.
Migrant Worker and Labor	Primary	Labors and workers inside and outside of Project areas for participating in construction and production activities	Medium	• Responsible for undertaking mostly skill and unskilled-based work during the construction phase. • Skilled-based work during the operation/production period. • Interest is high but influence is low.
Community				
Local Community	Primary	Primarily includes communities residing adjacent to the project site.	High	• Receptors of potential air, water pollution, and other environmental and social risks. • Potential beneficiaries of infrastructural and other development activities. • Potential beneficiaries of business and job opportunities. • Community has no major concern about the project. • Interest high but low influence
Affected Landowners and Land users	Primary	Primarily includes landowners and land users whose land will	Medium	• Livelihood will be impacted. • No influence over the government-led land acquisition.

Stakeholders	Category of stakeholder	Brief profile	Overall stake on the project	Basis of the Rating
		need to be acquired for the project intervention.		
Vulnerable Households	Primary	Includes poor households, elderly persons, women-headed households, and households headed by persons with disabilities.	Medium	• Low influence due to the vulnerability. • High interest due to vulnerability, as they are more severely impacted and less able to restore livelihoods than other affected groups.
Regulatory/Administrative Authorities and Agencies				
Department of Environment (DOE), Bangladesh	Primary	The Department of Environment 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 Environmental Impact Assessment (EIA) study • Responsible for monitoring the project's Environmental compliance throughout the project lifecycle. • High Interest and High influence.
Deputy Commissioner's Office	Primary	The principal administrative authority at the district level in Bangladesh is responsible for governance, development, land acquisition and public service delivery.	High	• Responsible for various permits and licenses pertaining to the Project. • Responsible for land acquisition.
Department of Agriculture	Secondary	Local governmental agency is responsible for the	Medium	• High interest, as the intervention area is a significant boro rice–producing zone.

Stakeholders	Category of stakeholder	Brief profile	Overall stake on the project	Basis of the Rating
		implementation of governmental agricultural activities.		• Low influence over the project intervention.
Department of Fisheries	Secondary	Local governmental agency is responsible for the implementation of governmental fisheries activities.	Medium	• High interest, as the project area is a Haor region that supports significant fisheries resources. • Low influence over the project intervention.
Upazila Bit/Range Office of Forest	Secondary	Local government agency is responsible for the protection and maintenance of forests and wildlife	Medium	• High interest, as the project area overlaps with wetland and riparian ecosystems under its mandate. • Low influence over the project intervention.
Department of Bangladesh Haor and Wetland Development	Secondary	Government agency mandated to plan, manage, and conserve Haor and wetland ecosystems	Medium	• High interest due to its mandate, but low direct influence over project interventions.
Political Administration				
Union Parishad Chairman and local representatives	Secondary	Elected chairman and local representatives	Medium	• Plays an important role in providing public opinion and sentiment on the project • Empowered to provide consent and authorization for the establishment of project on behalf of the community • Influence high but low interest
Other Stakeholders				
Local NGOs, Civil Societies, Printed and Electronic Media	Secondary	Local NGOs, civil society and media work to represent community interests, support social development, and advocate	Medium	• High interest due to their role in community advocacy, awareness-raising, and accountability

Stakeholders	Category of stakeholder	Brief profile	Overall stake on the project	Basis of the Rating
		for environmental and social accountability.		• Limited direct influence over project decisions

9.6 Information Disclosure, Consultation, and Participation

Several consultations were conducted during this phase of EIA preparation. The stakeholders consulted include local people, 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 well noted and incorporated in the EIA report.

A combination of mixed methods of information disclosure and consultation process was adopted at this stage of E&S study preparation. The method selected for consultation was basically designed to keep in mind the profile of the stakeholders, type of information desired, and level of engagement required. In each consultation session, the consultants introduced themselves and introduced the project and the purpose of engagement with the respective stakeholders.

The methods used in the consultation process were:

- Individual or Key Informant Interview (KII).
- Focus Group Discussion (FGDs).
- Public Consultation Meeting (PCM).

The consultation and information disclosure were held in a free and fair environment giving prior information about the same to the stakeholders. On all occasions, the date, time, and venue of the consultation were decided by the stakeholders keeping in view their prior engagement and availability.

9.6.1 Key informant Interviews

Key Informant Interviews (KIIs) were conducted with different government stakeholders and individuals who possess knowledge about events and affairs within a particular community. In this study, KIIs were conducted with the representatives of BWDB, LGED, DoE, District Forest Offices, Department of Bangladesh Haor and Wetlands Development, Upazila Agricultural Officers, Upazila Fisheries Officers, local elites and so on. Their opinion/suggestion is given in the Appendix B-1.

9.6.2 Focused Group Discussion (FGDs)

FGDs are important when gauging with a group of stakeholders on issues related to the project activities. FGD has been used to understand the needs, perceptions, and concerns of the group. The discussion also gave space for the members to voice their concerns and suggestions. During EIA preparation, FGD with various groups including local community people (farmers, fishermen), people to be affected, saltpan workers and shrimp cultivators were conducted.

The participant details and the minutes of the FGDs are provided in Appendix B-2 and Appendix B-3. The discussions were designed to gather information from the participants in regard to the following outcomes.

- To inform stakeholders regarding the project and to understand their general perception and the status of their awareness about the proposed project.
- To know about their expectations from the project proponent.
- To understand the potential risk, threats and benefits associated with this project.

9.6.2.1 Summary of Stakeholder Consultation

Numerous consultations with various stakeholders including relevant government administration and other departments, affected groups and local communities that include women, salt farmers, shrimp cultivators, etc. have been conducted.

Stakeholder consultation covers several issues including the stakeholders' knowledge and perception of the project, anticipated impacts, opinions, major concerns, and suggested mitigations from their end. The major findings of the stakeholder consultations are given in Table 9-3.

Table 9-3: Summary of stakeholder consultation

Discussed Issues	Responses/ Findings/Observations
Perception about the Project	During the stakeholder consultations, local communities and other stakeholders expressed strong support for the project. The participants highlighted that the rehabilitation and construction of embankments would protect agricultural lands from early flooding, thereby securing their main source of livelihood. The development of harvesting roads was welcomed as it would improve access to fields and facilitate timely transportation of crops/production, reducing post-harvest losses.
Land Acquisition and Compensation	Consultations with different stakeholders revealed that land acquisition will be necessary in certain locations for the construction of new embankments. Although there is no chance of affecting any structure, it may cover some fallow or private agricultural lands. The landowners and sharecroppers may lose their livelihood due to the acquisition and therefore, they should be compensated. The stakeholders emphasized that, in such cases, proper and timely compensation must be ensured for affected households and landowners. Compensation and resettlement activities should strictly follow the provisions of relevant national legislation, while also complying with JICA's Guidelines for Environmental and Social Considerations, which require fair, transparent, and participatory processes. This includes ensuring that affected persons are not disadvantaged, their livelihoods are restored or improved, and vulnerable groups receive special attention.
Local Economy, Employment, and Livelihoods	The Haor region is predominantly agrarian, with rice cultivation being the primary source of income and employment for local households. Boro paddy is the main crop, but its production is highly vulnerable to early flash floods, which often cause significant crop damage and income losses. Alongside farming, fishing in beels and rivers constitutes an important livelihood activity, particularly during the monsoon season, contributing both to household nutrition and cash income. Participants opined that fish population is decreasing day by day due to many reasons like overexploitation and reduction of fish sanctuary. Many local fish species are being rare day by day. Small-scale livestock rearing, day labor, petty trade, and seasonal migration also supplement livelihoods in the area. Employment opportunities are generally limited, with a large proportion of the labor force engaged in informal, low-paid, and seasonal work. Many usually migrate to the neighboring districts and the capital city to seek season employment during wet season and they again come back during dry season to cultivate boro crops and other local paid activities. Someday laboring opportunities are there in the local markets for supporting goods transportation, and other works. Women often contribute to household income through homestead-based activities such as poultry rearing, vegetable gardening, and post-harvest processing. Poverty levels are relatively high, and livelihood security is highly dependent on natural resources and climate conditions. Their livelihood may be affected during the land acquisition and construction under the project. Few farmers may lose their ownership over and access to their lands if those are acquired for embankment. Or some may be affected

Discussed Issues	Responses/ Findings/Observations
	temporarily during construction due to construction material placement in their lands. Stakeholders suggested to mitigate this impact by compensation and other possible ways. They also expressed their expectation that the affected people will be benefited by their engagement in construction works, fisheries promotion activities, agriculture promotion and livelihood improvement. It will not only benefit the affected people but also enhance the employment of other local people including farmers, fishermen, local businessmen, etc.
Existing Social Infrastructure and Services	The stakeholders discussed that the project interventions will be implemented in open field/haor areas and may cover some of agricultural land, therefore, there is no major chance to affect existing social infrastructure. Moreover, the stakeholders expressed their expectation that the construction of new and rehabilitation of existing embankment will facilitate their communication that will ultimately benefit them in multiple ways such as accessing schools, local market and regional commutations during dry session. Other social infrastructure like existing graveyards, religious places, health facilities, etc. will not be affected.
Water Uses and Rights	Consultations with local communities including farmers and fishermen, Agriculture Offices and relevant stakeholders indicated that water in the Haor region serves multiple purposes, including agriculture, fisheries, domestic use, and livestock. Boro cultivation is heavily dependent on seasonal water availability, while haor, beels and khals support both subsistence fishing and in some cases commercial duck rearing activities, which are essential for household income and nutrition. Communities also use water for bathing, washing, and limited domestic consumption. Tube well is the safe drinking water source concentrated around settlements. Stakeholders emphasized that water rights are traditionally managed at the local level, with customary practices guiding access to irrigation form haor and beels. Conflicts over water are rare and there are less chance to arise such tension during peak agricultural or fishing seasons. The proposed project interventions such as embankments, sluice gates, canal re-excavation, beel development, community engagement are expected to influence water distribution and flow patterns. Stakeholders highlighted the need to ensure equitable water access, maintain fisheries productivity, and avoid negative practices like harmful fertilizer and pesticide for cultivation and fishing. Community stakeholders also expressed their willingness to participate and support community water or beel management groups if such initiatives are taken.
Social Conflicts and Movements	Stakeholders opined that there is no major chance of social conflict or opposition against any of the activities of the project. Rather they will support the project in every possible way. Some stakeholders like BWDB emphasized providing timely compensation if any private land is taken. Otherwise, it may lead to local reaction against the project. Community people emphasized the timely completion of the construction works to avoid delay and interruption in cultivation in the agricultural lands adjacent to the proposed embankments and roads. Farmers and fisherman anticipated benefits from different interventions along with the embankment construction and rehabilitation such as harvesting roads development, farmers' capacity building, Khal/canal re-excavation, bridge/culvert

Discussed Issues	Responses/ Findings/Observations
	construction, growth center, rural market and ghats development, village protection walls, community engagement and other activities under different components of the project.
Vulnerable Groups (Women, Poor, Children)	Local women reported that they are mostly housewives engaged in poultry, homestead vegetation, and cattle rearing. They are highly concerned about crops damaged by floods which usually impact on their food security and livelihoods directly. Many women are involved in post-harvesting crop processing activities. Therefore, the projection of the Boro crop is one of their key expectations. Women and poor people also expressed their interest in participating agriculture and fishery promotion activities to enhance their capacity to sustain their livelihoods. They are willing to participate if any women-led group is established under the project.
Environmental Concerns	The DoE, Forest Office and other government and local stakeholders emphasized the ecological sensitivity of the haor setting. Since construction works are expected to be done during dry season, they raised no major concern. However, stakeholders like DoE requested not to work at night, to avoid all possible harm to local wild species due to the noise. They also requested to remain careful about construction material placement so that it does not harm any local animal or aquatic species. Overall, stakeholders emphasized that environmental risks could be addressed through strict monitoring and management.
Mitigation Measures and Recommendations	Across consultations, stakeholders consistently recommended: (i) Fair and transparent compensation at replacement cost, including non-titleholders. (ii) Priority employment for locals, including women and youth during construction. (iii) Establish women led groups/ensure women participation if any group/association is formed. (iv) Enhance capacity of farmers and fishermen. (v) Adoption of traffic management and road safety measures to during rehabilitation of existing embankment and roads.

9.6.3 Public Consultation Meeting

According to the JICA Guidelines for Environmental and Social Considerations (2022) and the Environment Conservation Rules (2023), a total of four Public Consultation Meetings (PCMs) were conducted across four upazilas in three districts.

Table 9-4: Summary of the PCM locations

SN	Division	District	Location of PCM	Considered Haors
1	Sylhet	Sunamganj	Bishwamvapur Upazila	Shanir Haor, Hailr Haor, Karchar Haor, Pathor Chauli Haor
2			Jagannathpur Upazila	Khai Haor, Chaptir Haor, Boram Haor, Naluar Haor (Polder-1), Makalkandi Haor, Ballar Haor (Chagaiya Haor)

SN	Division	District	Location of PCM	Considered Haors
3	Dhaka	Kishoreganj	Itna Upazila	Mrigar Haor, Humaipur Haor, Khaliajuri FCD (Polder-1), and Khaliajuri FCD (Polder-3)
4	Mymensingh	Netrokona	Kalmakanda Upazila	Updakhali Haor

9.6.3.1 Public Consultation Meeting in Bishwamvarpur, Sunamganj

Venue: Upazila Parishad Auditorium, Bishwambharpur, Sunamganj

Date: 1 December 2025

Time: 3:30 PM to 5:00 PM

Chair: Mr. Rajat Kanti Das, Upazila Engineer, LGED, Bishwambharpur, Sunamganj

Special Guest: Mr. Md. Mohaiminul Haque, Assistant Director, Department of Environment, Sunamganj

Other Guests:

1. Mr. Golam Kibria, Sub-Assistant Engineer, Bangladesh Water Development Board (BWDB), Bishwambharpur, Sunamganj
2. Advocate Mr. Shobab Mia, Chairman, Badaghat Dakshin Union Parishad, Bishwambharpur, Sunamganj
3. Nurul Amin, Assistant Professor, Digendra Barman Government College, Bishwambharpur, Sunamganj
4. Abdul Baten, Assistant Professor, Digendra Barman Government College, Bishwambharpur, Sunamganj
5. Md. Saiful Islam, Inspector, Department of Environment, Sunamganj
6. Md. Badruzzaman, Manager, IRA (NGO), Bishwambharpur, Sunamganj
7. Local leaders, journalists, and residents of the Haor region.

9.6.3.1.1 Introduction

A public consultation meeting is a process that enables local communities to present their views regarding a project and ensures that their comments and concerns are taken into account during decision-making. As per Rule 16 of the Environmental Conservation Rules 2023, this meeting was organized to disclose information on the draft Environmental Impact Assessment (EIA) and to collect opinions from the local community. The consultation meeting was held on 1 December 2025, with a total of 60 representatives (60 male) from various institutions and stakeholder groups in the project area.

9.6.3.1.2 Methodology

Following Rule 16 (2) of the Environmental Conservation Rules 2023, an application including the draft Environmental Impact Assessment report and its Bangla summary was submitted to the Department of Environment (DoE) Headquarters seeking approval for organizing the consultation meeting. In response, the DoE nominated a representative to attend the meeting. Furthermore, on 26 November 2025, a public notice regarding the consultation meeting was published in a national newspaper, Daily Samakal, and a local newspaper, Daily Banglar Darpan. Invitations were also sent to stakeholders.

9.6.3.1.3 Opening of the Session

The meeting commenced with the recitation of the Holy Qur'an and readings from the Srimad Bhagavad Gita. Following this, Mr. Golam Kibria, Sub-Assistant Engineer, Bangladesh Water Development Board (BWDB), welcomed the participants and officially opened the session. In his speech, he stated that

within the Bishwambharpur Upazila region, BWDB has recognized five haor systems. He informed participants that embankment construction and rehabilitation activities are ongoing in these haor areas. BWDB implements various construction, repair, and maintenance activities every year aimed at protecting haor residents and farmers from early floods, riverbank erosion, and rising floodwaters. He further mentioned that the Haor Area Resilience and Development (HARD) Project aims to reduce long-term suffering, recurring flood losses, and crop risks for haor communities, while establishing a sustainable and efficient haor management framework. He expressed hope that the proper implementation of water management and embankment maintenance activities would significantly improve the lives, agriculture, and overall economic stability of haor residents.

9.6.3.1.4 Presentation on the Draft Environmental Impact Assessment

Mr. Tauhidul Hasan, Senior Consultant and Environmental Specialist from EQMS Consulting Limited, greeted the participants and delivered a presentation on the draft EIA report. He discussed the following topics.

1. Purpose of public consultation
2. Project background
3. Project description
4. Sample designs related to the project
5. Environmental baseline data
6. Environmental and social impact assessment (pre-construction, construction, and operational phases)
7. Environmental Management Plan
8. Environmental Monitoring Plan
9. Conclusion and recommendations

9.6.3.1.5 Open Discussion and Feedback

After the presentation, an open discussion and question–answer session were held. The discussion points are summarized in Table 9-5. Responses were provided by Mr. Tauhidul Hasan (Environmental Specialist, EQMS Consulting Limited), Mr. Golam Kibria (Sub-Assistant Engineer, BWDB), and Mr. Rajat Kanti Das (Upazila Engineer, LGED) on behalf of their respective organizations.

Table 9-5: Brief overview of the public consultation meeting

S/N	Name & Designation	Questions/Comments	Response
1	Md. Jalal, Farmer	He emphasized that a proper road across the haor is essential so that farmers can easily transport their harvested paddy. He suggested constructing a protective embankment from Bishwambharpur to Piritpur Bazar to help regulate water during the monsoon. He also added that a similar embankment from Katakhali to Abuya River would protect crops from floods and make post-harvest activities easier.	The project includes the improvement of internal communication and road networks within the haor. The proposed embankments from Bishwambharpur to Piritpur Bazar and from Katakhali to Abuya River will be considered based on technical feasibility. The embankment design will prioritize water regulation, crop protection, and ease of agricultural activities, while maintaining compatibility with the haor's natural landscape and ecosystem. These components are addressed in detail in the Environmental Impact Assessment (EIA) report.
2	Mr. Ali, Businessman	He stated that after cutting soil for embankment construction, it becomes difficult to source adequate soil during the next year's maintenance works. Embankments built too close to the riverbanks are easily damaged by strong currents. He recommended constructing embankments at a safer distance from the river.	Embankment designs will maintain a safe distance from riverbanks, considering river flow, topography, and flood risks. Advanced engineering techniques and quality materials will be used to ensure long-term stability. Regular monitoring and maintenance mechanisms will also be included. Additionally, the project will strengthen the capacity of Beel Management Groups (BMGs) and Water Management Groups (WMGs).
3	Md. Hossain Ali, Farmer	He requested road construction from Bahadurpur to Fulbhori and from Fulbhori to Gopalpur. Adequate small culverts and bridges are needed to allow quick drainage of hill runoff. He also asked whether farmers would be compensated if agricultural land is required for the project.	The project includes the development of roads with adequate culverts and bridges to ensure proper drainage of monsoon and hill runoff. Any agricultural land affected by the project will be compensated following applicable guidelines, ensuring that farmers do not incur financial losses.
4	Moslem Ali, Farmer	He mentioned a decline in tree coverage in the haor and asked whether tree plantation activities would be included. He also inquired about excavation of the Angarhali Canal.	Environmental conservation is a key component of the project. Tree plantation will be carried out at suitable locations. Angarhali Canal, along with other canals, will be excavated to improve water flow and irrigation efficiency, supporting the haor ecosystem and agricultural needs.

S/N	Name & Designation	Questions/Comments	Response
5	Abdul Malek, NGO Representative, Sushilon	He asked whether local representatives would be involved in the project, whether there would be measures to address natural disasters, and whether capacity building and employment opportunities would be provided for local communities.	The project will ensure active participation of local representatives. Community-based disaster preparedness and capacity-building programs will be implemented. Skill development and employment opportunities will also be created to enhance livelihoods and socio-economic resilience.
6	Badruzzaman Rony, NGO Representative, IRA	He expressed concern about the declining fish resources in the haor and asked what measures would be taken.	The project will support sustainable fisheries management through canal re-excavation, restoration works, and improved management of approximately 300 beels. Water resource management and ecosystem restoration measures will help revive fish habitats and strengthen local food security and income sources.
7	Golap Mia, Farmer	He noted that construction of embankments in one haor should not negatively impact upstream haors. He emphasized ensuring that floodwater flows smoothly through the Jadukata River.	Embankment and water management structures will be designed to minimize upstream–downstream impacts. The natural flow of the Jadukata River will be maintained. The EIA report includes detailed analysis of water flow, river connectivity, and measures to safeguard hydrological balance across haor systems.
8	Saiful Islam, NGO Representative, VARD	He mentioned the need for embankments or retention walls to protect villages from strong flood currents that damage houses.	The project incorporates village protection measures, including embankments, retention walls, and water-regulation structures. These will safeguard homes and support long-term security of agricultural and economic activities. Awareness programs will also be conducted for safe and effective use.
9	Swapan Kumar Bormon, President, Press Club, Bishwambharpur	He stressed ensuring fair wages for workers, constructing durable embankments, and avoiding unplanned construction.	Fair wages for workers will be ensured. Durable embankments will be constructed using high-quality materials and modern engineering methods with regular supervision. All construction works will follow proper planning and safety protocols to avoid unplanned activities or structural failures.
10	Shabbab Mia, UP Chairman,	He noted that canals in the haor have narrowed, reducing water flow. Flooding also occurs due to overflow from the Surma, Kushiyara, and Jadukata rivers. The switch gate at	The project will incorporate sufficient culverts, retention structures, and water-flow systems. New water-regulation structures will be constructed to ensure proper flow even during

S/N	Name & Designation	Questions/Comments	Response
	Badaghat Dakshin Union Parishad	Basantapur does not allow adequate water passage. He recommended adequate culverts along the embankment from Bishwambharpur to Rajnagar.	monsoon seasons. Flood fuses will be installed to regulate excess water safely. These structures will align with local topography and hydrological conditions to ensure long-term protection.
11	Nurul Amin, Assistant Professor, Digendra Barmon Government College	He expressed optimism about the project but emphasized strong coordination among LGED, BWDB, and other agencies. He asked about measures to increase public awareness.	Coordination among implementing agencies such as LGED and BWDB will be strengthened. Local communities will be regularly informed about project activities, benefits, and safety measures. Strengthening BMGs and WMGs will enhance awareness and community participation. Public consultation meetings, such as this one, are part of that process.

9.6.3.1.6 Special Guest's Statement

The special guest, Mr. Mohaiminul Haque, Assistant Director, Department of Environment, Sunamganj, began by thanking all participants for attending the consultation meeting and for providing their well-considered opinions. He also expressed gratitude to the organizers for presenting the draft Environmental Impact Assessment (EIA) report in a clear and comprehensive manner. He emphasized the importance of stakeholder consultation in environmental impact assessment processes and expressed optimism that the project would be effective in flood control. He advised that embankments and sluice gates should only be constructed where necessary, that waste management should be ensured, and that proper project management must be maintained. He called for incorporating the feedback received during the consultation into the EIA report and urged that the key points raised be implemented according to the project's feasibility and scope.

9.6.3.1.7 Chairperson's Statement

The Chairperson, Mr. Rajat Kanti Das, Upazila Engineer, LGED, Bishwambharpur, Sunamganj, began by thanking all attendees for their participation in the consultation meeting. He provided insights into various aspects of the project and discussed its environmental impacts. He highlighted the need to avoid activities that could create negative impacts. He advised that fish sanctuaries and natural fish breeding and movement should not be obstructed and emphasized the importance of protecting agricultural land from waterlogging. He urged the Bangladesh Water Development Board to ensure these measures. On behalf of his department, he assured full cooperation and coordination for the successful implementation of the project. He also stressed that all feedback from the consultation meeting should be recorded in the report, and that project activities should be implemented efficiently and sustainably, contributing to livelihood improvement, socio-economic development, and the achievement of the project's overall objectives. He concluded the meeting by thanking all participants.

9.6.3.1.8 Summary of Public Consultation

A detailed Environmental Impact Assessment (EIA) report was prepared for the proposed "Haor Area Resilience and Development (HARD) Project," and a public consultation meeting was held on 1 December 2025 at the Upazila Parishad Auditorium, Bishwambharpur, Sunamganj. The potential positive and negative impacts of the project were presented and analyzed during the meeting. Stakeholders provided valuable feedback, which will serve as important guidance for project implementation.

It is noted that every project has both positive and negative impacts. In this case, the positive impacts are predominant. Proper implementation of the designated mitigation measures will effectively reduce potential negative environmental effects.

The project is expected to deliver significant social, economic, and environmental benefits for the haor region while minimizing possible adverse impacts. Through proper mitigation and adherence to the Environmental Management Plan, the project will enhance flood resilience, safeguard agricultural productivity, improve fisheries resources, and ensure the stability of local infrastructure and livelihoods.

Integration of local community participation, climate-resilient engineering design, and environmentally friendly management practices will set an example of sustainable development. In the long term, the project will support climate change adaptation, biodiversity conservation, and the improvement of vulnerable communities' quality of life, creating a sustainable and prosperous future for both people and nature.

Overall, considering the project's positive impacts and its environmental and social significance, it can be strongly concluded that the proposed project will bring about meaningful and beneficial changes in the environment and the lives of local communities.

9.6.3.2 Public Consultation Meeting in Jagannathpur, Sunamganj

Venue: Upazila Model Mosque Meeting Room, Jagannathpur, Sunamganj

Date: 2 December 2025

Time: 3:15 PM – 5:00 PM

Chairperson: Mr. Sohrab Hossain, Upazila Engineer, LGED, Jagannathpur, Sunamganj

Chief Guest: Mr. Md. Barkat Ullah, Upazila Executive Officer, Jagannathpur, Sunamganj

Special Guest: Mr. Md. Mohaiminul Haque, Assistant Director, Department of Environment, Sunamganj

Other Guests:

1. Mr. Sheikh Farid, Sub-Assistant Engineer, Bangladesh Water Development Board (BWDB), Jagannathpur, Sunamganj
2. Mr. Kawsar Ahmed, Upazila Agriculture Officer, Jagannathpur, Sunamganj
3. Mr. Shahidul Islam Bakul, UP Chairman, Chilaura-Holdipur Union Parishad, Jagannathpur, Sunamganj
4. Mr. Ashesh Kanti De, Lecturer, Jagannathpur Government College, Jagannathpur, Sunamganj
5. Mr. Kabir Ahmed, SI, Jagannathpur Police Station, Sunamganj
6. Mr. Tajuddin Ahmed, President, Jagannathpur Press Club, Sunamganj
7. Local leaders, journalists, media personnel, and residents of the haor area.

9.6.3.2.1 Introduction

A public consultation meeting is a process that allows the general public to express their opinions on a project and ensures that these views are considered in the decision-making process. According to the Environment Conservation Rules 2023 (Rule 16), such meetings are organized to share information about the project's environmental impacts with local communities and to collect their feedback. The meeting was held on 2 December 2025 and was attended by 40 representatives (37 male and 3 female) from various local institutions and stakeholder groups.

9.6.3.2.2 Methodology

As per Rule 16(2) of the Environment Conservation Rules 2023, a request for permission to hold the consultation meeting was submitted to the Department of Environment along with the draft EIA report and its Bengali summary. Subsequently, a representative was appointed by the Department to attend the meeting. The meeting notice was published on 26 November 2025 in the national daily newspaper Samakal and the local newspaper Banglar Darpan. Invitations were also sent to stakeholders.

9.6.3.2.3 Inauguration of the Meeting

The meeting commenced with the recitation of the Holy Quran. Following this, Mr. Sheikh Farid, Sub-Assistant Engineer, BWDB, welcomed the participants and formally inaugurated the meeting. He stated that there are two BWDB-recognized haors in the Jagannathpur area and that ongoing works include the construction and maintenance of embankments and roads. Every year, BWDB undertakes activities such as flood forecasting, riverbank protection, and safeguarding crops and settlements during floods to protect haor residents and farmers.

He further highlighted that the haor region of northeastern Bangladesh supports the livelihoods of approximately 20 million people, with Boro rice cultivation and fishing as the primary economic activities. However, climate change, unexpected floods, and extreme weather events increasingly threaten these livelihoods and ecosystems. The Bangladesh Delta Plan 2100 and other national development plans have identified the haor region as a priority area for flood management, poverty alleviation, and climate resilience. Building on the experiences from the previous HFMLIP project, the Haor Area Resilience

and Development (HARD) Project has been launched, to be implemented by BWDB and LGED across 15 selected haors in five districts. The project's main objectives include the rehabilitation and strengthening of embankments, installation of sluice gates and regulators, re-excavation of canals, and implementation of erosion control measures, all aimed at reducing long-term vulnerabilities and enhancing the stability of livelihoods, agriculture, and the local economy.

9.6.3.2.4 Presentation on the Draft Environmental Impact Assessment

Mr. Tauhidul Hasan, Senior Consultant and Environmental Specialist from EQMS Consulting Limited, greeted the participants and delivered a presentation on the draft EIA report. He discussed the following topics.

1. Purpose of public consultation
2. Project background
3. Project description
4. Sample designs related to the project
5. Environmental baseline data
6. Environmental and social impact assessment (pre-construction, construction, and operational phases)
7. Environmental Management Plan
8. Environmental Monitoring Plan
9. Conclusion and recommendations

9.6.3.2.5 Open Discussion and Feedback

Following the presentation, a question-and-answer session and open discussion were conducted, which are summarized in Table 9-6. Responses were provided by Mr. Tauhidul Hasan from EQMS Consulting Limited, Mr. Sheikh Farid, Sub-Assistant Engineer, BWDB, and Mr. Sohrab Hossain, Upazila Engineer, LGED.

Table 9-6: Brief overview of the public consultation meeting

S/N	Name & Designation	Questions/Comments	Response
1	Md. Lilu Mia, Farmer	Soil is extracted annually from haor khas land for embankment and road maintenance. Excessive extraction has now caused a soil shortage. Sustainable embankment and road construction is necessary. If river dredging is done and the soil is stored for later use, this issue can be mitigated. Attention of the project implementing authority is requested.	Soil extraction and storage for embankment and road construction will be conducted in a planned manner, maintaining environmental balance. The feasibility of dredging the river to store soil for future embankment and road repair will be examined. Sustainable construction and use of reusable materials will ensure soil conservation, protecting the natural haor layer and benefiting local farmers and communities in the long term.
2	Din Kanti Das, Farmer	Other canals including Mashokhali canal need dredging. Embankments are needed to protect Saleha village. Roads through the haor will greatly benefit farmers for transporting crops.	The project includes dredging of canals, haor road improvement, and construction of embankments to protect villages. Proper canal dredging will ensure smooth water flow. Roads through the haor will allow farmers to transport crops easily, improving overall agricultural operations. Project planning will jointly protect environmental and community interests. Measures will be taken to strengthen the Beel Management Group (BMG) and Water Management Group (WMG).
3	Md. Abu Ali, Former UP Member	If the haor survives, Sunamganj will thrive. The embankment west of Burakhali needs repair. Will the project include drainage measures?	The project includes embankment and road improvement. Small culverts and bridges will be constructed to ensure proper drainage of rainwater, allowing hilly water flow to pass quickly and safely. Adequate compensation will be provided for affected agricultural land, ensuring farmers do not suffer loss of production or income. The project ensures infrastructure development as well as the stability of agriculture and haor-based livelihoods.
4	Tayyabur Rahman, Media Person	Due to strong water currents along the embankment, nearby houses collapse. Will embankments be constructed to protect villages?	The project includes embankments and retention structures to protect villages and settlements. These embankments will be designed according to local terrain and river flow to regulate water and ensure the safety of houses and crops. Sustainable

S/N	Name & Designation	Questions/Comments	Response
			project planning will provide long-term benefits to local communities.
5	Tajuddin Ahmed, President, Jagannathpur Press Club	Beels need dredging. If the local population is aware, project effectiveness will increase. Drainage should be easier to handle floods. Transparency in the project is necessary.	Beel dredging will improve water drainage and reduce flood risks. All project activities will be carried out transparently and according to regulations, ensuring the community understands benefits and water management processes. Community-based capacity building and seasonal planning will be implemented to address natural disasters. Skills development and employment will be provided, increasing income and improving livelihoods. Thus, the project contributes to both infrastructure and social-economic development.
6	Shahidul Islam Bakul, UP Chairman, Chilaura-Holdipur Union Parishad	Early floods occur in Chaitra (March). Development should not hinder fish movement. Installing culverts from Burakhali to Gorma would improve drainage. Side block slopes on embankments will make them sustainable. Local people are ready to cooperate in all matters.	Culverts will improve drainage and reduce flood impact. Block slopes along embankments will ensure stability. Flood management will be ensured through floodfuse systems. Fish movement and haor water resources will be protected, preventing damage to the environment and local economy. The local community will have opportunities to participate and cooperate in project activities.
7	Kawsar Ahmed, Upazila Agriculture Officer, Jagannathpur	Jagannathpur produces approximately 128,467 metric tons of rice per year. There are 12 haors with many canals, which need dredging to supply irrigation during the dry season.	Dredging haors and canals will ensure irrigation water supply during the dry season. This is crucial for improving haor water environments, agricultural activities, and local livelihoods. Canal dredging will also control water flow, reduce flood risks, and ensure sustainable water management.
8	Shah Fuza Ahmed, Journalist	The project must be implemented protecting farmers' and local residents' interests. Special importance should be given to environmental conservation.	The project will prioritize local residents' and farmers' interests. Environmental conservation is a key component, ensuring balance in haor biodiversity, climate, and agriculture. Project planning will be sustainable, ensuring long-term benefits for the haor environment and communities.

S/N	Name & Designation	Questions/Comments	Response
9	Md. Sujat Mia, Farmer	Farmers should not face difficulties. Kamarkhali river needs dredging. Soil extracted from river and canals should be stored and later used for embankment repair.	Dredging rivers and canals will ensure water flow and soil conservation. LGED and BWDB will consider whether extracted soil can be stored for later embankment and road repairs. This will help farmers protect their crops and land, ensuring long-term sustainability of the project's embankments and infrastructure.

9.6.3.2.6 Special Guest's Speech

The Special Guest, Mr. Mohiuddinul Haque, Assistant Director, Department of Environment, Sunamganj, began by thanking all participants for attending the consultation meeting, particularly for their thoughtful opinions. He also expressed gratitude to the organizers for presenting the draft Environmental Impact Assessment (EIA) report effectively. He emphasized the importance of stakeholder consultation regarding environmental impact assessment and expressed hope that the project would be fruitful in flood control. He further advised that embankments and sluice gates should be constructed only where necessary. In addition, he highlighted the importance of proper waste management and effective project administration. He urged that the feedback received during the meeting be included in the report and requested that critical issues be implemented in accordance with the project's capacity and scope.

9.6.3.2.7 Chief Guest's Speech

The Chief Guest, Mr. Md. Borokat Ullah, Upazila Executive Officer, Jagannathpur, Sunamganj, began by greeting the meeting president, local chairpersons, journalists, and all attendees. He noted that numerous important and thoughtful suggestions had been received during the consultation and thanked the organizers for this. Addressing the Bangladesh Water Development Board (BWDB), he stated that annually implemented embankment projects often collapse or get damaged, necessitating reconstruction the following year. Therefore, he stressed the need for substantial, long-term projects to achieve sustainable solutions and urged local people to understand the importance of these initiatives. He emphasized efficient project implementation to reduce waste and hoped the project would play a significant role in fisheries development. He also requested that all projects be coordinated to avoid overlapping in the same areas, implementing different projects only where necessary. Finally, he urged that the relevant embankment projects improve agriculture and minimize flood damage in the Upazila and expressed optimism that more projects would be implemented sustainably, without harming the environment, to ensure overall development of the Upazila.

9.6.3.2.8 Chairperson's Speech

The Chairperson, Mr. Sohrab Hossain, Upazila Engineer, LGED, Jagannathpur, Sunamganj, expressed gratitude to all attendees for participating in the consultation meeting. He provided insights into various aspects of the project and discussed environmental impacts during its implementation. He emphasized avoiding activities that could cause negative effects. He noted that RCC roads are more suitable for haors than BC flexible roads. In Noluwa Haor alone, over 12,000 trucks transport rice annually, rapidly damaging haor roads. He advised protecting fish sanctuaries and natural fish reproduction and movement and called on BWDB to ensure that agricultural land is not damaged due to waterlogging. On behalf of his department, he assured full cooperation and coordination for project implementation. He stressed that all feedback received should be documented in the report, the project should be implemented properly and sustainably, and that it would lead to livelihood improvement, positive socio-economic changes, and achievement of overall project objectives. He concluded by thanking all participants for attending the meeting.

9.6.3.2.9 Summary of Public Consultation

A detailed Environmental Impact Assessment (EIA) report was prepared for the proposed Haor Area Resilience and Development (HARD) Project, and a stakeholder consultation meeting was held on 2 December 2025 at the Upazila Parishad Auditorium, Jagannathpur, Sunamganj, to discuss the various impacts of the project. During the meeting, potential positive and negative impacts were presented and analyzed in detail. Stakeholders provided valuable feedback, which will serve as critical guidance for project implementation.

Every project has both positive and negative impacts. In this case, the positive impacts were predominant. If the proposed mitigation measures are properly implemented, the potential negative environmental impacts can be effectively minimized.

The project will provide significant social, economic, and environmental benefits to the haor region while keeping potential negative impacts at a minimum. Proper mitigation measures and adherence to an environmental management plan will enhance flood resilience, protect agricultural productivity, improve fisheries, and stabilize local infrastructure and livelihoods.

By combining local community participation, climate-resilient engineering design, and environmentally friendly management, the project will serve as an example of sustainable development. Over the long term, this will support adaptation to climate change, biodiversity conservation, and improvement of the livelihoods of vulnerable communities, ensuring a sustainable and prosperous future for both people and nature.

Overall, considering the project's positive aspects and its environmental and social significance, it is clear that the proposed project will bring a positive change to the environment and the lives of local communities.

9.6.3.3 Public Consultation Meeting in Itna, Kishoreganj

Venue: Upazila Parishad Conference Room, Itna, Kishoreganj

Date: 2 December 2025

Time: 3:30 PM to 5:00 PM

Chairperson: Mr. Nani Gopal Das, Upazila Engineer (LGED), Itna, Kishoreganj

Chief Guest: Mr. Md. Muntasir Hasan Khan, Upazila Land Officer and Assistant Commissioner (Land), Itna, Kishoreganj

Special Guest: Mr. Md. Abdullah Al Matin, Assistant Director, Department of Environment, Kishoreganj

Other Guests:

1. Mr. Mohammad Riyajul Islam, Sub-Assistant Engineer, Bangladesh Water Development Board (BWDB)
2. Mr. Bijoy Kumar Haldar, Upazila Agriculture Officer, Itna, Kishoreganj
3. Mr. Khairul Alam, Union Parishad Chairman, Itna, Kishoreganj
4. Mr. Amjad Hossain Bahadur, Daily Jugantor, Itna, Kishoreganj
5. Mr. Md. Anwar Hossain, ASA (NGO), Kishoreganj
6. Mr. Shinji Tanaka, Associate Senior Staff, International Environmental Department, Nippon Koei
7. Local leaders, journalists, and community members from the haor area.

9.6.3.3.1 Introduction

A public consultation meeting is a formal process that allows local communities and stakeholders to share their opinions on a proposed project and have their views considered in decision-making. In accordance with the Environmental Conservation Rules 2023 (Rule 16), this public consultation was organized as part of the draft Environmental Impact Assessment (EIA) process to disclose project-related environmental information to local people and to collect their feedback. The meeting was held on 2 December 2025, with a total of 35 representatives (31 male and 4 female) from different institutions and stakeholder groups in attendance.

9.6.3.3.2 Methodology

As per Environmental Conservation Rules 2023 (Rule 16, Sub-rule 2), an application along with the draft EIA report and Bangla executive summary was submitted to the Department of Environment (DoE) Head Office to obtain permission to organize the public consultation meeting. Following this, the Department of Environment nominated a representative to attend the meeting. Notices of the consultation meeting were published on 26 November 2025 in a national daily newspaper (The Daily Samakal) and a local daily newspaper (Banglar Darpan). In addition, stakeholders were formally invited through official invitation letters.

9.6.3.3.3 Inauguration of the Meeting

The meeting commenced with recitations from the Holy Quran and the Holy Bhagavad Gita. Afterward, Mr. Mohammad Riyajul Islam, Sub-Assistant Engineer of BWDB, welcomed the participants and initiated the session. He informed that construction and rehabilitation works of embankments are currently ongoing in different haor areas. Every year, BWDB carries out construction, repair, and maintenance works to protect crops and homesteads from early flash floods, riverbank erosion, and abnormal flood water levels.

He further mentioned that through the Haor Area Resilience and Development (HARD) Project, plans will be undertaken to protect the people of the haor region from long-term sufferings, recurrent flood damages, and crop risks, and to establish a sustainable and effective haor water management framework. He expressed optimism that proper implementation of water management and embankment maintenance activities would significantly contribute to improving the livelihoods, agriculture, and overall economic stability of the haor communities.

9.6.3.3.4 Presentation on the Draft Environmental Impact Assessment

Mr. Aminur Islam, Consultant and Environmental Expert from EQMS Consulting Ltd., warmly welcomed the participants and delivered a presentation on the draft EIA report. The presentation covered the following key aspects.

1. Purpose of public consultation
2. Project background
3. Project description
4. Sample designs related to the project
5. Environmental baseline data
6. Environmental and social impact assessment (pre-construction, construction, and operational phases)
7. Environmental Management Plan
8. Environmental Monitoring Plan
9. Conclusion and recommendations

9.6.3.3.5 Open Discussion and Feedback

Following the presentation, a question-and-answer session and open floor discussion were conducted, which are summarized in Table 9-7. Responses to the questions were provided by Mr. Aminur Islam (EQMS Consulting Ltd.), Mr. Mohammad Riyajul Islam (BWDB), and Mr. Nani Gopal Das (Upazila Engineer, LGED) on behalf of their respective organizations.

Table 9-7: Brief overview of the public consultation meeting

S/N	Name & Designation	Questions/Comments	Response
1	Bijoy Kumar Haldar, Upazila Agriculture Officer	He mentioned that agriculture in the haor area is completely dependent on seasonal water, early flash floods, and proper drainage. He pointed out that unplanned embankment construction, delayed canal excavation, or dredging at the wrong time can damage agricultural land and disrupt crop production. He stressed that work schedules should be carefully prepared considering farmers' interests.	To avoid disruption of agricultural activities, the timing of embankment construction, repair, and excavation works will be planned carefully in alignment with the agricultural calendar. Proper soil and spoil management will be ensured during excavation to maintain soil fertility. In addition, awareness programs and training activities involving farmers will be considered to help them better understand and benefit from the project.
2	Mohammad Khairul Islam, Local Farmer	He shared his real-life experience and stated that flash floods are the greatest disaster in their lives every year. Within just a few days, their entire Boro rice crop gets submerged, pushing farming families into severe financial hardship. He strongly stated that without strong embankments, timely canal excavation, and effective sluice gate management, a permanent solution to these problems is not possible.	The project includes embankment rehabilitation, river and canal re-excavation, and improvement of water control structures. These interventions aim to significantly reduce the risks of early flash floods. The project will also coordinate with relevant government departments to explore possible support measures for affected farmers, including assistance and recovery initiatives where feasible.
3	Nurul Amin, Assistant Professor, President Abdul Hamid Government College	He noted that flooding, riverbank erosion, and inadequate drainage have been long-standing problems in the haor region. He emphasized the need for scientifically designed and climate-resilient infrastructure tailored specifically for this area. He also stated that project structures should be designed to maintain a proper balance between agriculture, fisheries, and the natural environment.	Embankments, regulators, sluice gates, flood fuses, and river/canal re-excavation works will be implemented following climate-resilient and scientifically sound designs. Final designs have been prepared by considering natural water flow patterns and biodiversity of the haor ecosystem. All recommendations from the Environmental Impact Assessment (EIA) will be strictly followed.
4	Khairul Alam, Union Parishad Chairman	He stated that for many years, people of the haor area have suffered due to weak embankments, wave actions, and poor communication systems. He expressed hope that, if properly implemented, this project would significantly improve the living standards of the local	Active participation of local government institutions, elected representatives, and community members will be ensured during project implementation. Local labor will be given priority in construction works to promote local employment. Regular monitoring, supervision, and reporting systems will be

S/N	Name & Designation	Questions/Comments	Response
		population. He also stressed the importance of transparency, involvement of local labor, and regular supervision.	strengthened to ensure quality and transparency throughout the project period.
5	Md. Anwar Hossain, ASA (NGO)	He highlighted that poor, landless households, female-headed families, and persons with disabilities in the haor area are the most affected during disasters. He emphasized that development should not only focus on infrastructure, but also include social protection and livelihood restoration programs for these vulnerable groups.	As part of the project's social management framework, a Livelihood Restoration Plan (LRP) will be prepared and implemented. Special initiatives such as cash-for-work programs, skills development training, and access to easier credit support will be considered for poor and vulnerable households. Coordination with NGOs and social organizations will be strengthened to make these interventions more effective.
6	Amjad Hossain Bahadur, Daily Jugantor	Based on his long experience in journalism, he stated that many past projects failed to deliver expected benefits due to poor construction quality, delays, and lack of proper supervision. He stressed that ensuring quality of work, transparency, and timely implementation is essential for the success of this project.	A strong quality control system will be put in place, including regular inspections and third-party quality audits. Timely completion of works will be strictly monitored, and project progress will be regularly shared with the public and the media to ensure transparency and accountability.
7	Nazmul Hossain, Daily Mujahid	He expressed concern that failure to prevent embankment breaches, sluice gate malfunctions, and poor coordination in excavation works in advance could damage public trust. He stressed that planning should be based on local realities and field-level experiences.	Preventive maintenance planning and emergency repair mechanisms will be adopted for high-risk locations. Field-based, location-specific measures will be designed based on local feedback. Regular site inspections and stronger supervision will be ensured throughout the project.
8	Mujahid Sarkar, Fisherman	He stated that excavation works at the wrong time can disturb fish breeding and severely reduce the income of fishermen. He emphasized the importance of maintaining natural water flow in canals and rivers to ensure free movement of fish.	Excavation and water management activities will be scheduled by considering fish breeding seasons. Sluice gate operation procedures will be developed in consultation with local fishing communities to protect fish migration routes and safeguard fishermen's livelihoods.
9	Mr. Shinji Tanaka, Associate Senior Staff, International	He stated that for projects funded by international donor agencies, environmental and social safeguards are given the highest priority. He mentioned that no project can be	The project will be implemented in full compliance with JICA Guidelines and other relevant international environmental and social safeguard policies. Regular environmental and social

S/N	Name & Designation	Questions/Comments	Response
	Environmental Department, Nippon Koei	sustainable without active participation of local communities.	monitoring will be conducted, and community feedback will be systematically incorporated into both planning and implementation phases.
10	Habib Hossain, Auto Driver	He emphasized that workers involved in the project should receive fair and timely wages. He also stressed that embankment construction must be durable and long-lasting, and warned against unplanned or poorly managed construction activities. He urged the project authorities to pay special attention to proper planning and supervision to avoid substandard work.	The project will give high priority to ensuring fair and timely payment of wages to all workers. Durable and sustainable embankments will be constructed using quality materials, modern engineering methods, and regular technical supervision. All project activities will be carried out in a well-planned manner, strictly adhering to safety standards and quality control procedures, in order to minimize the risk of unplanned construction and potential accidents.

9.6.3.3.6 Special Guest's Speech

Mr. Md. Abdullah Al Matin, Assistant Director, Department of Environment, Kishoreganj, began by thanking all participants for attending the stakeholder consultation meeting and for providing their thoughtful comments. He also expressed appreciation to the organizers for effectively presenting the draft Environmental Impact Assessment (EIA) report. He highlighted the importance of stakeholder consultations in environmental impact assessments and noted that the Haor region is ecologically highly sensitive, where any infrastructure development can directly affect water, soil, air, biodiversity, and the livelihoods of local communities. He emphasized that conducting a proper EIA within the legal framework is crucial before project implementation.

9.6.3.3.7 Chief Guest's Speech

Mr. Md. Muntasir Hasan Khan, Upazila Land Officer and Assistant Commissioner (Land), began by greeting the meeting chair, local chairpersons, journalists, and all participants. He acknowledged receiving numerous important and well-considered comments during the consultation and thanked the organizers. He highlighted that land acquisition in the Haor region is highly sensitive because most people directly depend on agricultural land. He stressed that any land acquisition must be legal, transparent, and fair, with timely compensation and proper resettlement provided to affected families.

9.6.3.3.8 Chairperson's Speech

Mr. Nani Gopal Das, Upazila Engineer (Itna), emphasized the importance of maintaining construction quality and protecting the environment during the implementation of the HARD Project. He stated that every project activity directly impacts local livelihoods, agriculture, water management, and the environment, so all work must be carried out responsibly and with caution. He further noted that environmental standards, safe construction practices, and the preservation of natural water flows will be prioritized. Before starting any infrastructure work, careful analysis of local conditions, agricultural land, access routes, and water flows will be conducted. He reassured the community that environmental protection will be prioritized at every stage, with mitigation measures implemented as needed, and special measures will be taken to reduce dust, noise, traffic disruptions, and excavation-related inconveniences. Local concerns will be considered during implementation, and the Upazila Engineering Department will ensure quality through regular monitoring.

9.6.3.3.9 Summary of Public Consultation

As part of the EIA process for the proposed Haor Area Resilience and Development (HARD) Project, a draft EIA report was prepared and presented during a stakeholder consultation meeting held on 2 December 2025 at the Upazila Parishad conference hall in Itna, Kishoreganj. A total of 42 participants attended, including representatives from government departments, local elected officials, journalists, NGO representatives, and local community members from the Haor region. The meeting included detailed presentations on the project background, objectives, potential engineering structures, environmental baseline conditions, and anticipated environmental and social impacts during pre-construction, construction, and operation phases. Participants provided important comments and recommendations on land acquisition, compensation, flood mitigation, embankment design, canal re-excavation, sluice gate management, fishery resource conservation, agricultural land protection, biodiversity preservation, and community participation.

Most participants expressed satisfaction with the overall purpose and planning of the project, recognizing it as a timely and necessary initiative for the Haor region. They noted that successful project implementation would significantly reduce flood risks, protect agricultural production, improve fisheries resources, enhance local infrastructure, and improve the livelihoods of Haor communities.

Participants also acknowledged that, like any large-scale development project, some potential negative environmental and social impacts may occur. However, they agreed that proper implementation of the

Environmental Management Plan (EMP), Environmental Monitoring Plan (EMoP), and mitigation measures can effectively control and minimize these impacts.

Overall, stakeholders concurred that the project, if implemented with active local participation, climate-resilient engineering designs, transparent management, and environmentally friendly practices, will serve as a sustainable development model for the Haor region. It is expected to enhance climate adaptation capacity, conserve biodiversity, improve the quality of life for vulnerable communities, and ensure long-term social and economic stability.

In conclusion, considering the discussions and stakeholder feedback, the proposed HARD Project is strongly anticipated to bring positive environmental, social, and livelihood benefits to the local communities in the Haor region.

9.6.3.4 Public Consultation Meeting in Kalmakanda, Netrokona

Venue: Upazila Parishad Hall Room, Kalmakanda, Netrakona

Date: 1 December 2025

Time: 3:30 PM to 5:00 PM

Chair: Mr. Md. Mominul Islam, Upazila Engineer, LGED, Kalmakanda, Netrakona

Chief Guest: Ms. Faizul Wasima Nahat, Upazila Nirbahi Officer, Kalmakanda Upazila, Netrakona

Special Guest: Mr. Md. Abdullah Al Matin, Assistant Director, Department of Environment, Netrakona

Other Guests:

1. Mr. Mahmudul Hasan, Assistant Commissioner (Land), Upazila Land Office, Kalmakanda, Netrakona.
2. Mr. Saiful Islam, Upazila Agriculture Officer, Kalmakanda, Netrakona.
3. Mr. Md. Jahidul Islam, Upazila Fisheries Officer, Kalmakanda, Netrakona.
4. Mr. Md. Mahbubur Rahman, Upazila ICT Officer, Kalmakanda, Netrakona.
5. Mr. Ibrahim Khalil Ullah Khan, Sub-Assistant Engineer, Bangladesh Water Development Board.
6. Ms. Romman Ara, Sub-Assistant Engineer, Upazila Public Health Office, Kalmakanda, Netrakona.
7. Local leaders, journalists, and residents of the haor area.

9.6.3.4.1 Introduction

A public consultation meeting is a process that provides the public with an opportunity to express their opinions on a project and ensures that their comments and views are considered in the related decision-making process. In accordance with the Environment Conservation Rules 2023 (Rule 16), this public consultation meeting was organized as part of the draft Environmental Impact Assessment (EIA) to disclose information on the potential environmental impacts of the project to the local community and to collect their opinions.

The mentioned public consultation meeting was held on 1 December 2025. A total of 45 representatives (43 male and 2 female) from various institutions and stakeholders of the concerned area were present at the meeting.

9.6.3.4.2 Methodology

In accordance with the Environment Conservation Rules 2023 (Rule 16, sub-rule 2), an application was submitted to the Head Office of the Department of Environment seeking permission to organize the public consultation meeting, along with the draft Environmental Impact Assessment (EIA) report and its Bangla summary. Following this, the Department of Environment nominated a representative to attend the meeting.

Notices of the said public consultation meeting were published on 26 November 2025 in The Daily Samakal, a national daily newspaper of Bangladesh, and The Daily Banglar Darpan, a local newspaper. In addition, stakeholders were invited through formal invitation letters.

9.6.3.4.3 Opening of the Session

The public consultation meeting commenced with recitation from the Holy Qur'an and readings from the Shrimad Bhagavad Gita. Thereafter, Mr. Ibrahim Khalil Ullah Khan, Sub-Assistant Engineer, Bangladesh Water Development Board, formally inaugurated the meeting by welcoming the participants.

He stated that there are three haor areas officially recognized by the Bangladesh Water Development Board in Kalmakanda Upazila. At present, construction of submersible embankments is ongoing in Updakhali Haor, and regular repair and development activities are undertaken every year to protect crops from early floods and ensure safe harvesting. He also mentioned that embankment erosion occurs every year at several connecting points of haors linked with the Updakhali River. Furthermore, he noted that over the past two years they have faced various challenges while repairing several vulnerable embankments.

He expressed hope that through this project, the long-standing hardships of the haor community would be alleviated and a sustainable solution for crop protection would be established.

9.6.3.4.4 Presentation on the Draft Environmental Impact Assessment

Mr. Ferdous Alam Quraishi, Senior Consultant and Environmental Specialist of EQMS Consulting Limited, began the presentation by extending his sincere greetings to the participants. He delivered a presentation on the draft Environmental Impact Assessment (EIA) report covering the following aspects.

1. Purpose of public consultation
2. Project background
3. Project description
4. Sample designs related to the project
5. Environmental baseline data
6. Environmental and social impact assessment (pre-construction, construction, and operational phases)
7. Environmental Management Plan
8. Environmental Monitoring Plan
9. Conclusion and recommendations.

9.6.3.4.5 Open Discussion and Feedback

After the presentation, an open discussion and question–answer session were held. The discussion points are summarized in Table 9-8.

Table 9-8: Brief overview of the public consultation meeting

S/N	Name & Designation	Questions/Comments	Response
1	Mokles Uddin Khanl, Farmer, Pogla	He told that, if a flushing sluice gate is constructed at Location 2 of the Gunai River in Bhogla Union, the local people will benefit from flood damage, and water management can be effectively controlled.	
2	Mosabbir Talukdar, Businessman, Madhyanagar	Due to the siltation of the Gunai River, several thousand hectares of land from Tuker Bazar to Saho are now at risk. Because of the siltation, rainwater and water from the haor freely enter the fields, causing regular and extensive crop damage. He further mentioned that the Updakhali embankment project had been previously inspected by the authorities, but it now urgently requires repair. He requested the concerned authorities to take the necessary actions promptly.	
3	Md. Mobarak Hossain, Student, Pachkatha	In Pachkatha Union, the canals coming down from the hills and the Updakhali River are gradually getting silted. Due to the siltation of the river and canals, serious problems have arisen in the local irrigation system. Because the Updakhali embankment is weak, even a minor flood causes water to flow directly into agricultural fields, destroying crops. The local people stated that earlier they could cultivate crops in two seasons per year, but due to the absence of effective and permanent embankments, it is now not possible to safely cultivate two crops. The same issue is occurring in several hectares of Pachkatha village. Even if one season of crops is possible, during floods the weak embankments break or get damaged, resulting in crop loss.	

S/N	Name & Designation	Questions/Comments	Response
		They believe that constructing a permanent and strong embankment will improve the local irrigation system, reduce flood damage, and allow farmers to safely cultivate two crops per year. Such embankment construction would be highly beneficial and provide a long-term solution for the local community.	
4	Md. Abu Taher, Businessman, Nazirpur	The canal passing by the primary school in Haripur village of Nazirpur Union, which flows from Madankhali Bill and joins the Pachkatha River, is eroding and silting up. As a result, even moderate rainfall quickly floods the school playground. During heavier floods, water fails to drain properly and enters the school building, severely disrupting the learning environment. He requested the UNO to authorize dredging of the canal along the western bank of Madankhali, adjacent to the primary school. This would restore normal water drainage, reduce waterlogging in the school and surrounding areas, and significantly benefit the local community.	
5	Md. Anwar Hossain, Businessman, Kalmakanda	Although it is possible to cultivate two crops per year from Bashhawra to Badi (Kalmakanda Sadar), during floods, the riverbanks overflow, causing water to inundate the fields and resulting in extensive crop damage. The local people believe that if a protective embankment is constructed in this area, cultivation could be carried out safely on many acres of land across 3 to 4 villages. At the same time, it would also facilitate irrigation by lifting water from the river. This would increase agricultural production and significantly benefit the local farmers.	

S/N	Name & Designation	Questions/Comments	Response
6	Rasel Ahmed, Businessman, Nazirpur	In their area, there is a protective embankment and a sluice gate on the Bacha River, but the canal that was meant for drainage has silted up, preventing water from flowing out normally. As a result, even light rainfall quickly floods the agricultural fields, causing significant losses to farmers. The locals stated that if the canal is dredged to restore proper drainage and the embankment along the Batla River is reconstructed, the entire community would benefit significantly. This would not only protect crops but also make agriculture more sustainable and secure in the long term.	
7	Md. Asaduzzaman, Service Holder, Kalmakanda	He stated that this project will certainly bring benefits to the area. He mentioned that there are approximately 5,000 hectares of haor in the region, but the project is primarily designated for the Updakhali Haor. He inquired whether the project would be effective only for the Updakhali Haor or if all the haors in Nazirpur Union would be included. Additionally, he was interested to know whether other haors outside Updakhali would also fall under the project. He emphasized that the main goal of the project is to improve agriculture, so he seeks a clear understanding of the project's scope and effectiveness.	Mr. Ferdows Alam Quaraishi responded that the project primarily covers the Updakhali Haor area. Work will be carried out on the canals and rivers associated with Updakhali Haor, but at present, no work is planned outside this area. He also mentioned that the complete project area has not yet been finalized, as it is still in the feasibility assessment stage.
8	Md. Saidur Rahman Bhuiya, Chairman, Lengura	He stated that the embankment stretching approximately 7–8 kilometers from Jatrabari to Bausali village towards the northeast repeatedly breaks, causing vast amounts of crops to be submerged each time and farmers to suffer severe losses. He noted that if a sluice gate is installed in the area, thousands of farmers would directly benefit. He further mentioned that the currently constructed temporary embankments break almost every year,	

S/N	Name & Designation	Questions/Comments	Response
		resulting in significant government expenditure. Instead, if a sustainable and permanent embankment is constructed along with a paved road on top, the local community would gain long-term benefits, and the safety of farmers and crops would be ensured. He appealed to the government to refrain from constructing temporary embankments and instead undertake the construction of durable, strong, and long-lasting embankments so that government expenditure is reduced and the local people and farmers receive lasting benefits. He also highlighted that the existing embankment in the Boroi area is only 4 feet high, which is insufficient to protect crops from floods. Raising it to 6–8 feet would effectively safeguard crops in the area from flood damage. Overall, he specially requested the higher authorities once again to avoid temporary measures and focus on constructing sustainable, strong, and long-lasting infrastructure, which would save government funds and provide real and lasting benefits to farmers.	

9.6.3.4.6 Speech by Special Guest

At the beginning of his speech, the special guest, Mr. Md. Abdullah Al Matin, Assistant Director, Department of Environment, Netrokona, sincerely thanked all participants of the public consultation meeting for their participation and for presenting their thoughtful opinions. He praised the organizers, noting that the draft Environmental Impact Assessment (EIA) report had been presented very systematically and clearly, making it easy for all participants to understand the subject.

He highlighted the importance of stakeholder consultation meetings in the EIA process, emphasizing that the opinions of local people, relevant institutions, and field-experienced individuals are extremely valuable for any development project. He further requested that all feedback, concerns, and recommendations received from this meeting be appropriately incorporated into the final report so that environmental protection and the interests of the local community are given the highest priority during project implementation.

9.6.3.4.7 Speech by Special Guest

At the beginning of his speech, the chief guest, Mr. Faizul Wasima Nahat, Upazila Executive Officer, Kalmakanda, extended his heartfelt greetings to the president of the public consultation meeting, local chairpersons, journalists, and all attendees. He noted that the meeting had received many important and well-considered opinions, which would play a significant role in project planning and implementation. He expressed his gratitude to the organizers for this.

Addressing the representatives of the Bangladesh Water Development Board, he stated that Kalmakanda Upazila possesses all the characteristics of a haor upazila, and it is essential to take necessary steps to officially declare it as such. He added that if declared a haor upazila, many haor-centric development projects would come to the area, from which Kalmakanda is currently being deprived.

He critically pointed out that every year, embankments constructed by cutting soil often break or collapse during floods, requiring repairs at the same locations the following year. He emphasized the need to adopt large and sustainable projects instead of repeatedly implementing small ones, as this would provide long-term solutions. He also urged local residents to understand the necessity of the project so that they can actively cooperate in the development activities.

He further appealed that all relevant institutions should coordinate among themselves for project implementation. Instead of implementing multiple projects in the same location, projects should be prioritized and distributed to different necessary sites to ensure more effective development.

Finally, he requested that embankment projects be designed to support crop production and flood prevention, especially to ensure that Kalmakanda Upazila suffers minimal damage from floods. He expressed optimism that many more sustainable development projects would be implemented in the upazila in the future without harming the environment, thereby accelerating the overall development of Kalmakanda.

9.6.3.4.8 Speech by Chairperson

At the beginning of his speech, the chairperson, Mr. Md. Mominul Islam, Upazila Engineer, LGED, Kalmakanda, Netrokona, warmly welcomed all attendees to the public consultation meeting. He provided a brief overview of the overall aspects of the project, its potential benefits, and the implementation process. At the same time, he emphasized the necessity of giving utmost importance to environmental aspects during project implementation.

He stated that no activities should be undertaken in the project area that could have negative impacts on the environment. In particular, he advised caution to ensure that fish sanctuaries, natural breeding grounds, and their natural movement are not disturbed. He also made a special request to the

Bangladesh Water Development Board to ensure that waterlogging does not cause damage to agricultural fields.

He further noted that all opinions and recommendations received from this public consultation meeting should be properly recorded in the report. He expressed hope that if the project is implemented properly, in a planned and sustainable manner, it will improve the livelihoods of local people, bring positive changes to the socio-economic conditions, and successfully achieve the main objectives of the project.

He emphasized that, for the overall infrastructural development of Kalmakanda Upazila, it is essential to officially declare the area as a haor region.

Finally, he thanked all participants and formally concluded the consultation meeting.

9.6.3.4.9 Summary of Public Consultation

A detailed Environmental Impact Assessment (EIA) report has been prepared for the proposed “Haor Area Resilience and Development Project,” and based on this, a public consultation meeting was held on 1 December 2025 at the Upazila Parishad Hall, Kalmakanda, Netrokona. During the meeting, the potential positive and negative impacts of the project were presented and analyzed in detail. Various stakeholders attending the meeting provided their valuable opinions, which will serve as important guidance for project implementation.

It is noteworthy that every project has both positive and negative impacts. In this case, the positive impacts of the project are significantly predominant. If the prescribed mitigation measures are properly implemented, the potential negative impacts on the environment can be effectively minimized.

The project will provide important social, economic, and environmental benefits for the haor region while keeping potential negative impacts to a minimum. By implementing appropriate mitigation measures and following the Environmental Management Plan, the project will enhance flood resilience, protect agricultural production, develop fisheries resources, and ensure the stability of local infrastructure and livelihoods.

The integration of local community participation, climate-resilient engineering designs, and environmentally friendly management will collectively establish a model of sustainable development. This approach will ensure a sustainable and prosperous future for both people and nature in the long term by enabling climate change adaptation, biodiversity conservation, and improved quality of life for vulnerable communities.

Overall, considering the positive aspects of the proposed project and its environmental and social significance, it can be confidently stated that the project will bring a positive change to the environment and the lives of the local population.

CHAPTER 10

Environmental Management Plan

10 ENVIRONMENTAL MANAGEMENT PLAN

10.1 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.

10.2 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 under:

- To comply with all the regulations/applicable laws.
- 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.
- To contribute significantly to sustainable development.

Environmental Management Plan (EMP) includes a list of actions for curbing environmental and social adverse impacts, monitoring, and also formulating budgetary costs for the implementation of Environmental and Social Management Systems (ESMS). In case any non-compliance, change in scope, or unanticipated impact arises during project implementation, corrective action would be taken accordingly as per statutory requirements and funding agencies' environmental and social guidelines and standards.

10.3 Environmental Mitigation Plan

Key environmental impacts have been identified and reported in Chapter 8 along with mitigation measures. A summary of mitigation measures for environmental, ecological receptors, and socio-economic conditions identified for the construction and operation phases of the project is presented in Table 10-1 and Table 10-2, respectively.

Table 10-1: Environmental mitigation plan during the construction phase

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Air pollution 【Common Measures for All Haors】	Dust Emissions	• Follow the approved Environmental Management and Monitoring Plan. • Phase and schedule dust-generating activities; work during low-wind periods. • Use water spraying for excavation, earth handling, and material storage areas. • Store soil/sand in designated areas; cover stockpiles with tarpaulin, keep below 2 m, and maintain distance from receptors. • Re-vegetate exposed ground promptly. • Maintain and clean access roads and nearby streets; enforce vehicle speed limits. • Educate communities on dust hazards and preventive measures. • Keep a grievance register on site. • Conduct periodic ambient air quality monitoring.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
	Vehicular Emissions	• Follow the approved Environmental Management and Monitoring Plan. • Maintain machinery to prevent smoke emissions and ensure compliance. • Regularly check vehicle emissions. • Use electric or battery-powered equipment where possible; maintain diesel equipment properly. • Avoid idling of vehicles and equipment to reduce exhaust emissions.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Prohibit open burning of waste at or near the site. • Conduct periodic ambient air quality monitoring.		
Water quality 【Common Measures for All Haors】	Surface water contamination	• Implement temporary bunds to control runoff and prevent sediment from entering water bodies. • Store fuels, oils, and chemicals safely with spill containment. • Treat construction camp wastewater before discharge. • Limit earthworks near watercourses; schedule dredging/excavation in low-flow periods. • Monitor surface water quality regularly during construction. • Train workers on safe material handling to prevent spills.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
	Groundwater contamination	• Store fuels, oils, and chemicals with proper containment. • Treat construction camp wastewater; avoid direct soil infiltration. • Manage solid waste properly to prevent leaching. • Monitor groundwater quality regularly near construction sites. • Avoid excavation and material handling in sensitive recharge zones.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Soil 【Common Measures for All Haors】	Soil Contamination	• Maintain equipment regularly to prevent fuel leaks. • Manage soil contaminant spills and handle dredged/excavated waste properly. • Store fuels, chemicals, and lubricants with containment measures. • Treat and safely dispose of liquid and hazardous waste. • Minimize soil disturbance during construction.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Monitor soil quality periodically and train staff on safe material handling.		
Waste 【Common Measures for All Haors】	Generation of waste	• Implement a comprehensive solid waste management plan for construction activities and labor camps. • Segregate waste at source into biodegradable, non-biodegradable, and hazardous categories. • Store hazardous materials, including chemicals and fuels, in securely labeled and bunded areas; limit on-site storage to minimize risk. • Collect, transport, and dispose of construction debris and domestic waste regularly at approved facilities. • Reuse or recycle construction debris wherever feasible to reduce landfill disposal. • Clearly demarcate all storage and handling areas, ensuring proper labeling and security for hazardous materials. • Train and instruct workers to prevent littering and random disposal of waste on-site. • Remove all construction debris and level the site to its original condition upon completion of development activities. • Develop and enforce a construction waste management plan (segregation, collection, and safe disposal). • Monitor waste management practices regularly to ensure compliance with national regulations and the project EMP.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Noise	Increased ambient noise	• Schedule the noisiest construction activities to minimize disturbance; limit operation times of noisy equipment.	Appointed Contractor	Project management team of LGED and Design and

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
【Common Measures for All Haors】		• Regularly maintain and service all equipment, including mufflers; replace damaged components promptly. • Restrict public access within 10 m of construction areas. • Use quieter equipment models and acoustic covers where practicable; erect acoustic barriers along site boundaries. • Train workers on noise-reducing practices and provide ear protection in high-noise areas; include reminders in daily toolbox briefings. • Reduce the number of simultaneously operating equipment; route mobile noise sources to minimize disturbance. • Prohibit vehicle movement at night on access roads. • Conduct daily inspections and noise monitoring to ensure compliance with Noise Pollution (Control) Rules, 2025.		Supervision Consultant
Vibration 【Common Measures for All Haors】	Vibration generation	• Operate machinery per manufacturer guidelines to reduce vibration. • Limit heavy equipment use near sensitive structures. • Schedule high-vibration activities to minimize exposure. • Periodically monitor vibration near sensitive structures.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Offensive Odor 【Common Measures for All Haors】	Temporary odors may occur	• Ensure proper storage of fuels, oils, and chemicals in designated bunded areas. • Maintain sanitation facilities in construction camps, with regular cleaning and safe waste disposal. • Immediately clean up accidental spills of fuels or chemicals and dispose of contaminated materials appropriately. • Cover or enclose odorous materials and chemicals to reduce emissions.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Educate construction workers on proper handling practices to minimize odor release. • Monitor areas with higher potential odor generation and respond promptly to complaints or issues.		
Bottom Sediment【Common Measures for All Haors】	Bottom sediment contamination	• Schedule dredging during dry or low-flow periods to minimize turbidity. • Limit dredging/excavation area and duration to reduce sediment resuspension. • Dispose of dredged material at designated sites, not directly into water bodies. • Monitor turbidity and suspended sediments during construction. • Train contractors and workers on responsible practices near aquatic habitats.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Biodiversity【Shanir Haor】	Terrestrial Ecosystems and Biota	• Although Shanir Haor is not part of a protected area, it is located near Tanguar Haor (a protected area) and may serve as a habitat for important species, such as migratory birds that visit Tanguar Haor in winter. Therefore, a baseline survey should be conducted during the DD stage, and additional mitigation measures will be implemented as necessary. • Restrict tree felling to the minimum and implement compensatory plantations. • Suppress dust (water spraying, covering stockpiles). • Limit noisy activities to daylight hours. • Salvage and reuse topsoil for revegetation.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
	Fisheries and Aquatic Resources	• Prepare the construction plan in consultation with local fishers, considering the existing sanctuaries. • Foraging ground of migratory birds should not be disturbed by dredging and excavation works. • Implement silt curtains to minimize turbidity in adjacent beels. • Dispose of dredged spoil in approved upland areas or use for community asset elevation (schools, homesteads). • Restrict night-time noisy works near key bird habitats. • Maintain spill response kits and emergency protocols for hazardous material handling.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Biodiversity 【Other Haors】	Terrestrial Ecosystems and Biota	• Restrict tree felling to the minimum and implement compensatory plantations. • Suppress dust (water spraying, covering stockpiles). • Limit noisy activities to daylight hours. • Salvage and reuse topsoil for revegetation.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
	Fisheries and Aquatic Resources	• Prepare the construction plan in consultation with local fishers, considering the existing sanctuaries. • Foraging ground of migratory birds should not be disturbed by dredging and excavation works. • Implement silt curtains to minimize turbidity in adjacent beels. • Dispose of dredged spoil in approved upland areas or use for community asset elevation (schools, homesteads). • Restrict night-time noisy works near key bird habitats. • Maintain spill response kits and emergency protocols for hazardous material handling.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Topography/geology 【Common Measures for All Haors】	Modifies the natural topography through earth filling and embankment works.	• Save topsoil removed at the start of the project and use it for reclaiming disturbed areas upon completion of development and construction activities. • Restrict earth cutting and filling to the minimum required level consistent with submerged road design standards.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Loss of land 【Common Measures for All Haors】	Land acquisition may impact on the livelihoods of the people who own or use the affected land.	• The project should aim to minimize land acquisition, avoid physical displacement, and prevent the takeover of productive land. • When avoidance or minimization is not possible, a comprehensive Resettlement Action Plan (RAP) should be prepared, with provisions for cash compensation for acquired land. • Proper monitoring of the RAP implementation should be carried out.	• Office of the Deputy Commissioner • Implementing NGO	Project management team of LGED and Design and Supervision Consultant
Sharecroppers 【Common Measures for All Haors】	May lose access to the agricultural land	• A context-specific ILRP should be prepared. • Implementation of ILRP should be ensured to minimize livelihood impacts.	Implementing NGO	Project management team of LGED and Design and Supervision Consultant
Poor People and Socially vulnerable 【Common Measures for All Haors】	The poor people who worked in the acquired land may be affected by losing access to the land.	• Particular attention should be paid to the needs of the poor and vulnerable and adapt the engagement process accordingly. • A context-specific ILRP should be prepared. It is necessary to ensure that women have a role in decision-making. • Implementation of the ILRP should be ensured to minimize livelihood impacts.	Implementing NGO	Project management team of LGED and Design and Supervision Consultant

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Loss of livelihood 【Common Measures for All Haors】	Affected people will lose livelihood due to land acquisition and restriction during construction	• Title and non-title vulnerable households should be identified during the RAP and a context-specific ILRP should be prepared. • Implementation of ILRP should be ensured to minimize livelihood impacts. • Project Affected Persons (PAPs) should be prioritized during any employment opportunities related to this project. • Develop and enforce a construction waste management plan (segregation, collection, and safe disposal). • Follow measures to avoid disturbance in adjacent lands.	Implementing NGO	Project management team of LGED and Design and Supervision Consultant
Land use and utilization of local source 【Common Measures for All Haors】	Reduction of agriculture land may result in a shift in agricultural practices of some people.	• Provide fair compensation to the affected people. • Prepare context specific ILRP and ensure proper implementation. • Training and financial support for farmers to transition to alternative employment or modern agricultural techniques.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Local Communities and Decision-making Institutions 【Common Measures for All Haors】	Social institutions and local decision-making institutions of the project area may be impacted.	• The land acquisition process should be conducted through the enforcement of Acquisition and Requisition of Immovable Property Act, 2017 (ARIPA), the landowner will be duly compensated as per the provisions mentioned in the Entitlement Matrix of Resettlement Action Plan • Coordinate with relevant institutions like Union Parishad, DC office, etc. • Ensure participatory consultations with affected people.	Implementing NGO	Project management team of LGED and Design and Supervision Consultant

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Uneven distribution of damage and benefit 【Common Measures for All Haors】	Only landowners and affected laborers will be eligible for compensation and rehabilitation and other can be excluded form the criteria.	• Cover the impacted people under the agriculture promotional activities like training for the farmers. • Encourage contractors to prioritize hiring local workers, including unskilled labor, to ensure more equitable distribution of job opportunities. • Conduct consultations with affected communities to identify vulnerable groups and ensure their concerns are addressed in compensation and employment strategies. • Implement context oriented LRP. • Set up a transparent grievance redress system to allow affected individuals to voice concerns and seek fair resolution regarding compensation and employment.	Implementing NGO	Project management team of LGED and Design and Supervision Consultant
Conflicts of Interest within the Region 【Common Measures for All Haors】	Due to an increase in employment opportunities during construction, construction workers may experience some conflicts between local communities.	• Ensure that contractors implement fair recruitment practices that prioritize local workers for unskilled or semi-skilled labor positions. • Conduct regular consultations with local communities to understand their concerns regarding employment opportunities and ensure transparency in the hiring process. • Establish a clear grievance redress system where local workers can raise concerns about employment opportunities and resolve issues amicably.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Gender 【Common Measures for All Haors】	There will be some impact due to chance of gender-based violence.	• Resident women should be closely informed about the days during which the works will occur in the areas they used to move or for other activities. • EPC contractors should alert the labor and worker group for not being involved with such activity.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Proper guidelines and training should be provided to the workers regarding GBV. • The OHS manager and Social Safeguard specialist or any such designated person should be in charge of monitoring during the construction work. • Onsite grievance box should be maintained.		
Children's Rights 【Common Measures for All Haors】	The construction activity may create some impact school-going children who travel on the roads twice a day.	• Traffic personnel should be appointed at every potential crossing of school for commuting children. • Safety signage should be placed properly so that school-going children can easily access the route. • Proper consultation should be conducted with the schoolteacher and management committee. • EPC contractors should alert the workers/drivers to avoid school time for construction work in those particular areas. • Child labor at the construction site during the project implementation shall be strictly prohibited since both Bangladesh laws and JICA guidelines ban such practices.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Infectious Disease, such as HIV/AIDS 【Common Measures for All Haors】	Influx of workers may increase the risk of infectious diseases.	• In order to minimize the impact, preventive measures against such diseases should be considered, and implemented by construction contractors. • To provide surveillance for workers' health. • Prevention of illness among workers by undertaking health awareness and education initiatives and by conducting immunization programs for workers. • To provide treatment through standard case management in on-site and community health care facilities as necessary.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Educating project personnel and area residents on risks, prevention, and available treatment. • Promoting collaboration with local authorities to enhance access of workers' families and the community to public health services and promoting immunization as necessary. • Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites.		
Working environment (work safety) 【Common Measures for All Haors】	There would be the possibility to accidents and incidents occurring during construction works for the implementation of the project.	• Maintain general OHS guidelines at workplace. • Areas that are under construction should be protected from trespassing. • Emergency response measures like first aid and rescuing facilities for any accident should be available.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Climate Change 【Common Measures for All Haors】	GHGs emissions	• Ensure regular maintenance of construction vehicles and machinery to reduce fuel consumption and GHG emissions. • Optimize machinery operation to avoid unnecessary idling or inefficient usage. • Use low-emission fuels or energy-efficient machinery where feasible. • Implement mitigation measures from the air quality management plan to indirectly reduce GHG emissions. • Monitor GHG emissions from major construction activities periodically.	Appointed Contractor	Project management team of LGED and Design and Supervision Consultant
Accidents	Construction accidents and road accidents	• Follow the Health and Safety Management Plan (HSMP) rules and regulations designated by contractors.	Appointed Contractor	Project management team of LGED

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
【Common Measures for All Haors】		• Provide traffic signs, road markings, speed bumps, zebra crossings, guard rails, poles, and curb stones as required. • Implement a proper traffic management plan to separate construction vehicles, machinery, and pedestrian movement. • Train workers in safety procedures and ensure the use of personal protective equipment (PPE). • Maintain emergency response measures and first-aid facilities on-site. • Conduct regular safety audits and hazard monitoring.		and Design and Supervision Consultant

Table 10-2: Environmental mitigation plan during the operation phase

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Air pollution 【Common Measures for All Haors】	Dust emissions	• Maintain and, where possible, pave roads to reduce dust. • Spray water or dust suppressants on unpaved sections. • Enforce speed limits to minimize dust. • Establish roadside vegetation to stabilize soil. • Clean paved surfaces regularly. • Cover and store construction materials properly. • Monitor dust levels at sensitive locations.	PMO	LGED
	Vehicular emissions	• Promote smooth traffic flow through signage, speed control, and junction improvements. • Enforce vehicle emission standards and encourage cleaner fuels and low-emission vehicles. • Develop green belts to filter vehicular pollutants.	PMO	LGED

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Conduct driver awareness campaigns on maintenance and fuel efficiency. • Monitor ambient air quality at sensitive locations. • Encourage public transport, non-motorized transport, and ride-sharing. • Maintain paved surfaces to reduce dust and congestion.		
Biodiversity 【Common Measures for All Haors】	Terrestrial Ecosystems and Biota	• Maintain buffer strips along wetlands, beels, and riparian vegetation to protect sensitive habitats from maintenance activities. • Schedule desilting, re-excavation, and other disruptive maintenance outside amphibian breeding periods and peak bird nesting/migratory seasons. • Retain native trees along embankments and avoid complete clearance during routine maintenance. • Limit human and vehicle movement to designated paths to reduce trampling and habitat disturbance. • Educate communities and maintenance teams about wildlife-sensitive practices.	PMO	LGED/FD
	Fisheries and Aquatic Resources	• Implement fish-friendly gate operation schedules (partial opening, staggered drainage) in coordination with DoF and BWDB. • Promote integrated pest management (IPM) and organic fertilizer use. • Maintain and expand community-based wetland afforestation (Hijol, Pulm) to stabilize banks and provide fish/bird habitats.	PMO	LGED/DoF

Affected Aspect	Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		• Regulate boat speeds and restrict night navigation in ecologically sensitive haor pockets.		
Hydrology 【Common Measures for All Haors】	Submerged roads can modify micro-hydrology	• The natural drainage pattern should be preserved. • Align roads along natural ridges or higher ground to minimize interference with flood flow. • Provide adequate cross-drainage structures (culverts, bridges, regulators) at regular intervals to maintain natural water movement and connectivity.	PMO	LGED
Climate Change 【Common Measures for All Haors】	Leading to a slight rise in vehicle-related emissions	• Promote regular maintenance of operational vehicles to reduce fuel consumption and emissions. • Encourage the use of low-emission vehicles and fuel-efficient driving practices. • Optimize traffic management to reduce congestion and associated emissions. • Maintain climate-resilient features of the road to prevent damage from extreme weather and preserve natural hydrological flows. • Periodically monitor vehicle-related GHG emissions in high-traffic sections to identify mitigation opportunities.	PMO	LGED

10.4 Greenbelt Development

Establishing a greenbelt in the project area is an effective measure to control environmental pollution. Vegetation functions as a natural sink for air pollutants, reduces wind speed, and allows dust and other suspended particles to settle. It also contributes to lowering noise levels to some extent. For the HARD Project, the primary purpose of the greenbelt is to create a buffer zone between potential sources of pollution and nearby settlements or sensitive areas. In addition to capturing fugitive emissions and dampening noise, the greenbelt will enhance the visual landscape and improve the overall environmental quality of the haor region.

10.5 Environmental Monitoring Plan

A monitoring plan has been prepared to ensure compliance with the applicable environmental laws and conditions stipulated in the environmental permits. The monitoring plan also ensures compliance with the recommended safeguards for pollution prevention and abatement and sustainable development of the project.

The implementation of a comprehensive impact and compliance monitoring plan is of utmost importance. The main objectives of the monitoring plan include:

- Assessing the performance and effectiveness of monitoring activities by comparing monitoring results with the baseline data and/or environmental standards.
- Identifying the extent of environmental impacts predicted in the EIA.
- Determining project compliance with regulatory requirements.
- Adopting remedial action and further mitigation measures if found to be necessary.

10.5.1 Environmental Monitoring Plan during Construction Phase

A summary of the monitoring indicators with corresponding locations and frequency is presented in Table 10-3. The monitoring plan shall be the same for all haors.

Table 10-3: Summary of the proposed monitoring plan during the construction phase

Impact	Monitoring Means	Parameters	Location	Frequency	Responsibility	
					Implementation	Supervision
General 【Common Measures for All Haors】	Visual inspection of all active work areas	General compliance with mitigation measures presented in the EMP	Project activity areas and construction worker's camp	Daily	Appointed Contractor	Project management team and designated HSE team
Air quality 【Common Measures for All Haors】	Measurement/ sampling	PM_{10}, $PM_{2.5}$, SPM, NOx, SO_2, CO, O_3	Construction sites	Quarterly		
Noise 【Common Measures for All Haors】	Measurement	Leq (dBA)	Construction sites	Quarterly		
Surface water and groundwater 【Common Measures for All Haors】	Sampling	Temperature, Turbidity, pH, Dissolved Oxygen (DO), BOD_5, COD, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Electric Conductivity (EC), Ammonia (NH3), Nitrate (NO_3), Coliform (total), Chloride (Cl-)	River/Khal at all construction sites	Quarterly		
Soil 【Common Measures for All Haors】	Sampling	pH, Soil texture, TOC, Total N, Total P, and Total K	Construction sites	Quarterly		

Impact	Monitoring Means	Parameters	Location	Frequency	Responsibility	
					Implementation	Supervision
Solid waste 【Common Measures for All Haors】	Audits, photographic documentation, and interviews	Generation, storage, recycling, transport, and disposal	Construction sites	Monthly		
Terrestrial Ecosystem 【Common Measures for All Haors】	Vegetation clearance	Number of trees fell, area of vegetation cleared	Project Site	Once before starting the construction		
	Disturbance to migratory birds/ waterbirds	Species composition and abundance, migration pattern	• In and around the IBAs overlapped with Study Haor • Road and Bridge/Culvert Crossings location	Monthly (November - March) for migratory birds/ waterbirds		
Aquatic Ecosystem 【Common Measures for All Haors】	Fish and crustaceans	Fish species, abundance, CPUE, fish mortality	In and around the project site within 5 km	Quarterly		
Health and safety 【Common Measures for All Haors】	Health and safety surveys	Proper use of PPE, presence of safety signs, first aid kit, firefighting devices, and injury/illness records	Construction site	Continuously		

10.5.1.1 Reporting Requirements

During the construction stage of the project, it is necessary to prepare a periodic environmental monitoring report in English, which will be submitted to the Client (LGED) and the funding agency (JICA). This report will encompass air, noise, and water quality data, along with supporting elements such as maps, diagrams, plans, tables, and other relevant information. It is imperative that all environmental data is accurately and thoroughly reflected in these reports. The following report is required to be prepared.

- Quarterly Environmental Monitoring Report.

Annual Environmental Monitoring Report

During the construction period, environmental inspections and reporting shall be prepared annually by the contractor.[35] The annual report shall consist of a complete environmental compliance checklist developed using the EMP and approved by the Supervision Consultant such that actions necessary for each relevant mitigative action are identified and a summary of all actions recorded. The EIA contains mandatory sampling specifications that the contractor shall be required to adhere to. This report is mandatory and must be submitted to LGED, JICA, and DOE.

Incident Report

Annual environmental monitoring report will be submitted to LGED, JICA, and DOE as part of the project's environmental compliance framework. In addition, incident reports will be prepared and submitted immediately in the event of any emergency situation such as accidents, safety breaches, environmental contamination, or other unplanned events. Each incident report will include details of the incident, immediate response actions, root cause analysis, and corrective and preventive measures taken.

10.5.2 Environmental Monitoring Plan during Operation Phase

Monitoring of air quality, noise levels, terrestrial biodiversity, resource use, traffic, health and safety, and socio-economics, as well as operations, is essential. For certain parameters, sampling and chemical analysis are necessary while for others, only visual inspection and photographic documentation by experienced personnel are adequate. In the case of non-compliance, efforts should be made to:

- Identify the most probable source.
- Check on the proper implementation of the specified mitigation measures.
- Review the effectiveness of the environmental management plan and propose alternative actions as appropriate.
- Increase the monitoring frequency to assess the effectiveness of remedial measures.

Quarterly monitoring progress reports should be prepared, while yearly comprehensive reports should be generated to present the results of monitoring activities and assess the adequacy of environmental control measures. All monitoring records should be kept in an acceptable format (in word processing formats such as MS Word or spreadsheets such as MS Excel) and reported regularly to the responsible authorities and concerned stakeholders.

10.5.2.1 Summary of Monitoring Plan

A summary of the monitoring indicators with corresponding locations and frequency is presented in Table 10-4. While LGED can assist in the implementation of the monitoring plan, it is recommended

[35] For Phase 1, only a Periodic Environmental Report was submitted annually, and this arrangement was accepted by both JICA and DOE.

that an independent third-party consultant be responsible for the overall implementation of the monitoring in close coordination with LGED. The monitoring plan shall be the same for all haors.

Table 10-4: Summary of the proposed monitoring plan during operation phase

Impact	Monitoring Means	Parameters	Location	Frequency	Responsibility	
					Implementation	Supervision
General 【Common Measures for All Haors】	Visual inspection of all project areas	General Compliance with mitigation measures presented in the EMP	Project area	Weekly	PMO	• LGED • Department of Environment (DOE)
Air quality 【Common Measures for All Haors】	Dust emissions	PM_{10}, $PM_{2.5}$, SPM, O_3	Adjacent settlement area	Quarterly		
	Vehicular emissions	NO_X, SO_2, CO,	Adjacent settlement area	Quarterly		
Noise 【Common Measures for All Haors】	Measurement	Leq (dBA)	Adjacent settlement area	Quarterly		
Terrestrial Ecosystem 【Common Measures for All Haors】	Disturbance to migratory birds/ waterbirds	Species composition and abundance, migration pattern	In and around the IBAs overlapped with Study Haor	Monthly (November - March)		
Aquatic Ecosystem 【Common Measures for All Haors】	Fish and crustaceans	Fish species, abundance, CPUE, fish mortality	• In and around the seasonal beels targeted for excavation and fish sanctuary establishment • Road and Bridge/Culvert Crossings location • Fish Sanctuary and Community-Managed Sites	Quarterly One year after the construction		

Impact	Monitoring Means	Parameters	Location	Frequency	Responsibility	
					Implementation	Supervision
			• Boat Landing Stations (Ghats) and Markets			

10.5.2.2 Inspection and Reporting of Environmental Monitoring

Environmental monitoring shall be carried out by the LGED during the operation phase, in accordance with the monitoring plan outlined in Table 10-4. An Independent Monitoring Group (IMG) shall be engaged to monitor the environmental quality parameter on a quarterly basis. The project proponent will prepare a quarterly report and submit it to JICA and DOE, as required. A summary of monitoring requirements, location, and frequency for environmental monitoring is presented in Table 10-4. The results of the monitoring will be compared against both national standards and WHO guidelines. The monitoring report will indicate whether the reference values have been met.

10.6 Budget Plan for Environmental Management

The project cost is inclusive of the cost for implementing the Environmental Management Plan (EMP) and the installation of pollution control measures.

Cost estimates are prepared for all the mitigation and monitoring measures proposed in the EMP. The details of the cost estimates and the budget during the construction phase and operation phase for the mitigation and monitoring measures are given in Table 10-5. The cost estimates for mitigation and monitoring measures during the operation phase are given yearly (for one year).

The cost estimates include the budget for environmental enhancement/compensation measures and environmental monitoring but not include the budget for consultants for EMP implementation, institutional strengthening, and capacity building of the plant staff.

Table 10-5: Summary of costs for environmental management during construction phase

Aspects	Tentative Cost in BDT		
	Mitigation Measures	Monitoring Measures	Total
Air quality	50,000	180,000	230,000
Noise	50,000	27,000	77,000
Surface water	50,000	190,000	240,000
Groundwater	50,000	225,000	275,000
Soil/Sediment	30,000	477,000	507,000
Waste minimization control	50,000	-	50,000
Terrestrial ecosystem	30,000	100,000	130,000
Aquatic ecosystem	50,000	300,000	350,000
Transportation management	30,000	-	30,000
Occupational health and safety	80,000	-	80,000
Community health and safety	50,000	-	50,000
Fire Emergency	50,000	-	50,000
Socio-economic condition enhancement	Included in operational cost	Included in operational cost	-
Greenbelt development	Included in operational cost	Included in operational cost	-

Table 10-6: Summary of costs for environmental management during operation phase

Aspects	Tentative Cost in BDT	
	Mitigation Measures	Monitoring Measures
Waste minimization control	Included in operational cost	Included in operational cost
Terrestrial ecosystem	Included in operational cost	Included in operational cost
Aquatic ecosystem	Included in operational cost	Included in operational cost
Transportation management	Included in operational cost	Included in operational cost
Community health and safety	Included in operational cost	Included in operational cost
Socio-economic condition enhancement	Included in operational cost	Included in operational cost
Greenbelt development	Included in operational cost	Included in operational cost

10.7 Institutional Setting and Implementation Arrangement

10.7.1 Overall Institutional Framework

The Environmental Management of the Project will involve a number of national level agencies.

These main agencies will include:

i. The LGED, under the control of the Ministry of Local Government, Rural Development and Cooperatives and guidance and supervision of the Governing Council (GC) of the Board, would be the leading agency of the project
ii. Department of the Environment (DOE), Ministry of Environment and Forestry, responsible for enforcement of the national environmental legislation.
iii. A Project Steering Committee (PSC) headed by Secretary, MOWR and participated by representatives of the DOE and other relevant ministries and agencies to be formed for the coordination of project implementation and relevant environmental issues at the central level.
iv. A Joint Management Committee (JMC) participated by representatives of LGED and relevant line departments, local governments, and WMOs to jointly decide on Project activities and post Project O&M activities including mitigation measures that will be undertaken by responsible line departments (including Department of Public Health Engineering (DPHE) responsible for supporting pilot arsenic mitigation), private providers, NGOs, and WMOs.

10.7.2 Project Level Institutional Framework

As the implementation structure for rural infrastructure and fisheries promotion activities, a Project Management Office (PMO) will be established at the LGED headquarters, headed by a Project Director (PD). Project Implementation Units (PIUs) will be set up within the existing LGED district offices located in the targeted districts i.e., Sunamganj, Habiganj, Sylhet, Netrokona, and Kishoreganj. The LGED project upazila offices are planned to be established within the existing LGED upazila offices. District offices of the Department of Fisheries (DoF) are expected to coordinate with LGED's PIUs to implement fisheries promotion activities.

A consultant team will be engaged to support the implementing agencies through the PMO.

The Consultant team will have specific responsibilities:

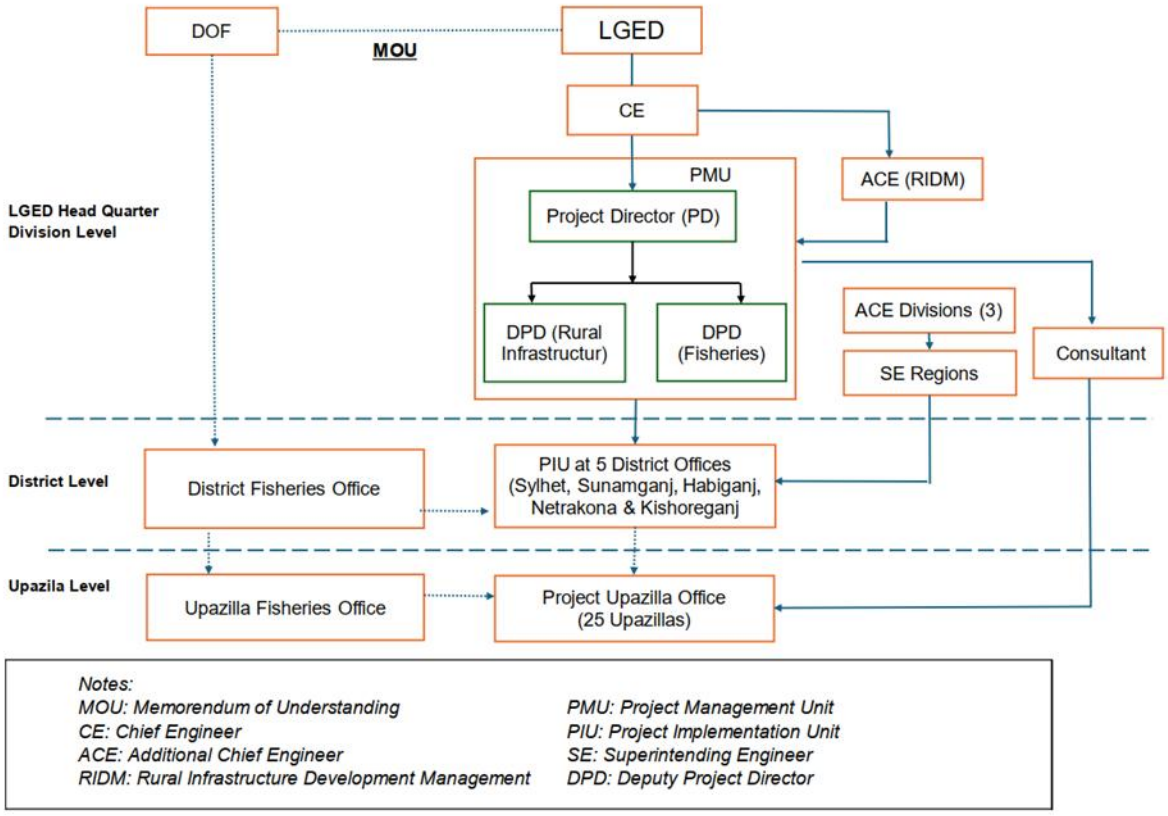
- **Environmental Management Monitor:** Engaged part-time to oversee EMP implementation, ensuring mitigation measures are applied effectively at subproject sites.
- **Environmental Specialist:** Responsible for capacity development, training LGED staff and local stakeholders, and supporting monitoring, reporting, and auditing of environmental indicators.
- **Technical Advisory Role:** Providing guidance on design, site selection, and operational measures to ensure environmental compliance and sustainability.

Roles of PMO

The PMO of LGED will be responsible for the overall management of rural infrastructure development and fisheries promotion activities, with the objective of efficiently achieving project outputs. To implement the project, the PMO will carry out the following tasks and responsibilities.

- Formulate the overall implementation plan.
- Procure and manage consultants and project staff, and closely monitor their performance based on their Terms of Reference (TOR), utilizing appropriate monitoring and evaluation (M&E) tools and human capital development systems.
- Prepare the Annual Work Plan and Budget (AWPB) and procurement plan for both the PMO and PIUs and obtain approval from the Chief Engineer of LGED.
- Conduct detailed design.
- Monitor progress of land acquisition.
- Supervise activities and monitor implementation progress.
- Coordinate rural infrastructure development with fisheries promotion activities.
- Provide guidance to the PIUs.
- Review and approve invoices from consultants and contractors.
- Ensure compliance with environmental and social safeguard requirements.
- Report to and coordinate with relevant agencies.
- Organize stakeholder workshops at each stage of implementation.
- Prepare knowledge management documents and share them with stakeholders.
- Draft and ensure implementation of the following Memorandums of Understanding (MOUs):
    - MOU between LGED and the Department of Fisheries (DoF).
    - MOU between the Local Government Division (LGD) and the Ministry of Land (MoL).
- Establish an internal control mechanism (including internal audit and audit by FAFD) and respond to audit recommendations.

Figure 10-1: Institutional arrangement for implementation of HARD Project



Roles of PIU

The PIU of LGED will be responsible for implementing rural infrastructure development and fisheries promotion activities in the targeted haor areas and upazilas. The PIU will undertake the following tasks and responsibilities.

- Prepare subproject and scheme implementation plans.
- Conduct surveys and measurements.
- Prepare bidding documents, issue bid invitations, and award and sign contracts (bid evaluation will be conducted by the Evaluation Committee, and the evaluation results will be approved by officials designated under government regulations).
- Review and verify design specifications.
- Carry out land acquisition.
- Supervise the construction of rural infrastructure and the implementation of fisheries-related activities.
- Review contractors' invoices.
- Prepare progress reports.

Operation and Maintenance Structure

The PIU of LGED will be responsible for implementing rural infrastructure development and fisheries promotion activities in the targeted haor areas and upazilas. The PIU will undertake the following tasks and responsibilities.

a) Rural Roads

The maintenance of Upazila roads, Union roads, and important village roads is carried out by LGED's district and upazila offices under the supervision of the Road Management and Road Safety Unit (RMRSU) and regional offices of LGED.

For village roads excluding those categorized as important village roads, maintenance activities are implemented by Local Government Institutions (LGIs) such as Upazila Parishads and Union Parishads, under the technical guidance of LGED.

b) Markets and Boat Landing Facilities

Maintenance of growth centers, rural markets, and boat landing facilities is conducted by lessees, Market Management Committees (MMCs), and Upazila Market Management Committees (UMMCs), using a portion of the lease revenues.

c) Village Protection Walls

For the proposed village protection wall, it is assumed that routine inspections and minor repairs will be carried out by the villagers, following the same maintenance approach as for existing wall. During the construction period, villagers are expected to participate in parts of the construction works (such as manual earthworks) through Labor Contracting Societies (LCS), which will help them gain an understanding of the structure and acquire basic skills for construction and repair.

In cases where medium- to large-scale repairs are required, the villagers may need to request support from LGIs.

10.7.3 Capacity Strengthening

Effective management of environmental issues requires appropriate institutional arrangements, clear roles and responsibilities, and adequate capacity within LGED and other concerned organizations, including WMOs. The assessment of environmental impacts and mitigation measures highlights the need for strong environmental management across the pre-construction, implementation, and O&M phases. This is essential to ensure optimal water resource management, mobilize local resources for sustainable O&M, and minimize negative environmental impacts. Implementation will require both technical systems (hardware and software) and robust monitoring of appropriate indicators.

The success of environmental management will largely depend on well-trained and motivated human resources. For LGED, this means going beyond engineering expertise to strengthen sensitivity to social and environmental issues, the ability to engage with beneficiaries and affected people, and skills for conflict resolution. Progress has been made in diversifying the skill mix by introducing positions for environmental, social, and other specialists, but this needs further expansion, supported by clear career progression and skills development pathways. LGED, with support from the GC, is already improving service rules for recruitment, promotion, and job rotation, which will help consolidate these efforts.

To meet project demands, LGED staff capacity must be enhanced, alongside broader water sector interventions. LGED is currently developing a human resources development policy and plan, also with GC support. In alignment with ongoing capacity-strengthening programs supported by development partners, including JICA, this project will identify capacity gaps in EMP implementation and provide targeted training for LGED staff, WMOs, and other relevant organizations. Where environmental specialists are insufficient, capacity-building efforts will also focus on equipping existing engineers with the knowledge and skills needed to address environmental issues effectively.

In the context of the EMP implementation in the two subproject areas, the Project through consulting services would also provide necessary hardware (such as monitoring equipment and computer

facilities) and software, with a focus on establishing effective environmental and other monitoring indicators, and its effective recording, reporting, and auditing mechanisms.

CHAPTER 11

Grievance Redress Mechanism

11 GRIEVANCE REDRESS MECHANISM

11.1 Objectives

The Objectives of grievance response are to create an enabling environment for any aggrieved persons and entities including project affected persons to lodge complaints, claims, grievances, etc. and their grievances are redressed as quickly as possible through a process of conciliation and negotiation. Thus, the GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental performance of the project.

11.2 Proposed Institutional Mechanism

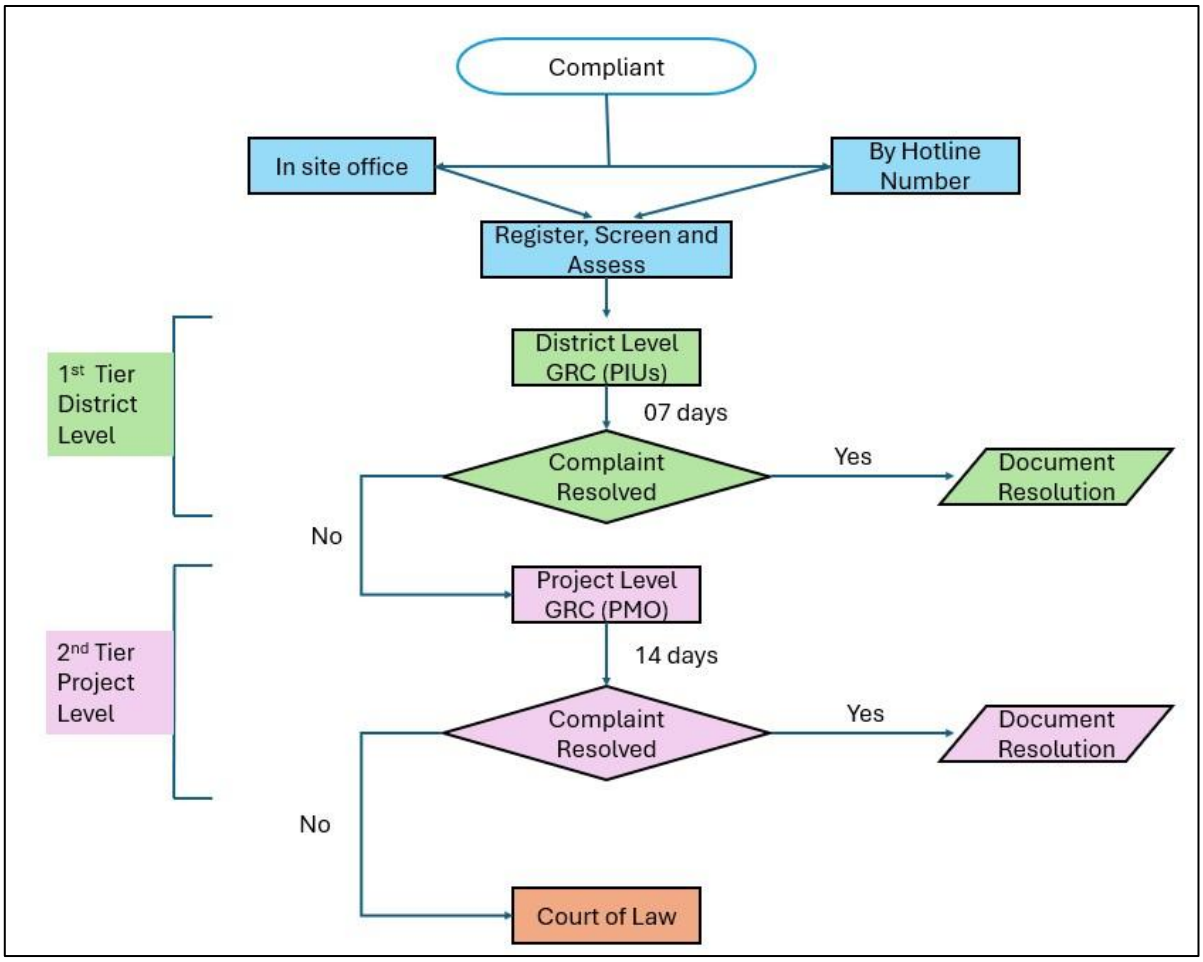
To ensure effective management of environmental and social safeguards, as well as to establish a transparent and responsive grievance handling system, a two-tier grievance redress mechanism is proposed for the HARD Project (LGED part). This mechanism will function at the District Level and the Project Level, allowing grievances and social concerns to be addressed efficiently at the lowest possible level while providing clear escalation pathways.

At the District Level (PIU), the District Grievance Redress Committee (D-GRC) will be chaired by the LGED District Executive Engineer and supported by Senior Assistant Engineer, Environmental Focal Persons, and local government representatives. This body will review unresolved grievances, verify and investigate issues through field visits, and provide decisions within seven (07) days of receiving the complaint.

At the Project Level, the Project Grievance Redress Committee (P-GRC) will be anchored at the PMO and chaired by the Project Director. It will include the Deputy Project Director, Environmental Specialist. The P-GRC will review complex or escalated grievances. Final decisions will be made within fourteen (14) days of receiving the complaint in the second tier. If grievances remain unresolved, complainants will retain the right to seek remedy through the formal judicial system.

Figure 11-1 represents how GRM will be implemented for LGED part of the HARD Project.

Figure 11-1: Proposed Grievance mechanism



11.3 GRM Implementation Approach

The Grievance Redress Mechanism (GRM) for the LGED part of HARD Project will be implemented through a structured and inclusive approach to ensure that concerns from affected persons and stakeholders are addressed promptly, fairly, and transparently. The approach emphasizes accessibility, accountability, and timely redressal at different levels of project implementation.

The GRM will function through two tiers: District Level and Project Level.

At the District Level, grievances will be received directly from affected communities through multiple entry points such as written complaints, verbal submissions, grievance boxes, or phone calls to the project site offices. These grievances will be recorded in a dedicated register and addressed within seven (07) days by the D-GRC, where the District Grievance Redress Committee (D-GRC), chaired by the Executive Engineer, will verify and investigate complaints, including conducting field visits if required.

If grievances remain unresolved, they will be further escalated to the Project Level. The Project Grievance Redress Committee (P-GRC), chaired by the Project Director, will review complex and sensitive issues such as land acquisition, compensation, and resettlement. The committee will engage relevant experts and stakeholders, ensuring that final decisions are made within fourteen (14) days of receipt in the second tier of the GRM.

Throughout the process, documentation and reporting will be mandatory at all levels to ensure transparency and traceability of decisions. Complainants will be kept informed of the status and

outcome of their cases, and they will retain the right to pursue legal recourse if not satisfied with the final decision of the GRM.

The GRM implementation approach will also include awareness campaigns by the Project Implementation Unit (PIU) to inform communities about their rights and the procedures for submitting grievances. This will ensure inclusivity, particularly for vulnerable groups such as women, the elderly, and marginalized communities.

11.4 Grievance Redress Committees (GRCs)

As for standard of the GRM system following the DOE EIA guideline, and JICA Environmental and Social Considerations 2022, this proposed project will form a 2-tier GRCs at the district level and project level to receive and address the complaints appropriately.

Table 11-1: Proposed GRC Committees under this Project

Tier 1: District Level GRC (PIUs)	Tier 2: Project Level GRC (PMO)
• Executive Engineer- LGED District Office (Chair) • Senior Assistant Engineer (Member Secretary) • Local Government Representative (e.g., Union Parishad Chairman) (Member)	• Project Director (Chair) • Deputy Project Director / PMO Officer (Member Secretary) • Environmental Specialist (Member)

11.5 Public Disclosure of the GRM

GRC procedures and operational rules will be publicized widely through community meetings and leaflets in Bengali so that the affected persons are aware of their rights and obligation, and procedures of grievance redress. Grievances received and responses will be documented and reported back to the affected people. The number of grievances recorded and resolved, and the outcomes will be displayed/disclosed PIU office, construction site and other key public offices along the project area. The contact number where grievances are to be recorded will be prominently displayed at the construction sites. Leaflets with project information, grievance redress details, addresses, and contact numbers were given to affected people so they know where to register complaints. A summary of complaints received and resolved status will be incorporated in the quarterly environmental monitoring report.

11.6 Training/Workshops/Meetings on Grievance Redress Mechanisms

A separate training/ workshop will be undertaken by the contractor(s)/LGED at the community level and at the workers level to discuss the process of how a grievance gets registered, the local contact person's/social safeguard officer details of receiving grievances, the significance of grievance boxes, the timelines for addressing the grievances and the personnel's involved in the redressal process. This training should be held half-yearly, and feedback/suggestions from the community should be acknowledged, and changes to the GRM should accordingly be undertaken to make it more user-friendly.

11.7 Recording of Grievances

Once the stakeholders are aware of the mechanism and access it to raise grievances, the contractor(s) is required to acknowledge the same and keep the complainant's identity anonymous (if requested). Consequently, the contractor(s) is required to collect grievances by checking the grievance boxes once every seven days, record and register the grievances that have come in as per the identified formats

and track them throughout the redressal process to reflect on their status and important details. A Grievance Log or database emphasizing the records and status of grievance is to be at the PIU level.

The Grievance Log can be used to analyze information about grievance, community issues and project operations to anticipate the kinds of conflicts that JICA might expect in the future both to ensure a grievance mechanism is set up to handle such issues and to propose organizational or operational changes.

Table 11-2: Sample record form of grievance received

Date of Receipt	Particulars of Complainant				Particulars of Grievance		
	Name	Address	Contact No	Whether acknowledgement is given at the time of receipt	The Subject of the Grievance	Brief Description	Date of acknowledgement/ date of redress

11.8 Grievance Resolution and Follow-Up

Once the corrective action has been agreed upon, a good practice is to collect proof of those actions in terms of taking photographs, documentary evidence, getting confirmation from the complainant and filing the same within the case documentation. Also, monitoring and follow up on the resolution agreed upon should be conducted once to close the case accordingly. Contractor(s)/LGED will require to provide regular (quarterly) reports to JICA that track the number of complaints received, resolved, not resolved and referred to a third party. In addition, the funding agency also needs to be constantly apprised of the yearly reports to support the identification of developing risks.

11.9 Monitoring and Reporting

Depending on the extent of project impacts and the volume of grievances, monitoring measures like internal (by identified contractor(s), LGED field level staff) and external audits (third party consultants) once in a year based on the complexity of the nature of grievances can be adopted by the contractor(s)/LGED.

Grievance records should provide the background information for these regular monitoring exercises. Through the review of each grievance and analysis of its effectiveness and efficiency, contractor(s)/LGED can draw the complaints to evaluate systematic deficiencies. In addition, monitoring of the grievance mechanism helps to ensure that the design and implementation of the mechanism are adequately responding to stakeholder's comments in a cost-effective manner.

All grievances registered have to be recorded and regularly updated. All minutes of meetings with stakeholders, complainants and Grievance Committee are to be recorded and documented regularly for reference purposes.

CHAPTER 12

Emergency Response Plan and Disaster Management Plan

12 EMERGENCY RESPONSE PLAN AND DISASTER MANAGEMENT PLAN

12.1 Introduction

A disaster or emergency refers to a significant disruption caused by either natural or man-made conditions, leading to substantial impacts on human life and resources. Most disasters unfold rapidly, allowing minimal time for preparation. The severity of a disaster is determined by factors such as loss of life, damage to facilities, and the external resources needed for recovery.

Preventing emergencies involves robust design, operation, maintenance, and inspection practices to minimize the likelihood and impact of such events. Despite these efforts, it's impossible to eliminate all risks, as random equipment failures, human errors, omissions, and unsafe acts may occur. Effective major hazard control involves not only preventing emergencies but also mitigating their effects and restoring regularity promptly.

To address such situations, the development of an emergency response plan and the establishment of an emergency response team are essential components. These measures are crucial for managing emergencies, ensuring a coordinated and timely response to mitigate adverse effects and expedite the return to normal activities.

12.2 Objective of Emergency Response Plan

The overall objective of an emergency response plan is to make use of the combined resources at the proposed project site and outside services to achieve the following.

- Localize and, where possible, eliminate emergencies at the project site.
- Minimize impacts of accidents on people, the environment, and property.
- Control incidents, remove hazards, and prevent escalation.
- Ensure timely rescue and medical treatment for affected personnel and communities.
- Protect other people in the vicinity of the incident.
- Evacuate staff and community members to safe locations.
- Coordinate and communicate effectively with statutory authorities.
- Contain the incident initially and restore control.
- Preserve records and equipment for post-incident investigation.
- Investigate causes and implement measures to prevent recurrence.

12.3 Elements of an Emergency Response Plan

The main elements of an emergency response plan are as follows.

- **Leadership and Administration:** Clear chain of command for decision-making during emergencies.
- **Role and Responsibilities of Key Personnel:** Defined duties for Project Director, Site Safety Officer, Health & Safety Team, and Community Liaison Officer.
- **Emergency Action:** Procedures for floods, storms, fire, accidents, and environmental incidents.
- **Emergency Light and Power:** Backup lighting and power sources for safe operations during emergencies.
- **Source of Energy Control:** Safe shutdown of machinery, equipment, and fuel sources to prevent escalation.
- **Protective and Rescue Equipment:** First aid kits, fire extinguishers, life jackets, ropes, boats, and rescue tools.

- **Communication:** Reliable channels for internal coordination and alerts to local authorities and communities.
- **Medical Care/First Aid:** On-site first aid, access to nearby hospitals, and trained medical personnel.
- **Public Relation:** Informing communities about emergencies, warnings, and evacuation procedures.
- **Protection of Vital Records:** Safeguarding project documents, equipment logs, and environmental data.
- **Training:** Regular drills for staff and community awareness programs on disaster response.
- **Periodical Revision of the Plan:** Updating the plan based on lessons learned, site changes, and feedback from exercises.

12.4 Hazards Associated with the Proposed Project

The HARD Project involves construction, water management, and embankment activities under BWDB in the Haor region. These activities expose workers, communities, and the environment to various risks, including site-related accidents, machinery operation, chemical handling, and natural disasters such as floods, cyclones, and riverbank erosion. Identifying these hazards is essential to plan effective emergency response and disaster management measures. The main hazards and causes of frequent accidents identified for the project include:

Project-Related Hazards

- Fire or explosion at construction sites, labor camps, or fuel storage areas.
- Accidents from construction activities and handling heavy materials.
- Lack of proper personal protective equipment (PPE), poor housekeeping, and inadequate safety signage.
- Work in water bodies, including risks of drowning for workers.
- Electrical hazards and risk of electrocution.
- Injuries from sharp objects or slippery surfaces.
- Snake bites and other wildlife-related risks.
- Operation and maintenance of heavy machinery and equipment.
- Mechanical failures of equipment.
- Accidental spillage or leakage of fuels, oils, or chemicals.
- Improper storage or containment of hazardous chemicals (e.g., leaky containers, inadequate sealing, or unsecured storage areas).

Natural Hazards/Calamities

- Floods and flash floods, especially during the monsoon season, impacting Haor wetlands and project sites.
- Cyclones and strong storms causing high winds, heavy rainfall, and localized water surges.
- Riverbank erosion affects embankments, water control structures, and surrounding agricultural lands.
- Landslides or soil instability in embankments and raised areas within the Haor region.
- Earthquakes, though low probability, may affect project structures and embankments in the Haor.

12.5 Hazard Identification and Risk Assessment

The risk is the likelihood of harmful effects big or small due to hazards, together with the severity of harm suffered. Risk also depends on the number of people exposed to hazards. Risk analysis provides the severity of harm from a particular type of hazard.

12.5.1 Floods and Flash Floods

Floods are an annual phenomenon in Bangladesh. Normally, the most severe flood occurs in Bangladesh during July and August. Regular river floods (during monsoon season) affect 20% of the country, which may increase up to 67% in extreme years like the 1998 flood. The most disastrous floods take place in 1988, 1998, and 2004. There are four types of floods in Bangladesh:

- Monsoon floods along major rivers during the monsoon rains (June-September).
- Flash floods caused by overflowing of hilly rivers of eastern and northern Bangladesh (Normally during April-May and September-November).
- Rain floods caused by drainage congestion during heavy rains.
- Coastal floods caused by storm surges.

The Haor region, being a low-lying wetland system in northeastern Bangladesh, experiences extensive monsoon flooding every year. These floods typically inundate vast areas for several months, impacting agriculture, infrastructure, and communities. The region acts as a natural flood reservoir, storing water during the monsoon and gradually releasing it during the dry season. Flash floods from upstream rivers can exacerbate inundation, and prolonged waterlogging can disrupt livelihoods and access to essential services.

12.5.2 Earthquake

Bangladesh has continually been one of the seismically active regions of the world and has experienced numerous large earthquakes during the past 200 years. Many seismic tectonic studies were undertaken in the area comprising the Indo-Burman ranges and their western extension in northern India. A seismic zoning map of Bangladesh was proposed by GSB in 1979 dividing the country into three seismic zones, which was accompanied by an outline of code for earthquake-resistant design. Later, a new updated seismic zoning map and detailed seismic design provisions were incorporated into BNBC. A seismicity map of Bangladesh and its adjoining areas was also prepared by BMD and GSB. As per the Seismic Zoning Map of Bangladesh, the county is divided into four seismic zones. A description of the seismic zones of Bangladesh is given in Table 12-1.

Table 12-1: Description of Seismic Zones of Bangladesh

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

Source: Bangladesh National Building Code (BNBC), 2020

The Haor Area Resilience and Development (HARD) Project sites are spread across Sunamganj, Habiganj, Sylhet, Netrokona, and Kishoreganj districts. These areas are located within Seismic Zone IV, which is designated as very severe with the highest seismic coefficient in the country (Z = 0.36). This means the haor belt faces significant earthquake risk.

Implications for the Project:

- All embankments, water management structures, flood shelters, and community infrastructures to be developed or rehabilitated in the project haors must be designed following the earthquake-resistant provisions of BNBC 2020.
- Special attention is needed for critical structures such as regulators, sluice gates, and flood control embankments, which, if damaged, could lead to large-scale flooding and failure of project objectives.
- Emergency preparedness planning should be integrated into the project, including earthquake awareness programs for local communities, development of evacuation routes, and rapid response measures to minimize risks in the aftermath of an earthquake.

12.5.3 Landslide

Landslides are a significant natural hazard in Bangladesh and are mostly concentrated in the hilly districts of Chattogram, Cox's Bazar, Rangamati, Khagrachari and Bandarban. They are primarily triggered by intense rainfall during the monsoon season along with deforestation and unplanned hill cutting.

The haor areas under the Haor Area Resilience and Development (HARD) Project which include Sunamganj, Habiganj, Sylhet, Netrokona, and Kishoreganj are generally flat floodplain ecosystems. For this reason, the risk of direct landslides within the project sites is considered very low. However, the surrounding hill regions to the north and northeast, particularly the Meghalaya Plateau and the Tripura Hills across the border, are prone to slope failures. During heavy rainfall events these upstream landslides can contribute to increased sediment inflow and soil erosion in the haor basins.

12.6 On-Site Emergency Response and Preparedness Plan for Construction Contractor

The scope of the on-site emergency response and preparedness plan is as follows.

- The on-site emergency preparedness plan is applicable to all the construction activities carried out at the project sites for both day and night-time operations and also for operations during the weekend, and off days. It is also applicable to the movement of project personnel to and from the identified locations, on the way to and from the duty assignment.
- These also apply to all employees, all contractors, sub-contractors & their employees, and visitors at the proposed project site/office.
- The emergency preparedness plan is designed to link all the emergency scenarios that are identified as possibly occurring in the project during construction.

12.7 Emergency Response Procedure

12.7.1 Emergency Identification

It is necessary to determine what circumstances or set of circumstances constitute an emerging emergency, which would, in turn, cause the activation of the emergency response team.

12.7.2 Emergency Action Plan at the Project Site

The action plan should consist of the following.

- Emergency Control Center.
- Key Personnel.

12.7.2.1 Establishment of an Emergency Control Center

It is very important to establish an emergency control center at the project site for managing any kind of emergency. This center will be the main center from where the operations handle the emergency will be directed and coordinated. The project manager's office of the contractor can be used as an emergency control center. After establishing the control center, the following facilities are to be made available in the emergency control center.

a. Internal and external communication systems.
b. Computer and other essential records.
c. Daily attendance of workers employed on the project site.
d. Records of the storage of fuel and hazardous material.
e. Pollution records.
f. Walky-talky.
g. Notebook, Pad, and Pencil.
h. List of key personnel with addresses, telephone numbers, etc.

12.7.2.2 Assembly Points

A safe place far away from the construction sites should be pre-determined as an assembly point where in case of emergency personnel evacuated from the affected areas are to be assembled. The construction workers, contract workers, and visitors should assemble at the assembly point in case of emergency, and the time office clerk should take their attendance so as to assess the missing persons during an emergency.

12.7.2.3 The Key Personnel for Emergency in the Project

The following key personnel will play a vital role during the emergency at the proposed project site. Their roles and responsibilities for emergency management are also given below.

A. Works Main Controller.
B. Works Incident Controller.
C. Other Key Officers.

Designated Person	Duties/Activities
Main Controller	
The Site Engineer of the construction contractor should act as the main controller	• Assess the magnitude of the situation and decide whether the evacuation of staff from the project is needed. • Exercise and direct operational control over areas other than those affected. • Maintain a continuous review of possible development and assessment in consultation with the work incident controller and other key personnel. • Liaison with Police, Fire Service, Medical Services, Site Inspectorate, and other Government Agencies. • Direct and control, rehabilitation of affected area after an emergency. • Ensure that evidence is preserved for inquiries to be conducted by statutory authorities.

Designated Person	Duties/Activities
Incident Controller	
The EHS officer of the construction contractor can work as an incident controller	• Assess the emergency and inform the Communication Officer to alert relevant agencies • Stop all operations in the affected area and order evacuation if needed • Act as Main Controller until relieved • Notify key personnel, security, fire services, and external agencies • Ensure non-essential staff are evacuated and the area is checked for casualties • Update the Communication Officer on developments • Preserve evidence related to the cause of the emergency
Other Key Personnel	
Communication Officer	• He will proceed to the control center and communicate to the work incident controller. • He will collect information from the emergency affected area and send the correct message to the main controller for a declaration of emergency. • He will maintain a logbook of the incident. • He will contact all essential departments. • He will communicate all information as directed by the works' main controller.
Security and Fire Office	• He will reach the incident area with fire and security staff. • He will inform the communication officer through telephone or walky-talky. • He will inform the work incident controller about the situation and requirements for outside help like Fire Service and other mutual aid members. • At the site, the entire fire squad member will respond to the advice and information given by the works incident controller. • The security will control the visitors and vehicle entry.
Administrative Officer	• To ensure that casualties receive adequate attention to arranging additional help if required and informing relatives. • To control traffic movement into the project site and ensure that alternative transport is available when needed. • When the emergency is prolonged, arrange for the relief of personnel and organize refreshment and catering facilities. • Arrange for financing for the expenditure to handle the emergency.

12.7.2.4 Alarm System

The alarm system varies and will depend on the size of the work area - simple fire bell, hand-operated siren breaks type, fire alarm, etc.

12.7.2.5 Communication System

Communication is a key component to control an emergency. The following communication systems may be provided in the proposed project: Walky-Talky, Telephone (internal and external), and Cell Phone.

12.7.2.6 Siren for Emergency

A siren for an emergency should be different from a normal siren. The emergency siren should be audible for a distance of 1km radius. The emergency siren should be used only in case of an emergency.

12.7.2.7 Counting of Personnel

All personnel working in the project area should be counted. Time's office persons should collect the details of personnel arriving at the assembly point. These should be checked with the attendance of regular workers and contract workers present at the site on the day of the emergency. Accident control should be established, and arrangements should be made to search for missing people in the emergency affected area. The employees' address and contact number of next to kin should be maintained in the office so that during an emergency relative of those affected due to the emergency may be informed accordingly. Information in respect of emergencies should be given to the media and other agencies.

12.7.2.8 All Clear Signal

After controlling the emergency, the work incident controller will communicate to the work's main controller about the ending of the emergency. The main controller can declare all-clear by instructing the time office to sound "All Clear Sirens".

12.7.2.9 Emergency Facilities

The following facilities should be provided at the project site to tackle any emergency at any time.

- Fire protection and firefighting facilities.
- Emergency lighting and standby power.
- Emergency equipment and rescue equipment: breathing apparatus with compressed air cylinder; fire proximity suit; resuscitator; water gel blanket; low-temperature suit; first aid kit; stretchers; torches and ladders.
- Safety equipment: respirators; gum boots; safety helmets; asbestos rubber hand gloves; goggles and face shield; oxygen measuring instruments and wind direction indicator.

12.8 Hazard Control Measures

12.8.1 Fire

To prevent and manage fire emergencies at the project site, the following measures will be ensured.

- Install automated fire alarms at labor camps and construction sites.
- Clearly mark fuel and oil storage areas.
- Conduct regular fire drills and awareness training for workers.
- Display emergency numbers and "no smoking" signs at key locations.
- Keep firefighting equipment such as sand buckets, water, and extinguishers ready.
- Maintain oxygen cylinders, medical kits, and masks for smoke protection.
- Train staff in first aid and firefighting, and coordinate with local fire, police, and medical services.

Steps during an emergency:

- Call the Fire-Rescue Department immediately and evacuate through the nearest exit.
- If clothes catch fire, stop, drop, and roll.

- Cover your nose and mouth with a wet cloth to reduce smoke inhalation.
- Stay low to avoid toxic gases, do not run in smoke-filled areas.
- Follow evacuation procedures and ensure headcount so no one is left behind.

12.8.2 Natural Disasters

Natural disasters strike without warning. Most disasters are of natural origin, including earthquakes, floods, riverbank erosion, and landslides. While we cannot prevent these occurrences, we can develop strategies to cope with the challenges they present. In events like floods, fires, earthquakes, and landslides, the initial response takes place on-site. Even before external assistance arrives, individuals affected by the disasters support one another. Both the government and various voluntary organizations dispatch teams of trained rescue workers to affected areas. These teams collaborate with local community helpers, such as doctors, nurses, social workers, and police officers, to provide aid and support.

12.8.3 Electrical Accidents

Electrical hazards pose the risk of burns, shocks, and even electrocution, potentially resulting in severe injuries or fatalities. When faced with potential electrical dangers, it is crucial to pause and consider the situation. Rather than taking unnecessary risks with personal safety, it is advisable to contact trained professionals to address the issues. Despite the temptation for individuals to handle electrical matters on their own, especially in smaller-scale repairs within a business environment, it is important to recognize when the expertise of professional service technicians is required. If one does choose to handle such matters independently, adhering to safety precautions becomes paramount to prevent injuries and avoid other potential losses.

Prevention of Electrical Accidents

Flexible cords connected to the appliance should be wired to conform to the international Color code. The color of the insulation on the wire is Brown represents live wire; Blue represents neutral wire and Green/yellow stripes represent earth wire.

What you should look for when selecting an electrical appliance is given below.

a. The appliance should be suitable for operation on the local electrical supply of 240 volts AC and a frequency of 50 Hz.
b. The appliance should preferably be tested and certified by the national or reputed standards testing authority
c. Look for certified plugs on the flexible cords connected to the appliances. If the appliance is double insulated and has a 2-pin plug, then it should be fitted with a suitable certified plug.
d. An essential formality when buying any appliance is a duly completed guarantee card with the dealer/retailer's official stamp and details of the appliance (serial number, etc.).

Safety precautions to be taken when using electrical appliances:

a. Avoid using handheld appliances when your hand and/or body is wet.
b. Do not use or leave appliances where liquid can splash onto them.
c. Flexible cords connecting the appliance and the plug should be in good condition, if the cord is frayed, chaffed, cut, or melted, have the entire cord replaced by a competent person.
d. Check accessories such as plugs attached to appliances for cracks and burnt marks and have them replaced. If undue overheating occurs or burnt marks appear in any electrical appliance, have it checked?

12.8.4 Personal Protective Equipment (PPE)

In certain circumstances, personal protection of the individual may be required as a supplement to other preventive actions. It should not be regarded as a substitute for other control measures and must only

be used in conjunction with substitution and elimination measures. PPEs must be appropriately selected individually fitted and workers trained in their correct use and maintenance. PPEs must be regularly checked and maintained to ensure by the contractor that the worker is being protected.

12.8.5 First Aid

All medical facilities construction camps and worksites shall be sufficient for the type of work being performed and the number of personnel at each work location. First Aid kits shall be supplied and maintained current and completeness of content by the contractor and will:

- Be immediately accessible to all personnel.
- Have emergency contact numbers (phone and/or radio) located in the vicinity of the kits along with a content list, treatment log, and pen.

Be marked clearly and numbered for identification and the contents inspected once every month for acceptability and completeness.

CHAPTER 13

Conclusion

13 CONCLUSION

The HARD Project is designed to deliver significant socio-economic and environmental benefits to the Haor region while minimizing adverse impacts. By integrating community participation, climate-adapted engineering, and ecosystem-based management, the project aims to enhance flood resilience, secure agricultural productivity, improve fisheries, and strengthen local infrastructure and livelihoods.

During the construction phase, the project will generate mainly short-term and localized environmental and social impacts. These include temporary air and noise pollution, sediment disturbance, soil and water contamination, waste generation, and risks to biodiversity and aquatic habitats. Social impacts such as land acquisition, livelihood disruption, vulnerability of poor groups, health and safety concerns, and risks of infectious diseases are also expected. However, these impacts are localized, temporary, and manageable through appropriate mitigation measures.

During the operation phase, potential impacts are limited to noise, increased traffic emissions, risks to biodiversity (particularly to fish sanctuaries and migratory species), and road safety hazards.

In contrast, the project will deliver long-term benefits, including improved flood protection, enhanced agricultural productivity, fisheries promotion activities (fish protection for natural fish productivity and some culture fisheries), diversified land use, better connectivity, expanded livelihood opportunities, and greater climate resilience.

APPENDICES

APPENDIX A

Appendix A: References

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APPENDIX B

Appendix B: Record of Meetings and Consultations

Appendix B-1: Minutes of KIIs

Date	Details of Participants	Issues Discussed	Response/Suggestions Made
19/08/25	Md. Shazzad Hossain, Executive Engineer, BWDB, Kishoreganj	• About the project intervention and readiness of BWDB for project implementation • Opportunities for development • Challenges for implementation	The Executive Engineers and their teams explained that their team is fully capable of implementing the project in the targeted areas. The discussions primarily focus on flood management, water control structures, and the broader challenges of protecting agriculture and livelihoods in the haor region. BWDB representatives highlighted that the haor ecosystem is extremely flood-prone, with flash floods from upstream hilly catchments posing the greatest risk to Boro cultivation. The officials explained that constructing and rehabilitating/ maintaining submersible embankments, regulators, and drainage structures will delay the entry of flash floods and allow farmers to harvest their crops in time. However, they acknowledged that many of the existing structures are old, poorly maintained, and often breached before the harvest season, resulting in heavy crop losses. These should be repaired. They further opined that proper land acquisition process needs to follow in the appliable areas to avoid any dissatisfaction among the community people. The compensation for their permanent and temporary loses need to be provided timely.
25/08/25	Imdadul Haque, Executive Engineer, BWDB, Sunamganj		
19/08/25	Enayet Kabir, Executive Engineer, LGED, Kishoreganj	• Importance of the project in local setting • Challenges and risks of the project • Condition of rural infrastructure	During the consultation with the Executive Engineer of the LGED and the representatives of district LGED office, the discussion emphasized the important role of rural infrastructure in supporting agriculture, livelihoods, and resilience in the haor region. The officer explained that LGED has been deeply involved in developing rural roads, bridges, culverts, and small-scale water control structures that connect isolated haor villages with local markets and
25/08/25	Assistant Engineer, LGED, Sunamganj		

Date	Details of Participants	Issues Discussed	Response/Suggestions Made
			service centers. In the haor context, where accessibility remains a major challenge during both the flood and dry seasons, rural infrastructure is seen as a lifeline for communities. The Executive Engineer noted that one of the biggest constraints for farmers is the lack of harvesting roads. Since Boro rice is the only major crop grown in the haor areas, transporting it quickly to safe storage and market facilities before the onset of early floods is essential. In the absence of reliable roads, crops often remain stranded in the fields, leaving them exposed to damage. LGED has therefore prioritized the construction of submersible and village roads, which not only help in crop evacuation but also improve year-round mobility, access to education, and healthcare. However, the officer acknowledged that many of these infrastructures are vulnerable to waterlogging, erosion, and poor maintenance, which reduces their effectiveness. The officer also highlighted the importance of rural growth centers and marketplaces. Small businessmen and traders in the haor depend on functional markets, but many are poorly equipped, seasonally submerged, or lack storage and hygienic facilities. Strengthening these rural markets through LGED interventions can directly enhance the resilience of farming and fishing communities by ensuring fairer trade opportunities and reducing post-harvest losses. They emphasize effective community engagement to avoid any threat or risk from the community during the implementation. They also expressed willingness to utilize their previous experience in implementing similar interventions in past.
19/08/25	Md. Momin Bhuyan, Assistant Director, DoE, Kishoreganj	• Discuss about the project • Environmental concern	DoE officials highlighted the importance of maintaining the ecological balance of the haor areas alongside development interventions. They emphasized that the haor wetlands are ecologically sensitive zones, supporting biodiversity,

Date	Details of Participants	Issues Discussed	Response/Suggestions Made
25/08/25	Mohaiminul Islam, Assistant Director, DoE, Sunamganj	• Recommendations of DoE	migratory birds, fisheries, and livelihoods, and therefore any infrastructure or livelihood project must comply with environmental regulations and safeguards (ECR 2023). The DoE pointed out if the intervention like unplanned infrastructure, excessive use of agrochemicals, and wetland encroachment will gradually degrade the natural ecosystem and reducing the resilience of the haor. Therefore, development should be well planned and balanced. They stressed the preparation of environmental impact assessments (EIAs) and strong monitoring mechanisms before undertaking large-scale interventions such as embankment construction, khal excavation, etc. The DoE recommended promoting eco-friendly agricultural practices, pollution control, and conservation of water bodies to ensure long-term sustainability. Officials also underlined the importance of integrating climate change adaptation measures into project design, as the haor region is highly vulnerable to floods, erratic rainfall, and rising temperatures. They also suggested that the project should adopt a balanced approach, where livelihood development and infrastructure expansion go hand-in-hand with wetland conservation, biodiversity protection, and pollution management to safeguard the ecological health of the haor region.
20/08/25	Foyjur Razzak, Upazila Engineer, LGED, Mithamoin, Kishoreganj	• Importance of the project in local setting • Challenges and risks of the project • Condition of rural infrastructure • Recommendations	Upazila Engineers of LGED highlighted the importance of the project relating to the roles of rural infrastructure in the haor areas. The engineer emphasized that timely harvesting of Boro crops is often hampered by the absence of proper roads, leaving paddy exposed to early floods. Submersible and climate-resilient roads are therefore a top priority. He also noted that unplanned road construction can obstruct natural water flow, causing drainage congestion that harms both agriculture and fisheries, underscoring the need for integrated planning with other agencies. The engineer further pointed out that many rural markets and community facilities in the haor remain submerged or inaccessible during floods, limiting
21/08/25	Nani Gopal Das, Upazila Engineer, LGED, Mithamoin and Itna, Kishoreganj		

Date	Details of Participants	Issues Discussed	Response/Suggestions Made
			trade and livelihoods. Upgrading these infrastructures would enhance resilience and economic activity. However, he recommended that the project prioritize climate-resilient designs, improved maintenance, and stronger community involvement to ensure long-term sustainability.
31/08/25	Md Joynal Abedin, Assistant Conservator of Forest, Sunamganj	• About the current activity • Any forest areas near/in project area • Recommendations	They already have 55 ha social forestry including Hijal & Koroch near Tanguar haor watch tower. This year they are planning for extra 50 ha forestation in this area. They have planted 50 ha in haor area, at Narsinghapur in Chhatak region. This year they have plans for afforestation in Sunamganj Sadar haor region. However, they have no forestation in our studied hoars. If BWDB or LGED inform them for any intervention and ask for support, they are willing to provide that.
27/08/25	Upazila Fisheries Officer, Jamalganj, Sunamganj	• Fisheries in the haor areas, • the challenges faced by fishing communities, • The measures needed to ensure sustainable management of aquatic resources	The officers explained that the haor wetlands used to be rich in open-water fisheries, providing a major source of food and livelihood for local people. However, over the past decades, fish resources have declined noticeably due to a combination of factors, including siltation of water bodies, reduction of fish breeding grounds, overfishing, and the adverse impacts of climate change. The officers emphasized that the loss of biodiversity is not only affecting traditional fishing households but also reducing the nutritional intake of the broader community, for whom fish is a staple protein source. They noted that beel and khal management is one of the most pressing needs in the haor areas. Many natural water bodies are silted or disconnected from the main rivers, limiting fish migration and breeding. Canal excavation and beel re-excavation were identified as vital interventions to restore water connectivity and support fish habitats. The officers also highlighted that local communities are often not fully involved in fisheries management, which results in overexploitation. They suggested strengthening community-based fisheries management approaches, where fishers' cooperatives or local institutions are
26/08/25	Upazila Fisheries Officer, Derai, Sunamganj		
31/08/25	Upazila Fisheries Officer, Jagannathpur, Sunamganj		

Date	Details of Participants	Issues Discussed	Response/Suggestions Made
			engaged in regulating access, protecting sanctuaries, and ensuring seasonal fishing bans are observed. Another key point raised was the need to promote fish sanctuary development and the conservation of indigenous species that are increasingly under threat. Overall, the Fisheries Officers underlined that the resilience of the haor communities is closely tied to the sustainability of open-water fisheries.
31/08/25	Upazila Agriculture Officer, Jagannathpur, Sunamganj	• Current agricultural practices • Major challenges for agriculture, • Current cropping patterns • Opinion regarding project interventions and possible cooperation • Recommendations and suggestions	During the consultation with the Upazila Agriculture Officers in the targeted haor areas, the discussions focused on the current agricultural challenges and possible interventions under the Project. The stakeholders explained that Boro paddy remains the main crop of the haor, and its cultivation is increasingly threatened by early flash floods. They noted that, although improved varieties have been introduced, many of them are still not sufficiently flood-tolerant or suitable for the short growing season in the haor landscape. The lack of strong and well-maintained embankments, coupled with inadequate harvesting roads, often results in severe crop losses just before harvest. Popular crop varieties are: BIRI 92, Jonok Raj/HYBRID, etc. The officers also highlighted issues of soil fertility decline and limited crop diversification. Since most of the land is single-cropped, farmers have few alternatives when the Boro crop is damaged. They welcomed the project and expressed their willingness to support the implementation.
26/08/25	Upazila Agriculture Officer, Derai, Sunamganj		
30/08/25	Upazila Agriculture Officer, Jamalganj, Sunamganj		

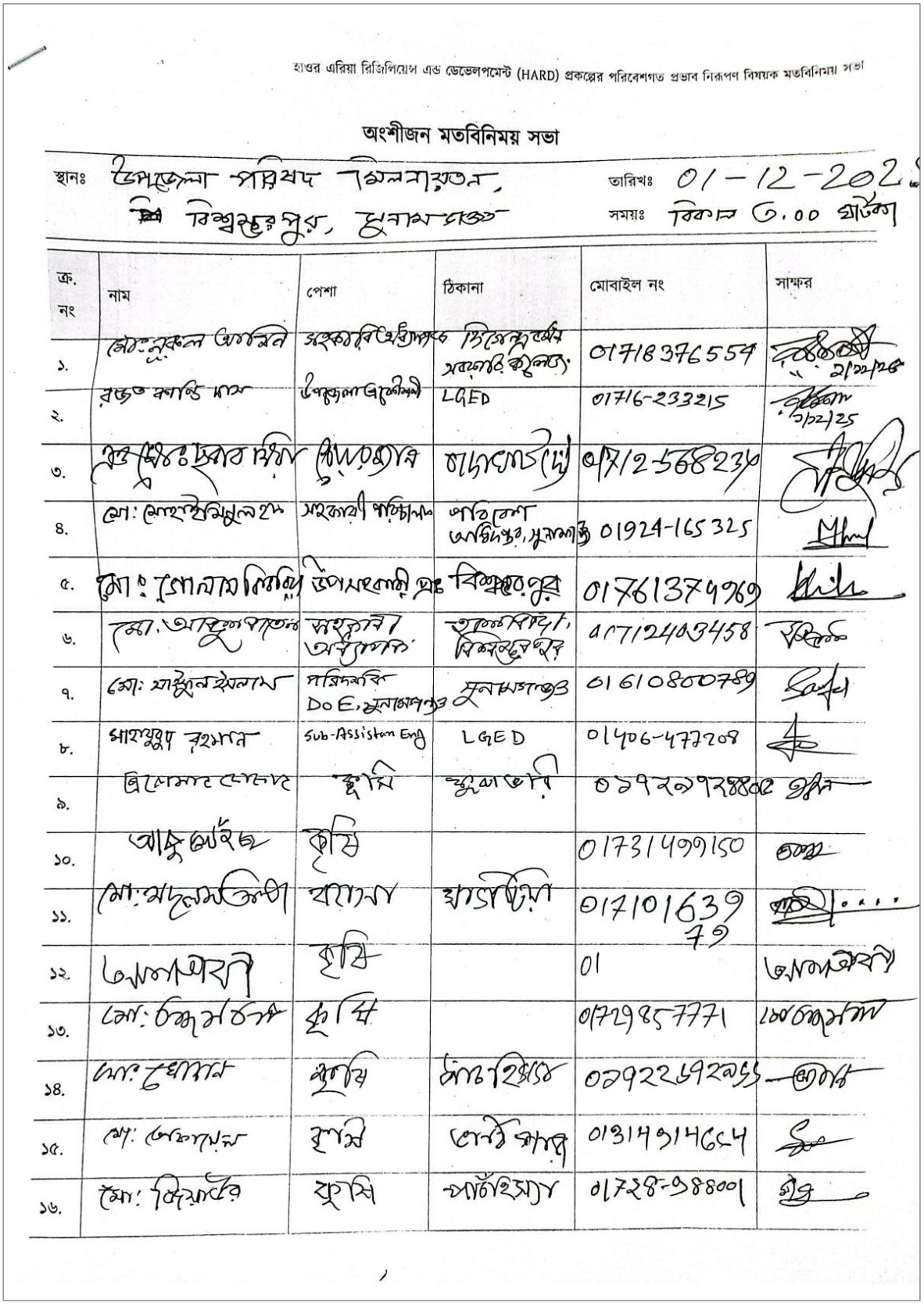
Appendix B-2: Minutes of FGDs

Date	Place	Target Group	No. of Participants	Issues/Topic Discussed	Opinion of Consulted Community People
20/08/25	Kazir Kola Boro Haor	Local elites, farmers, fishermen	11	• Information disclosure with stakeholders • Current condition of agricultural practices, fishing activities, beels, etc. • Experience of previous projects (if any) • Current status of the sharecroppers • Local communities' perception about the project • Women group's concerns related to gender-based violence, labor influx, and social cohesion • Suggestions and Recommendations	Several consultation meetings were held with different community groups including farmers, fishermen, sharecroppers, small businessmen, local elites, women representatives and others. During these discussions, the participants openly shared their views on the major challenges they face in sustaining their livelihoods and improving resilience in the haor ecosystem. Farmers described how the frequent early floods have become a major threat to Boro cultivation, as the standing crops are often damaged before harvest. They highlighted that the lack of protective embankments and harvesting roads increases their vulnerability, making it difficult to secure the only major crop of the year. Fishermen also reported that fish resources in the haors have declined significantly due to siltation, overexploitation, and the decrease of water in the beels. They stressed the importance of beel development and khal excavation to restore fish habitats, improve water connectivity, and ensure sustainable fishing opportunities. From the perspective of livelihoods, sharecroppers and small businessmen pointed out that their incomes remain uncertain and heavily dependent on seasonal changes. They noted that there are very limited alternative income opportunities beyond farming and fishing, which makes them more exposed to risks when natural disasters strike. Many farmers usually migrates to other areas including Dhaka during wet season and again come back to their areas during dry season for Boro cultivation. Women, in particular, raised concerns about their livelihood options and the challenges they face during the prolonged flood periods. They emphasized the importance of skill development
	Kazir Kola Boro Haor	Community People (Women)	14		
	Kazir Kola Boro Haor	Community People (farmers, fishermen, businessman, sharecropper)	6		
	Kazir Kola Boro Haor	UP representative and local elites	4		
21/08/25	Mrigar Haor	Local elites, farmers, fishermen	12		
21/08/25	Mrigar Haor	Community People, Farmers, Fishermen	10		
26/08/25	Chaptir Haor	Farmers, Beel Users, Fishermen	6		

Date	Place	Target Group	No. of Participants	Issues/Topic Discussed	Opinion of Consulted Community People
27/08/25	Halir Haor	Community People, Fishermen, Farmers	4		and small-scale income-generating activities such as poultry rearing, handicrafts, and homestead gardening, which could provide them with supplementary income and resilience. Women also expressed concern about the lack of roads to facilitate communication during emergency like accessing healthcare and education. While farmers anticipated a great benefit of the project, fishermen on the other hand reported that the project will support them in various ways. Rivere embankment and retained water in the beel help natural fish breeding by supporting fish habitat, throughout the seasons. Overall, the community members strongly support and expect the project to prioritize the strengthening of embankments, the construction of harvesting roads, and the excavation of khals to improve flood protection and water management. At the same time, they encouraged the promotion of climate-resilient agriculture, community-based fisheries management, capacity development and the creation of diversified livelihood opportunities, especially for women. These consultations reveal a strong sense of urgency among haor residents and underline the importance of integrating both infrastructural solutions and social development initiatives into the project's design in order to build resilience and improve the quality of life in the haor areas. Participants with different socioeconomic backgrounds also expressed their willingness to support the project in all possible ways.
	Halir Haor	Community People, Fishermen, Farmers	7		
28/08/25	Gurmar Haor	Farmers, Fishermen, Local Businessmen	5		
	Gurmar Haor	Farmers, Fishermen, Local Businessmen	4		
30/08/25	Naluar Haor	Farmers, Fishermen, Boatman	5		
	Naluar Haor	Community Poeple	5		
Total			**93**		

Appendix B-3: Attendance Sheets of Public Consultation Meeting

Appendix B-3.1: Attendance Sheets of Public Consultation Meeting at Bishwamvapur, Sunamganj



হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

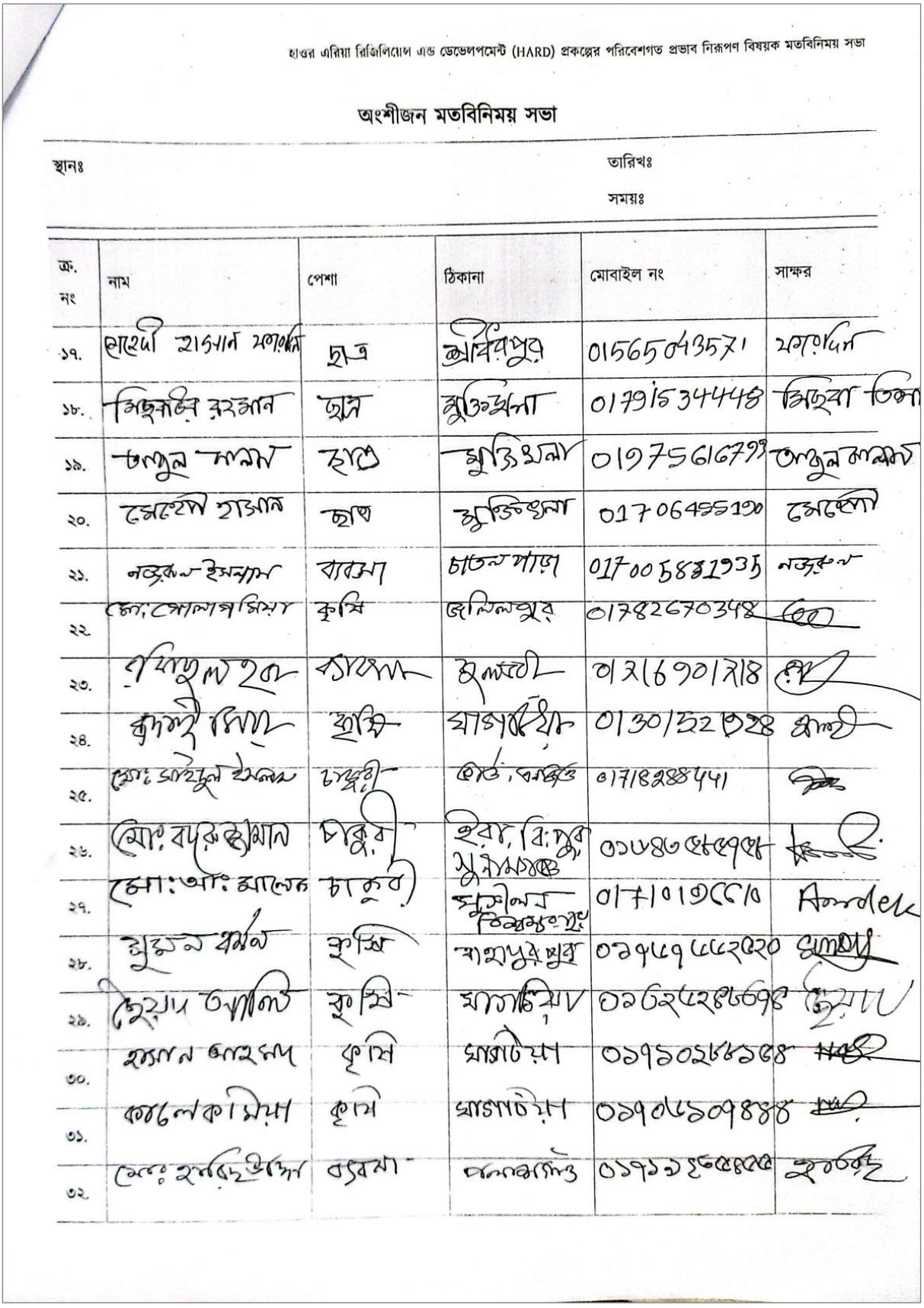
অংশীজন মতবিনিময় সভা

স্থানঃ উপজেলা পরিষদ মিলনায়তন, বিশ্বম্ভরপুর, সুনামগঞ্জ

তারিখঃ 01-12-202

সময়ঃ বিকাল ৩.০০ ঘটিকা

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	স্বাক্ষর
১.	মোঃ নুরুল আমিন	সহকারি অধ্যাপক	বিশ্বম্ভরপুর সরকারি কলেজ	01718376554	
২.	রতন কান্তি দাস	উপজেলা প্রকৌশলী	LGED	01716-233215	
৩.	[illegible]	[illegible]	[illegible]	[illegible]	
৪.	মো: মোহাইমিনুল হক	সহকারী পরিচালক	[illegible]	01924-165325	
৫.	মো: [illegible]	উপসহকারী প্রঃ	বিশ্বম্ভরপুর	01761374969	
৬.	মো. আব্দুল [illegible]	সহকারী অধ্যাপক	[illegible]	01712403458	
৭.	মো: মাহমুনুল ইসলাম	পরিদর্শক DoE, সুনামগঞ্জ	সুনামগঞ্জ	01610800789	
৮.	মাহফুজুর রহমান	Sub-Assistant Engr	LGED	01406-477208	
৯.	[illegible]	কৃষি	[illegible]	[illegible]	
১০.	আবু [illegible]	কৃষি		01731409150	
১১.	মো: [illegible]	[illegible]	[illegible]	01710163979	
১২.	[illegible]	কৃষি		01	
১৩.	মো: [illegible]	কৃষি		01729857771	
১৪.	মো: [illegible]	কৃষি	[illegible]	[illegible]	
১৫.	মো: [illegible]	কৃষি	[illegible]	01314914654	
১৬.	মো: [illegible]	কৃষি	[illegible]	01728-98800	



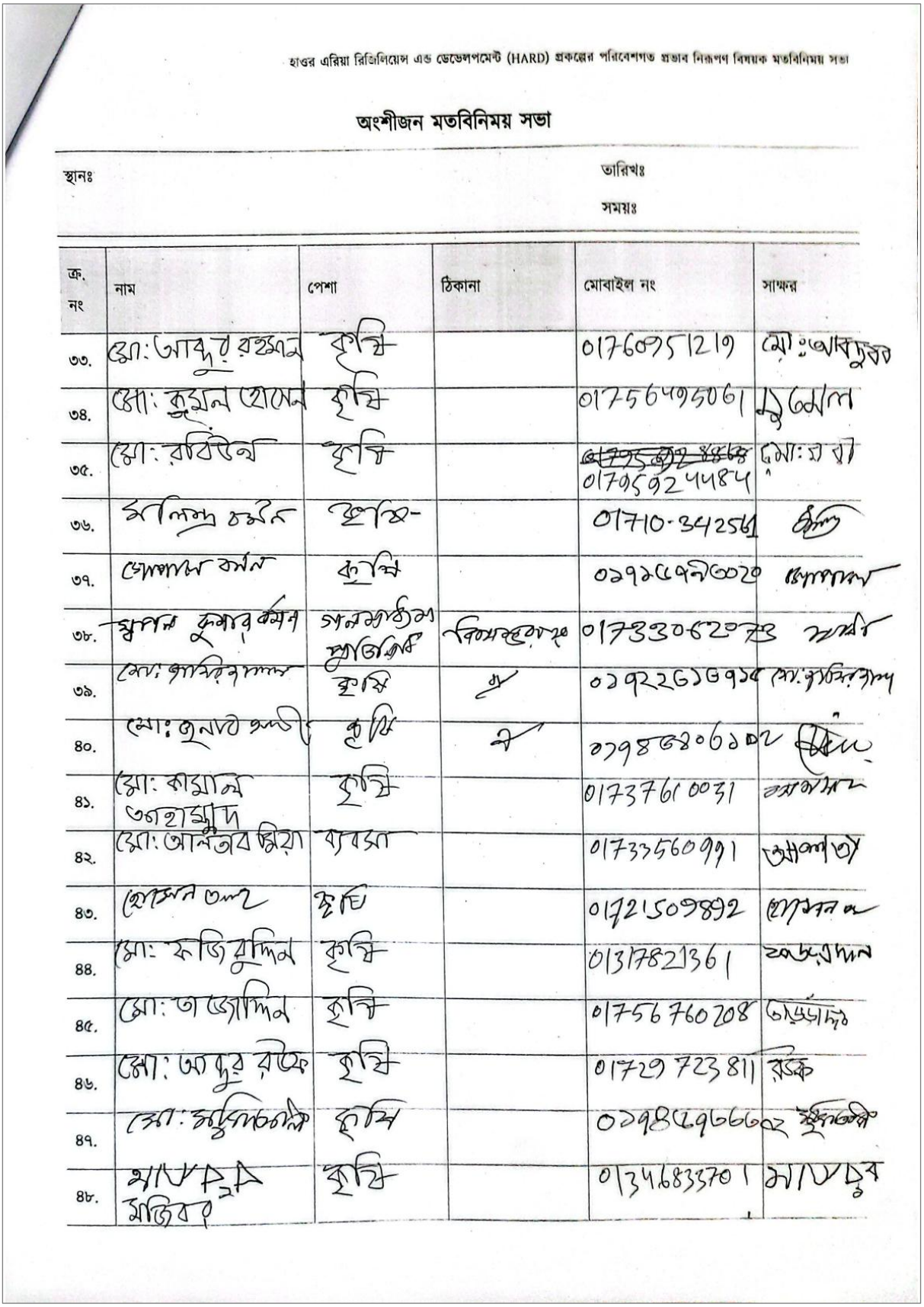
হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

অংশীজন মতবিনিময় সভা

স্থানঃ তারিখঃ

সময়ঃ

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	সাক্ষর
১৭.	[illegible]	ছাত্র	[illegible]	01565[illegible]	[illegible]
১৮.	[illegible]	[illegible]	[illegible]	01791[illegible]	[illegible]
১৯.	[illegible]	[illegible]	[illegible]	01975[illegible]	[illegible]
২০.	[illegible]	[illegible]	[illegible]	01706[illegible]	[illegible]
২১.	[illegible]	[illegible]	[illegible]	01700[illegible]	[illegible]
২২.	[illegible]	[illegible]	[illegible]	01782[illegible]	[illegible]
২৩.	[illegible]	[illegible]	[illegible]	01[illegible]	[illegible]
২৪.	[illegible]	[illegible]	[illegible]	01[illegible]	[illegible]
২৫.	[illegible]	[illegible]	[illegible]	01718[illegible]	[illegible]
২৬.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
২৭.	[illegible]	[illegible]	[illegible]	01710[illegible]	[illegible]
২৮.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
২৯.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
৩০.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
৩১.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
৩২.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



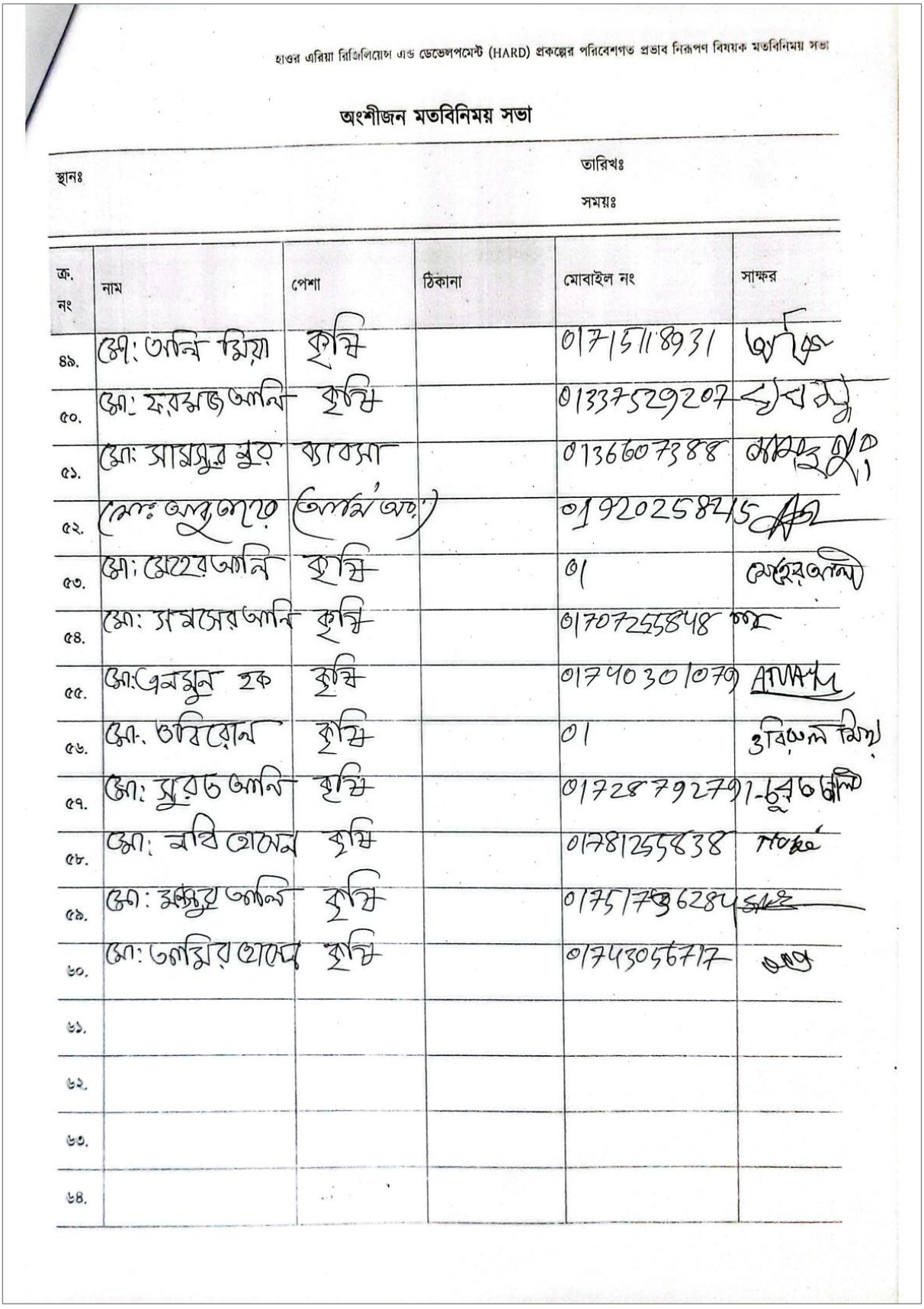
হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

অংশীজন মতবিনিময় সভা

স্থানঃ তারিখঃ

সময়ঃ

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	স্বাক্ষর
৩৩.	মো: আব্দুর রহমান	কৃষি		01760751219	মো: আব্দুর
৩৪.	মো: কুরমান হোসেন	কৃষি		01756495061	কুরমান
৩৫.	মো: রবিউল	কৃষি		~~01705 [illegible]~~ 01705924484	মো: র
৩৬.	সলিল চন্দ্র	কৃষি-		01710-342561	
৩৭.	গোপাল কর্মকার	কৃষি		01924094[illegible]20	গোপাল
৩৮.	সুপান কুমার কর্মকার	সনমন্ত্রিত সুপারভাইজার	বিশ্বম্ভরপুর	01733062[illegible]3	সুপান
৩৯.	মো: ফরিদ মিয়া	কৃষি	"	01925[illegible]9154	মো: ফরিদ মিয়া
৪০.	মো: তুনাই মিয়া	কৃষি	"	01798[illegible]0102	
৪১.	মো: কামাল উদ্দিন আহাম্মদ	কৃষি		01737610031	কামাল
৪২.	মো: আনিসুর রহিয়া	ব্যবসা		01733560991	আনিসুর
৪৩.	হোসেন মিয়া	কৃষি		01721509892	হোসেন
৪৪.	মো: ফজিলুদ্দিন	কৃষি		01317821361	ফজিলুদ্দিন
৪৫.	মো: তাজোদ্দিন	কৃষি		01756760208	তাজোদ্দিন
৪৬.	মো: আব্দুর রজ্জাক	কৃষি		01729723811	রজ্জাক
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৪৮.	[illegible] মজিবর	কৃষি		01346833701	[illegible]



হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

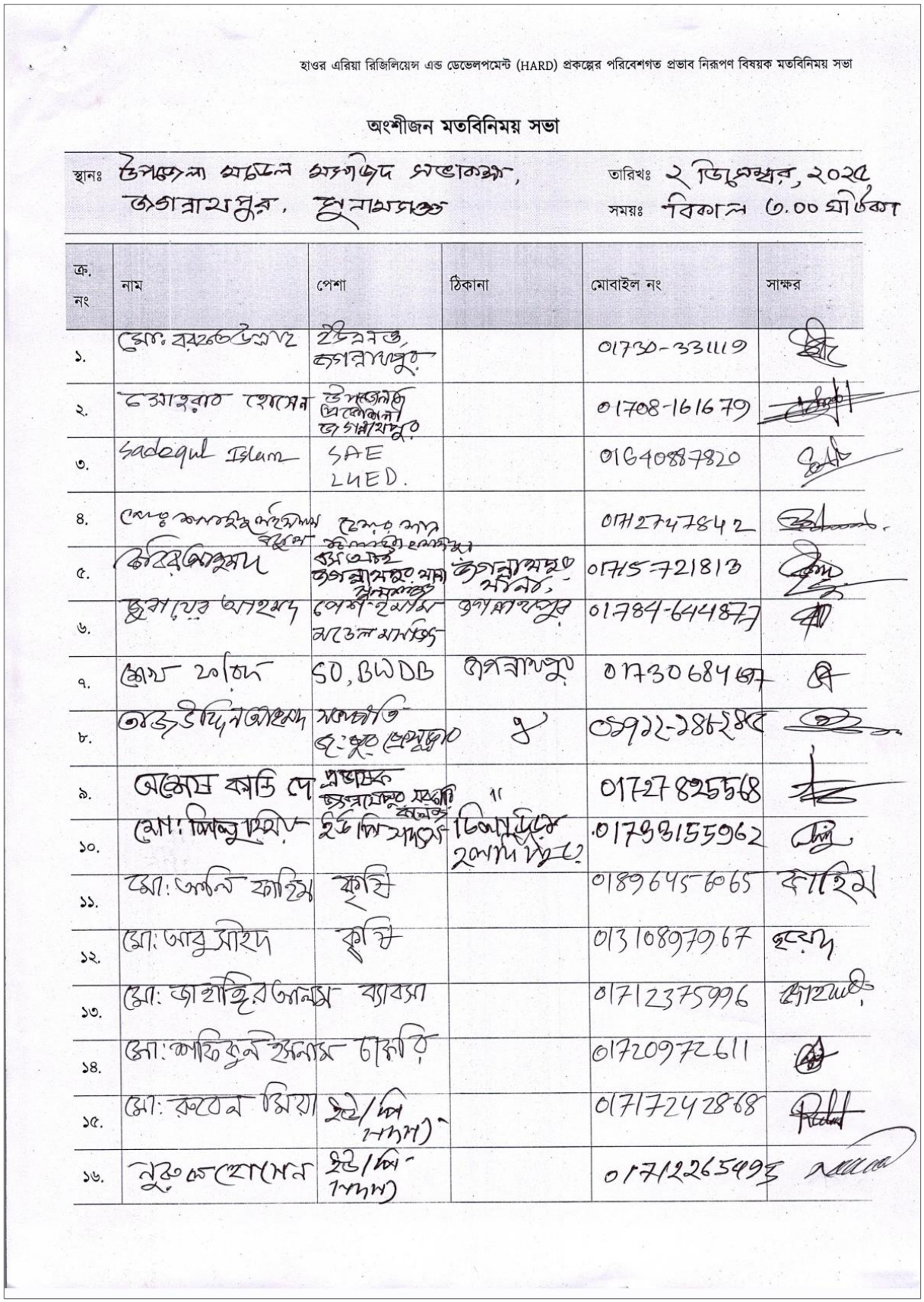
অংশীজন মতবিনিময় সভা

স্থানঃ তারিখঃ

সময়ঃ

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	সাক্ষর
৪৯.	মো: আনি মিয়া	কৃষি		01715118931	
৫০.	মো: ফরমজ আলি	কৃষি		01337529207	
৫১.	মো: সায়্যুর মুর	ব্যাবসা		01366073488	
৫২.	মো: আব্দুল্লাহ	(illegible)		01920258415	
৫৩.	মো: মেহের আলি	কৃষি		01	মেহের আলী
৫৪.	মো: মমসের আলি	কৃষি		01707255848	
৫৫.	মো: এনমুন হক	কৃষি		01740301079	
৫৬.	মো. তবিরোন	কৃষি		01	তবিজল মিয়া
৫৭.	মো: মুরুচ আলি	কৃষি		01728792791	মুরুচ আলি
৫৮.	মো: নবি হোসেন	কৃষি		01781255438	
৫৯.	মো: মস্তুর আলি	কৃষি		01751736284	
৬০.	মো: তাবির হোসেন	কৃষি		01743056717	
৬১.					
৬২.					
৬৩.					
৬৪.					

Appendix B-3.2: Attendance Sheets of Public Consultation Meeting at Jagannathpur, Sunamganj



হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

অংশীজন মতবিনিময় সভা

স্থানঃ উপজেলা পরিষদ সম্মেলন কক্ষ, জগন্নাথপুর, সুনামগঞ্জ

তারিখঃ ২ ডিসেম্বর, ২০২৫

সময়ঃ বিকাল ৩.০০ ঘটিকা

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	সাক্ষর
১.	মোঃ বরকতউল্লাহ	ইউনিয়ন, জগন্নাথপুর		0130-331119	
২.	তোফাজ্জল হোসেন	উপজেলা প্রকৌশলী জগন্নাথপুর		01708-161679	
৩.	Sadequl Islam	SAE LGED.		01640887820	
৪.				01827478422	
৫.				01715-721813	
৬.				01784-644877	
৭.		SO, BWDB		01730684967	
৮.				01912-188284	
৯.				01727825568	
১০.				01793155962	
১১.		কৃষি		01896456065	
১২.		কৃষি		01310897967	
১৩.		ব্যাবসা		01712375996	
১৪.		চাকরি		01720977611	
১৫.				01717247868	
১৬.				01712265493	

হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

অংশীজন মতবিনিময় সভা

স্থানঃ তারিখঃ

সময়ঃ

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	সাক্ষর
১৭.	মোঃ ছয়েদ উদ্দিন	ইউ-পি	৫নং চিলাকান্দা	01716023482	
১৮.	মোঃ রুহুল আমিন	কৃষক	চিলাকান্দা	01733413899	
১৯.	মোঃ জসিমউদ্দিন	চাষক	মেঘুয়ার চর ৫নং চিলাকান্দা	01733118[illegible]	
২০.	মো আহমদ আলী	সাবেক মেম্বার		01711395551	
২১.	[illegible] কান্তি সাহা	সাধক	ধনুয়ার	01761040415	
২২.	কামাল হোসেন	চাষাবাদ ও ব্যবসা		01717-802442	
২৩.	মোসাঃ আমেনা খাতুন	গৃহিনী	[illegible]	01713816851	
২৪.	মোছাঃ হালিমা বেগম	ইউ পি	৫নং	01750237696	
২৫.	মোছা: মোসলী বেগম	U.P	চিলাকান্দা ইলাদিয়ুর	01305814207	
২৬.	মোছাঃ মনতাজা বিবি	U.P	বাইকৈবন	01710032227	
২৭.	দীপেন্দ্র কুমার দাস	মৎস্য চাষি	মোহনগঞ্জ	01713800049	
২৮.	বিকাশ চন্দ্র [illegible]	চৌধুরী	নান্নাহুয়ুর	01749255922	
২৯.	মো: ইকবাল হোসেন	রাজ মিস্ত্রী		01709[illegible]130	
৩০.	মোঃ মুজাহিদ মিয়া	UP সদস্য-	৫নং চিলাকান্দা ইলাদিয়ুর-৩	01712-81587[illegible]	
৩১.	সুশীল চন্দ্র দাস	ব্যবসা	নতুন লালিয়াড়াট	01[illegible]4004429	
৩২.	মো: ওসমান গনি কিয়া		ডুবাখালি	01714104822	

হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

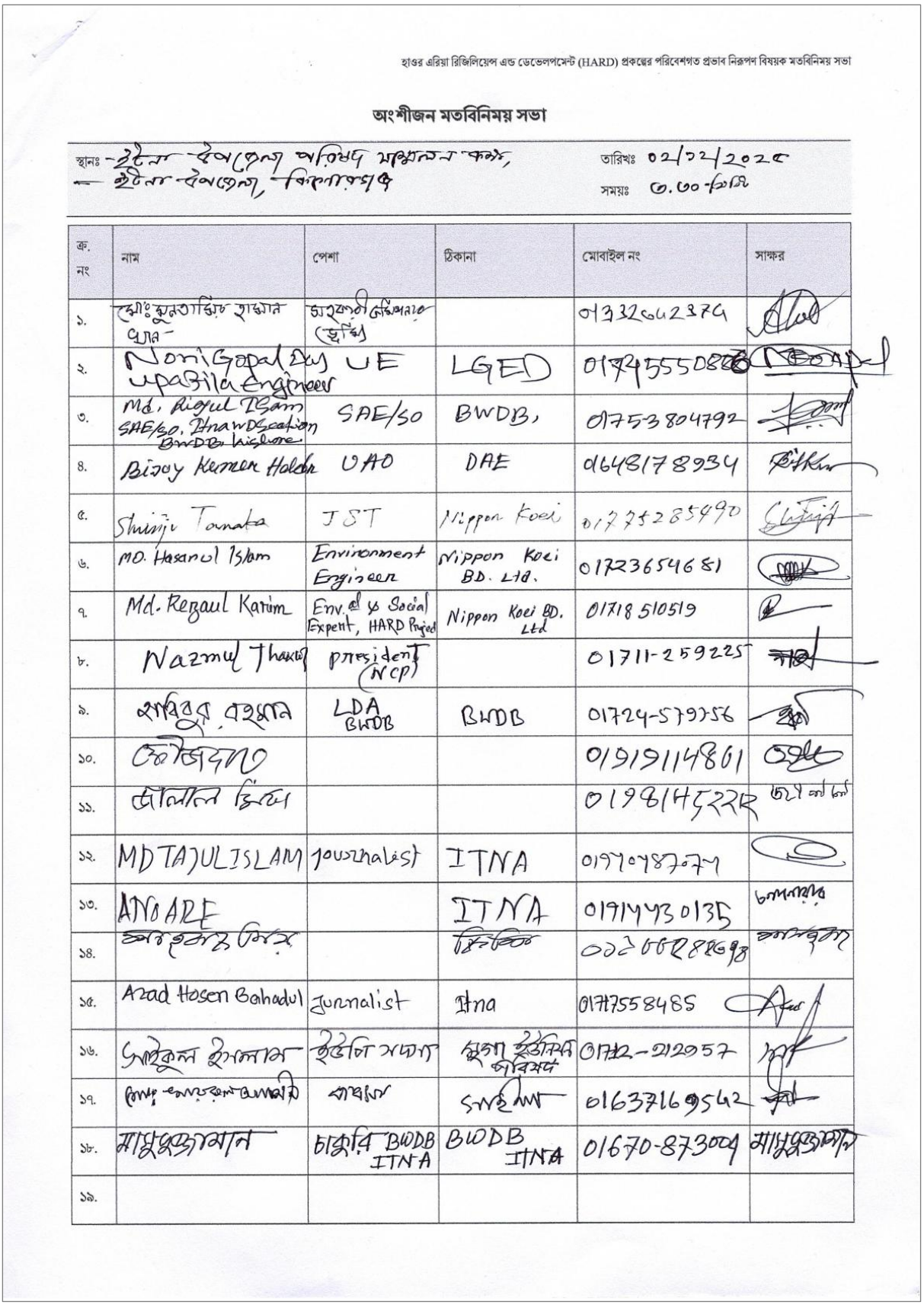
অংশীজন মতবিনিময় সভা

স্থানঃ তারিখঃ

সময়ঃ

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	সাক্ষর
৩৩.	[illegible]	[illegible]	[illegible]	01734556312	[illegible]
৩৪.	[illegible]	[illegible]	[illegible]	01211104448	[illegible]
৩৫.	[illegible]	[illegible]	[illegible]	01712-164478	[illegible]
৩৬.	[illegible]	[illegible]	[illegible]	01234-246818	[illegible]
৩৭.	[illegible]	UAO	[illegible]	01723-763283	[illegible]
৩৮.	[illegible]	[illegible]	[illegible]	01716023140	[illegible]
৩৯.	[illegible]	[illegible]	[illegible]	01752563748	[illegible]
৪০.	[illegible]	[illegible]	[illegible]	01763939624	[illegible]
৪১.	[illegible]				
৪২.					
৪৩.					
৪৪.					
৪৫.					
৪৬.					
৪৭.					
৪৮.					

Appendix B-3.3: Attendance Sheets of Public Consultation Meeting at Itna, Kishoreganj



হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

অংশীজন মতবিনিময় সভা

স্থানঃ ইটনা বৈঠকের অতিথি মিলনায়তন কক্ষ, ইটনা বাজার, কিশোরগঞ্জ

তারিখঃ ০২/১২/২০২৫

সময়ঃ ৩.৩০ ঘটিকা

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	সাক্ষর
১.	মোঃ মুস্তাফিজুর রাহমান খান	চাকরী (ভূমি)		০১৩২৬০২৩৭৫	
২.	Noni Gopal Das UE Upazila Engineer		LGED	০১৭৭৫৫৫০৪৫৫	
৩.	Md. Riajul Islam SAE/SO, Itna WDS cation BWDB, Kishore	SAE/SO	BWDB,	০১৭৫৩৮০৭৭৯২	
৪.	Bijoy Kumer Halder	UAO	DAE	০১৬৪৮১৮৯৩৪	
৫.	Shinji Tanaka	JST	Nippon Koei	০১৭২৫২৮৫৪৭০	
৬.	MD. Hasanul Islam	Environment Engineer	Nippon Koei BD. Ltd.	০১৭২৩৬৫৪৬৪১	
৭.	Md. Rezaul Karim	Env. & Social Expert, HARD Project	Nippon Koei BD. Ltd	০১৭১৮ ৫১০৫১৯	
৮.	Nazmul Thakur	president (NCP)		০১৭১১-২৫৯২২৫	
৯.	হাবিবুর রহমান	LDA BWDB	BWDB	০১৭২৪-৫৭৯৩৫৬	
১০.	[illegible]			০১৯১৯১১৪৮০১	
১১.	[illegible]			০১৯৪১৫২২৮	
১২.	MD TAJUL ISLAM	Journalist	ITNA	০১৯৭০৭৪৭০৭৭	
১৩.	ANOARE		ITNA	০১৯১৭৭৩০১৩৫	
১৪.	[illegible]		[illegible]	০২৫৬৬২৪৫৬৭৪	
১৫.	Azad Hosen Bahadul	Journalist	Itna	০১৭১৭৫৫৪৮৪৫	
১৬.	[illegible]	[illegible]	[illegible]	০১৭২-০২০৯৫৭	
১৭.	[illegible]	[illegible]	[illegible]	০১৬৩৭১৬৯৫৪২	
১৮.	[illegible]	চাকুরি BWDB ITNA	BWDB ITNA	০১৬৭০-৮৭৩০০৭	
১৯.					

হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

অংশীজন মতবিনিময় সভা

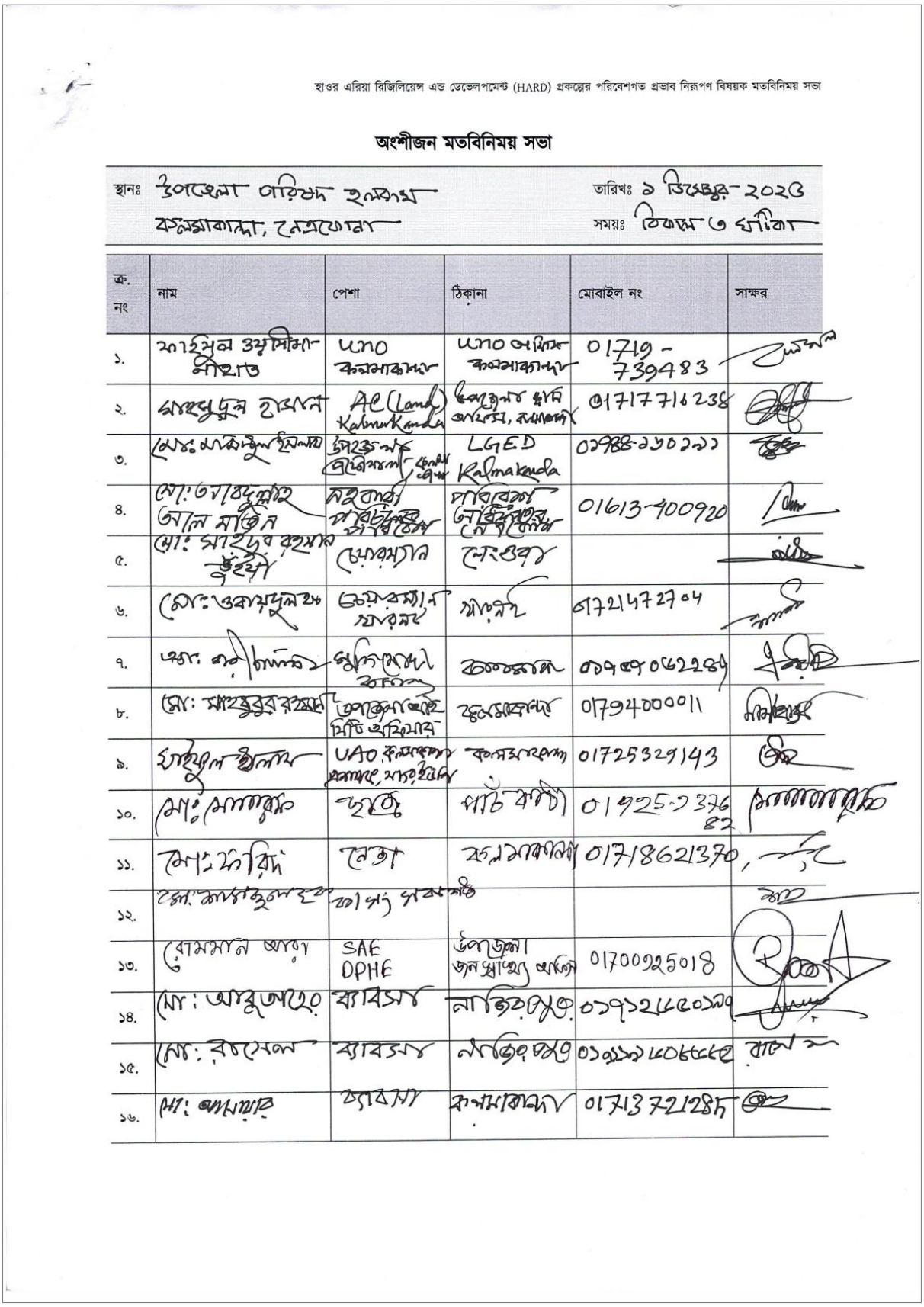
স্থানঃ ইটনা উপজেলা পরিষদ সম্মেলন কক্ষ, ইটনা উপজেলা, কিশোরগঞ্জ

তারিখঃ ০২/১২/২০২৫

সময়ঃ বিকাল ৩.০০

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	সাক্ষর
২০.	মোঃ বাচছু মিয়া	মেম্বার	কাটিয়ারকান্দি	০১৭২৮৬৭৩৪	
২১.	রেখা রানী দাস	ইউপি সদস্য	মুগা	০১৪২৩৬২৫৩	রেখা রানী দাস
২২.	মোছাঃ সাবিত্রী বেগম	〃	〃	০১৭৪৩৩৩১৭৫	সাবিত্রী
২৩.	মার্জিনা খাতুন	〃	〃	০১৪৩-৬৬৯১৩২	মার্জিনা
২৪.	আলী-আকবর	প্রকল্প সহকারী, UP	তাং মুগা	০১৮২৩৫৮২৮৭	
২৫.	আলী হোসেন	ইউ পি সদস্য	৬নং মুগা	০১৭২৯৩৫২৯৪	আলী হোসেন
২৬.	মোঃ জাহাঙ্গীর মিয়া	ইউপি. সদস্য	২নং ধনপুর	০১৯৪৫১৭৬৮	জাহাঙ্গীর
২৭.	মনকিশোর দাস	৫	৫	০১৭৬২৪৬৭৬৫৯	মনকিশোর
২৮.	গোকুল চন্দ্র বর্মন		২নং ধনপুর	০১৭৯৪-৫৮৬২৮০	গোকুল
২৯.	[illegible]	[illegible]	মুগা	০১৬৩২৩৯৪৫২	
৩০.	মোঃ ফয়জল ইসলাম	[illegible]	মুগা	০১৯১৮৭৫৪৫৫	
৩১.	তুহিন বেপারী	চাকুরী	ইটনা LGED	০১৯৩২৭৭৯১৬	
৩২.	হাবিব হাসান	চাকরি	ইটনা	০১৯১৫৫২৫১২	হাবিব
৩৩.	শরিফ উল্লাহ	ব্যবসা	ইটনা	০১৯১৮১৪৩৫১৭	
৩৪.	মিজানুর রহমান	কনসালটেন্ট	ঢাকা	০১৭৬১৩১ ৩৯০	মিজানুর রহমান
৩৫.	Aminur Rahman	Consultant	EQMS, Dhaka	০১৭২৩০৪২৩৬০	
৩৬.	Md. Aminul Islam	Admin	EQMS	০১৭১৬৬৩৪৪৩	
৩৭.					
৩৮.					

Appendix B-3.4: Attendance Sheets of Public Consultation Meeting at Kalmakanda, Netrokona



হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

অংশীজন মতবিনিময় সভা

স্থানঃ উপজেলা পরিষদ কলমাকান্দা, নেত্রকোনা — তারিখঃ ৯ ডিসেম্বর-২০২৩
সময়ঃ বিকাল ৩ ঘটিকা

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	সাক্ষর
১.	সাইফুল ওসমানী নীহাত	UNO কলমাকান্দা	UNO অফিস কলমাকান্দা	01719-739483	
২.	রাশেদুল হাসান	AE (Land) Kalmakanda	জেলা পরিষদ অফিস, কলমাকান্দা	01717716238	
৩.	মোঃ মাকসুদুল হিকমত	উপজেলা প্রকৌশলী	LGED Kalmakanda	02988-290291	
৪.	মোঃ তাহেদুল্লাহ তালুকদার	সহকারী পরিচালক	পরিবেশ অধিদপ্তর নেত্রকোনা	01613-400920	
৫.	মোঃ সাইফুর রহমান ভূঁইয়া	চেয়ারম্যান	লেংরুবর		
৬.	মোঃ ওবায়দুল হক	ভাইস চেয়ারম্যান	গাংনল	01721472704	
৭.	[illegible]	[illegible]	[illegible]	[illegible]	
৮.	মোঃ সাইফুর রহমান	[illegible]	[illegible]	01794000011	
৯.	হাফিজুল ইসলাম	UAO কলমাকান্দা	কলমাকান্দা	01725329143	
১০.	মোঃ সালাউদ্দিন	[illegible]	পাট কান্দি	01925-2376 82	
১১.	মোঃ সাবির	নেতা	কলমাকান্দা	01718621370,	
১২.	মোঃ কামরুল হক	[illegible]	[illegible]		
১৩.	মোহাম্মদ আবু	SAE DPHE	উপজেলা জনস্বাস্থ্য অফিস	01700225018	
১৪.	মোঃ আবুজাহের	ব্যাবসা	নাজিরপুর	01721[illegible]	
১৫.	মোঃ রহমান	ব্যাবসা	নাজিরপুর	01[illegible]	
১৬.	মোঃ আমজাদ	ব্যাবসা	কলমাকান্দা	01713721284	

হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

অংশীজন মতবিনিময় সভা

স্থানঃ উপজেলা পরিষদ হলরুম, কলমাকান্দা, নেত্রকোনা

তারিখঃ ৯ ডিসেম্বর-২০২৩

সময়ঃ বিকাল ৩ ঘটিকা

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	সাক্ষর
১৭.	মো: আনোয়ার	চাকুরী DSK	কলমাকান্দা	০১৯২৪৫৮৪৭৭৪	
১৮.	ইবাদুল পাটোয়ারী	সাবেক সমাজ ই/প্রেসক্লাব	"	০১৭৬১৫৩৬৭৩	
১৯.	আলোয়ার	কাচুড়ীয়া	কলমাকান্দা	০৩৭৭২৬৫৪০৭১	
২০.	আজিজুল হক	চাকুরী	কলমাকান্দা	০১৭২২১৩৪৩৩	
২১.	[illegible]	[illegible]	DSS	০১৯৫৫২২৯৯	
২২.	[illegible]	আনসার	কলমাকান্দা	০১৭৪০-২০১৬৪৪	
২৩.	নাহিম	নাহিমনুর	"	০১৬১১৫৭৩১৫১	
২৪.	[illegible]	নাহিমনুর	কলমাকান্দা	০১৯১১১৯৪৬৫	
২৫.	শাহ মছলি আলুকদার	বড়ইগাও,	কলমাকান্দা	০১৭২০৩৮-৬৮৮০	
২৬.	[illegible]	প্রেসক্লাব	কলমাকান্দা	০১৭১৬৫২২২২	
২৭.	মো: কবির হোসেন	কৃষক	কলমাকান্দা	০১৯১১৭১৯৪০২	
২৮.	মো: তাহিরুল	কৃষক	কলমাকান্দা	০১৯৭৯-৬০২০১৯	
২৯.	[illegible]	চাকুরী	নেত্রকোনা	০১৭১২৩৪৭৯৩	
৩০.	মো: হযরত আলী	সদস্য	কলমাকান্দা	০১৭৬৭২৯৪৪১২	
৩১.	মো: সাদিল	প্রেসক্লাব	কলমাকান্দা	০১৭৬৭৪১৬৫	
৩২.	মো: আবুল	চাকুরী	নেত্রকোনা	০১৭২৫৫১৩৬৮	

হাওর এরিয়া রিজিলিয়েন্স এন্ড ডেভেলপমেন্ট (HARD) প্রকল্পের পরিবেশগত প্রভাব নিরূপণ বিষয়ক মতবিনিময় সভা

অংশীজন মতবিনিময় সভা

স্থানঃ উপজেলা পরিষদ হলরুম — তারিখঃ ৯ ডিসেম্বর-২০২৩
কলমাকান্দা, নেত্রকোনা — সময়ঃ বিকাল ৩ ঘটিকা

ক্র. নং	নাম	পেশা	ঠিকানা	মোবাইল নং	সাক্ষর
৩৩.	মোঃ আলাউদ্দিন খন্দ	কৃষক	সাতকাহনিয়া দিঘি	০১৭১৪৮৭৬৩৭৪	
৩৪.	আলতু মিয়া	কৃষক	সাতকাহনিয়া দিঘি	০১৭২৯১৭১১৭	
৩৫.	মোঃ আবুল কাশেম খন্দ	চাকুরি	কলমাকান্দা সদর	০১৭২১১৩২৭৭৪	
৩৬.	মোঃ নূরুজ্জামান গং	কৃষক	কলমাকান্দা	০১৭১৫৭৩৬৪২৪	
৩৭.	মোঃ মোস্তাফিজুর	কৃষক	কলমাকান্দা	০১৭৩৪৭৫৩০০১	
৩৮.	মোঃ ইউনুছ মিয়া	চাকুরি	জামালপুর	০১৭৪০২৮৩১১৩	
৩৯.	[illegible]	[illegible]	[illegible]	০১৭৪৪৫২৭৭	
৪০.	[illegible]	ব্যবসা	[illegible]	[illegible]	
৪১.	[illegible]	[illegible]	[illegible]	[illegible]	
৪২.	মোঃ [illegible]	[illegible]	[illegible]	[illegible]	
৪৩.	[illegible]	[illegible]	[illegible]	[illegible]	
৪৪.	[illegible]	[illegible]	[illegible]	[illegible]	
৪৫.	ফেরদৌস [illegible]	চাকুরি	ঢাকা	[illegible]	
৪৬.	বলরাম কর্মকার	চাকুরি	ঢাকা	[illegible]	
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Appendix B-4: Attendance Sheets of FGDs

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Mirjahoni Haor | Date and Time: 21.08.2025

S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	[illegible]	M	UP. Member	[illegible]	01721-251148
2.	[illegible]	M	[illegible]	[illegible]	01783631317
3.	[illegible]	"	"	"	02926-666690
4.	[illegible]	"	"	"	8801291552785
5.	[illegible]	"	"	"	01921-496785
6.	[illegible]	"	"	[illegible]	01522-857323
7.	[illegible]	"	[illegible]	"	0294-845336
8.	[illegible]	"	[illegible]	[illegible]	01912130577
9.	[illegible]	"	"	[illegible]	01990-260628
10.	MD. Bikal Mia	"	student	"	01735-358263
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Kazirkhola			Date and Time: 21.08.2025		
S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	মোঃ মোস্তফা হোসেন	M	প্রশাসক	কাজিরখোলা	01714-965242
2.	Ronjit Das	"	UP Member	"	01956-792106
3.	Humayan Kabir	"	"	"	01715-695944
4.	আতাউর রহমান	"	"	"	017 55-8147 44
5.	AFRAN	"	"	"	01779-609082
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: kazirkhola Date and Time: 20-08-2025

S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	মোঃ শিহাব মিয়া	M	সমাজসেবী		0170-456213
2.	[illegible]	"	"		01407-681930
3.	[illegible]	"	[illegible]		01938-557913
4.	[illegible]	"	[illegible]		01775-059698
5.	[illegible]	"	সমাজসেবী		
6.	[illegible]	"	"		
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Kazirkholo Haor			Date and Time: 20-08-2025		
S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	মাফুজা বেগম	F	গৃহিনী	কোম্পানী	01941-098051
2.	মোনা বেগম	F	"	"	01984-436508
3.	চাঁদনি মজুমদার	F	"	"	01956-732552
4.	এলেনা	F	"	"	01912-204744
5.	নুর সাহার	F	"	"	01734-668988
6.	কবিতা	F	"	"	
7.	রোজিনী	F	"	"	019 25-46 7728
8.	সালমা আক্তার	F	"		01951-428092
9.	মাজিদা	F	"	"	
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Kazirkhola Haor			Date and Time: 20/08/2025		
S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	মোঃ আমতাব উদ্দীন ভূঁইয়া	M	সাধারণ চেয়ারম্যান	কাজিরকান্দা	01712-185306
2.	মোঃ জাহাঙ্গীর আলম	"	কৃষি	কাজিরকান্দা	01923-546625
3.	গোপাল চন্দ্র কর্মকার	"	"	"	01720-971877
4.	মোঃ মুজাহিদ মিয়া	"	"	"	01941-582548
5.	অখিল চন্দ্র রায়	"	ব্যবসা	"	01927-204931
6.	মোঃ মোমেন ভূঁইয়া	"	ব্যবসা	কাজিরকান্দা	
7.	মোঃ কামরুল	"	"	"	01764-192720
8.	লিয়াকত আলী	"	কৃষি	"	01912-204722
9.	কাজল মিয়া	"	ব্যবসা	কাজিরকান্দা	
10.	মিনাজ মিয়া	"	কৃষি	"	01407-848311
11.	জামিল মিয়া	"	"	"	-
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Chaptir Haor			Date and Time: 26.08.25		
S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	জয়নাল আবেদীন	M		চন্দীপুর	০১৭২৫-৮৫৭০২৪
2.	মিজানুর রহমান	"		"	০১৭৬৬৭০৭৪২৪
3.	বোরহান	"		"	০১৭১৩-৭৩৪০৬৩
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Naluar Haor, Jagannathpur			Date and Time: 30-08-2025		
S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	Shamsul Haque	M	Business & Farming	জগন্নাথপুর	01724-52 55 4764
2.	জলিল মিয়া	"	কৃষি	"	02 9999 0000
3.	[illegible]	"	"	"	0199 8 [illegible]
4.	[illegible]	"	"	"	
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Gangarar Haor, অষ্টগ্রাম			Date and Time:		
S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	[illegible]	M	[illegible]	[illegible]	01976-029[illegible]
2.	[illegible]	"	"	"	017[illegible]
3.	[illegible]	"	[illegible]	"	02990-[illegible]
4.	[illegible]	"	"	"	029[illegible]
5.	[illegible]	"	[illegible]	"	02972-[illegible]
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Gobermara Haor, সর্ষীকান্দা, কাইমারী Date and Time: 29.07.2021

S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	হাবি দাস	M	কৃষি	কাইমারী	01751-272085
2.	সুচিত্রা বিশ্বাস	ম.	"	"	01922-709690
3.	বিনয় কুমার দাস	"	"	"	01762-822915
4.	নিখিল চন্দ্র	"	"	"	01608-822922
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Halir Haor			Date and Time: 27.08.25		
S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	D. Somudra Das	M	Doctor	Derai	01742-873396
2.	[illegible]	"	[illegible]	"	09906-896662
3.	Sagar Chandra Das	"	[illegible]	"	01738878209
4.	Shah ALOM	"	Teacher	"	01729132730
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Haliz Haor			Date and Time: 27.08.25		
S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	নয় হোসেন	M	কৃষক	[illegible]	01710-862937
2.	আলী নুর	"	"	"	০১৭ ৮৩-৩৯০০৯২
3.	[illegible]	"	"	"	-
4.	[illegible]	"	"	"	
5.	[illegible]	"	[illegible]	"	01757 613382
6.	[illegible]	"	"	"	০২৯৩৭-৬২৬৫২
7.	Hosen	"	"	"	01819-292504
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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE HAOR AREA RESILIENCE AND DEVELOPMENT PROJECT (HARD PROJECT PHASE II)

Focus Group Discussion

Attendance Sheet

Location: Meghar Haor এলাকায় Date and Time: 21-08-2025

S/N (ক্রমিক)	Name (নাম)	Sex (লিঙ্গ)	Occupation (পেশা)	Address (ঠিকানা)	Cell (মোবাইল নং)
1.	MD. Anowar Hosen	M	President	মোল্লাপাড়া	01914-430635
2.	মোঃ শামসুদ্দিন	"	কৃষিশ্রমিক	"	01988-244374
3.	মোঃ লিয়াকত আলী	"	কা: নি: সদস্য	"	
4.	আলী আকবর	"	"	"	01876-102553
5.	আবুল কাশেম	"	"	"	01988-926325
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Appendix B-5: Photographs of Public Consultation Meeting

Appendix B-5.1: Photographs of Public Consultation Meeting at Bishwamvapur, Sunamganj











Appendix B-5.2: Photographs of Public Consultation Meeting at Jagannathpur, Sunamganj















Appendix B-5.3: Photographs of Public Consultation Meeting at Itna, Kishoreganj








Appendix B-5.4: Photographs of Public Consultation Meeting at Kalmakanda, Netrokona














মতবিনিময় সভা








মতবিনিময় সভা


মতবিনিময় সভা

Appendix B-6: Photographs of KII in the Study Area

		
KII with Senior Upazila Fisheries Officer, Moulvibazar Sadar, Moulvibazar	KII with Executive Engineer, Bangladesh Water Development Division (BWDB), Moulvibazar Sadar, Moulvibazar	KII with Executive Engineer, Local Government Engineering Department (LGED), Moulvibazar Sadar, Moulvibazar
		
KII with Senior Upazila Fisheries Officer, Osmaninagar, Sylhet	KII with Upazila Agriculture Officer, Osmaninagar, Sylhet	KII with Executive Engineer, Local Government Engineering Department (LGED), Companiganj, Sylhet
		
KII with Upazila Fisheries Officer, Jagannathpur, Sylhet	KII with Agriculture Extension Officer, Companiganj, Sylhet	KII with Upazila Fisheries Officer, Derai, Sunamganj
		

KII with Assistant Conservator of Forest, Sunamganj, Sylhet Forest Division	KII with Upazila Fisheries Officer of Mithamoin Upazila, Kishoreganj	KII with Upazila Fisheries Officer of Itna Upazila, Kishoreganj

Appendix B-7: Photographs of FGDs and Consultations in the Study Area



FGD with Local Fishing Community Mirzapur Village at Moulvibazar Sadar, Moulvibazar





Consultation with Fishermen in Mirzapur Village at Moulvibazar Sadar, Moulvibazar



Consultation with Fishermen in Osmaninagar, Sylhet





Consultation with Local Fisheries Community at Pathor Chauli Haor, Companiganj, Sylhet







FGD with Local Fishing Community at Pathor Chauli Haor, Companiganj, Sylhet







Consultation with Local Fisheries Community at Pathor Chauli Haor, Companiganj, Sylhet	Consultation with Local Fisheries Community (Right) and Aradar (Left) at Derai, Sunamganj





FGDs Conducted in Mithamoin and Itna Upazila of Kishoreganj

APPENDIX C

Appendix C: Photographs of Monitoring and Sampling

Appendix C-1: Photographs of Ambient Air Quality Monitoring

		
AAQ-1: Gumar Haor	AAQ-2: Halir Haor	AAQ-3: Chaptir Haor
		
AAQ-4: Naluar Haor	AAQ-5: Mrigar Haor	AAQ-6: Kazir Kola Boro Haor
		
AAQ-7: Pathor Chauli Haor	AAQ-8: Muktarpur Haor	AAQ-9: Hail Haor

Appendix C-2: Photographs of Ambient Noise Level Monitoring

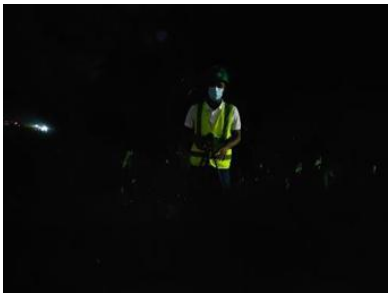
Appendix C-2.1: Photographs of Ambient Noise Level Monitoring (Day-time)

		
ANL-1: Gumar Haor	ANL-2: Halir Haor	ANL-3: Chaptir Haor

		
ANL-4: Naluar Haor	ANL-5: Mrigar Haor	ANL-6: Kazir Kola Boro Haor
		
ANL-7: Pathor Chauli Haor	ANL-8: Muktarpur Haor	ANL-9: Hail Haor

Appendix C-2.2: Photographs of Ambient Noise Level Monitoring (Night-time)

		
ANL-1: Gumar Haor	ANL-2: Halir Haor	ANL-3: Chaptir Haor
		
ANL-4: Naluar Haor	ANL-5: Mrigar Haor	ANL-6: Kazir Kola Boro Haor

		
ANL-7: Pathor Chauli Haor	ANL-8: Muktarpur Haor	ANL-9: Hail Haor

Appendix C-3: Photographs of Surface Water Sampling

Appendix C-3.1: Photographs of Surface Water Sampling during Dry Season

		
SW-1: Gumar Haor	SW-2: Halir Haor	SW-3: Chaptir Haor
		
SW-4: Naluar Haor	SW-5: Mrigar Haor	SW-6: Kazir Kola Boro Haor
		
SW-7: Pathor Chauli Haor	SW-8: Muktarpur Haor	SW-9: Hail Haor

Appendix C-3.2: Photographs of Surface Water Sampling during Wet Season

		
SW-1: Gumar Haor	SW-2: Halir Haor	SW-3: Chaptir Haor
		
SW-4: Naluar Haor	SW-5: Mrigar Haor	SW-6: Kazir Kola Boro Haor
		
SW-7: Pathor Chauli Haor	SW-8: Muktarpur Haor	SW-9: Hail Haor

Appendix C-4: Photographs of Groundwater Sampling

		
GW-1: Gumar Haor	GW-2: Halir Haor	GW-3: Chaptir Haor

		
GW-4: Naluar Haor	GW-5: Mrigar Haor	GW-6: Kazir Kola Boro Haor
		
GW-7: Pathor Chauli Haor	GW-8: Muktarpur Haor	GW-9: Hail Haor

Appendix C-5: Photographs of Soil Sampling

		
SL-1: Gumar Haor	SL-2: Halir Haor	SL-3: Chaptir Haor
		
SL-4: Naluar Haor	SL-5: Mrigar Haor	SL-6: Kazir Kola Boro Haor
		

SL-7: Pathor Chauli Haor	SL-8: Muktarpur Haor	SL-9: Hail Haor

Appendix C-6: Photographs of River Bottom Sediment Sampling

Appendix C-6.1: Photographs of River Bottom Sediment Sampling during Dry Season



RBS-1: Gumar Haor



RBS-2: Halir Haor



RBS-3: Chaptir Haor



RBS-4: Naluar Haor



RBS-5: Mrigar Haor



RBS-6: Kazir Kola Boro Haor



RBS-7: Pathor Chauli Haor



RBS-8: Muktarpur Haor



RBS-9: Hail Haor

Appendix C-6.2: Photographs of River Bottom Sediment Sampling during Wet Season



RBS-1: Gumar Haor



RBS-2: Halir Haor



RBS-3: Chaptir Haor

		
RBS-4: Naluar Haor	RBS-5: Mrigar Haor	RBS-6: Kazir Kola Boro Haor
		
RBS-7: Pathor Chauli Haor	RBS-8: Muktarpur Haor	RBS-9: Hail Haor

Appendix C-7: Pictorial Presentation of Plankton Sampling and Microscopic Observation in The Study Area

		
Dragging of Planktonic Net at Hail Haor	Collection of Samples in a Sample Bottle at Muktarpur Haor	Addition of Glycerol in the collected Samples at Pathor Chauli Haor
		
Addition of Preservatives in Sample Bottle at Gurmar Haor	Prepare the Sample for Lab Analysis at Hail Haor	Identification of Plankton Species in EQMS Lab

Appendix C-8: Pictorial Presentation of Benthos Sample Collection and Microscopic Identification in the Study Area

		
Sample Collection by Ekman Grab Sampler at Pathor Chauli Haor	Sample Transferred to a Bucket at Hail Haor	Sieving by 0.5 mm Mesh-sized Hand Sieve at Muktarpur Haor
		
Collection of Sieved Sample at Chaptir Haor	Adding 10% Buffered Formalin in a Sample Jar at Hail Haor	Identification of Macrobenthos in EQMS Lab

Appendix C-9: Photographs of Fish Market Survey Activities in the Study Area

		
Fish Market at Mirzapur Bazar, Sreemangal, Moulvibazar	Afrojganj Fish Market, Sherpur, Osmaninagar, Sylhet	Mahtabpur Fish Market, Companiganj, Sylhet
		
Derai Fish Market, Sunamganj	Jamalganj Fish Market, Sunamganj	Fish Market in Madyanagar, Sunamganj





Fish Market in Jagannathpur, Sunamganj | Fish Market in Mithamoin, Kishoreganj

Appendix C-10: Photographs of Boat to Boat Survey Activities in the Study Area






Hail Haor, Moulvibazar Sadar, Moulvibazar | Survey at Chaptir Haor, Derai, Sunamganj






Muktarpur Haor, Osmaninagar, Sylhet





Pathor Chauli Haor, Companiganj, Sylhet

Appendix C-11: Photographs of Fishing Activities in the Study Area

		
Angling Activity at Hail Haor, Moulvibazar Sadar, Moulvibazar	Fishing Activity with Anta at Hail Haor, Moulvibazar Sadar, Moulvibazar	Fishing with Barrier Net (Char Pata Jal) at Hail Haor, Moulvibazar Sadar, Moulvibazar
		
Fishing Activity with Chai (Kironbala) at Hail Haor, Moulvibazar Sadar, Moulvibazar	Fishing Activity with Hook and Line at Hail Haor, Moulvibazar Sadar, Moulvibazar	Fishing Activity with Thela Jal at Hail Haor, Moulvibazar Sadar, Moulvibazar
		
Fishing Activity with Lift Net at Hail Haor, Moulvibazar Sadar, Moulvibazar	Fishing Activity with Cast Net at Hail Haor, Moulvibazar Sadar, Moulvibazar	Fishing Activity with Current Jal at Muktarpur Haor, Osmaninagar, Sylhet

APPENDIX D

Appendix D: List of Recorded Flora and Fauna Species in the Study Area

Appendix D-1: List of Tree Species Recorded from the Study Area

S/N	Local Name	Common Name	Scientific Name	Family	Use	Dry Season									Wet season								
						A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
1	Aam	Mango Tree	*Mangifera indica*	Anacardiaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
2	Akashmoni	Earleaf Acacia	*Acacia auriculiformis*	Fabaceae	Timber	√	√		√		√				√	√	√	√	√	√	√	√	√
3	Ata	Custard Apple	*Annona reticulata*	Annonaceae	Fruit	√		√	√	√	√	√			√	√	√	√	√	√	√	√	√
4	Babla	Gum arabic tree	*Vachellia nilotica*	Fabaceae	Timber	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
5	Bel	Bael	*Aegle marmelos*	Rutaceae	Fruit	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
6	Bilati Gaab	Velvet Apple	*Diospyros blancoi*	Ebenaceae	Fruit	√	√	√	√	√	√	√	√	√		√				√		√	
7	Bokul	Spanish cherry	*Mimusops elengi*	Sapotaceae	Asthetic	√		√		√		√		√	√		√		√		√		√
8	Boroi	Indian jujube	*Ziziphus mauritiana*	Rhamnaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
9	Bot	Banyan Tree	*Ficus benghalensis*	Moraceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
10	Dalim, Anar	Pomegranate	*Punica granatum*	Lythraceae	Fruit	√		√		√			√	√	√		√		√			√	√
11	Debdaru	False Ashoka	*Polyalthia longifolia*	Annonaceae	Asthetic	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
12	Dumur	Cluster fig	*Ficus racemosa*	Moraceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
13	Eucalyptus	Eucalyptus	*Eucalyptus sp.*	Myrtaceae	Timber	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
14	Gaab	Malabar Ebony	*Diospyros malabarica*	Ebenaceae	Fruit											√	√	√	√	√	√	√	√
15	Hijol	Indian oak	*Barringtonia acutangula*	Lecythidaceae	Asthetic		√		√				√			√		√				√	
16	Jalpai	Indian olive	*Elaeocarpus floribundus*	Elaeocarpaceae	Fruit										√	√	√	√	√	√	√	√	√

S/N	Local Name	Common Name	Scientific Name	Family	Use	Dry Season									Wet season								
						A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
17	Jam	Java Plum	*Syzygium cumini*	Myrtaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
18	Jambura	Pomelo	*Citrus maxima*	Rutaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
19	Jamrul	Java Apple	*Syzygium samarangense*	Myrtaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
20	Kadam	Burflower-tree	*Neolamarckia cadamba*	Rubiaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
21	Kala Koroi	Shirish	*Albizia lebbeck*	Fabaceae	Timber	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
22	Kamranga	Carambola	*Averrhoa carambola*	Oxalidaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
23	Kath Badam	Indian Almond	*Terminalia catappa*	Combretaceae	Fruit											√		√			√		
24	Kathal	Jackfruit	*Artocarpus heterophyllus*	Moraceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
25	Khejur	Indian date	*Phoenix sylvestris*	Arecaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
26	Kodbel	Wood Apple	*Feronia limonia*	Rutaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
27	Krisnachura	Royal Poinciana	*Delonix regia*	Fabaceae	Asthetic	√		√		√		√		√	√		√		√		√		√
28	Lebu	Lemon	*Citrus limon*	Rutaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
29	Litchi	Lychee	*Litchi chinensis*	Sapindaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
30	Mahagony	West Indian Mahogany	*Swietenia mahagoni*	Meliaceae	Timber	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
31	Mandar	Indian coral tree	*Erythrina variegata*	Fabaceae	Asthetic											√				√			
32	Mehedi	Henna tree	*Lawsonia inermis*	Lythraceae	Medicinal	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
33	Narikel	Coconut	*Cocos nucifera*	Arecaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
34	Neem	Neem Tree	*Azadirachta indica*	Meliaceae	Timber	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

S/N	Local Name	Common Name	Scientific Name	Family	Use	Dry Season									Wet season								
						A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
35	Peyara	Guava	*Psidium guajava*	Myrtaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
36	Pitali	Shahi	*Trewia polycarpa*	Euphorbiaceae	Asthetic	√		√		√		√		√	√		√	√		√	√		√
37	Rain tree	Rain tree	*Samanea saman*	Fabaceae	Timber	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
38	Sajina	Drumstick tree	*Moringa oleifera*	Moringaceae	Medicinal	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
39	Shishu	Indian rosewood	*Dalbergia sissoo*	Fabaceae	Timber	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
40	Supari	Betel Nut	*Areca catechu*	Arecaceae	Fruit		√				√		√		√	√	√	√	√	√	√	√	√
41	Tal	Palmyra Palm	*Borassus flabellifer*	Arecaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
42	Tetul	Tamarind	*Tamarindus indica*	Fabaceae	Fruit	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
43	Karanja	Indian beech	*Pongamia pinnata*	Fabaceae	Medicinal	√	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√
44	Jarul	Queen's Flower	*Lagerstroemia speciosa*	Lythraceae	Timber	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Source: Field Survey, 2025

A = Gurmar Haor, B = Halir Haor, C = Chaptir Haor, D = Naluar Haor, E = Mrigar Haor, F = Kazir Kola Boro Haor, G = Pathor Chauli Haor, H = Muktarpur Haor, I = Hail Haor

Appendix D-2: List of All Recorded Avifauna Species in the Study Area

S/N	English Name	Local Name	Scientific Name	Family	IUCN Red List Status		Dry Season									Wet Season								
					National*	Global**	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
1	Great Cormorant	Boro Pankouri	*Phalacrocorax carbo*	Phalacrocoracidae	LC	LC	√				√					√	√	√	√	√	√	√	√	√
2	Grey Heron	Dhupni Bok	*Ardea cinerea*	Ardeidae	LC	LC										√	√	√	√	√	√	√	√	√
3	Great White Egret	Boro Boga	*Ardea alba*	Ardeidae	LC	LC	√									√	√	√	√	√	√	√	√	√
4	Black-crowned Night Heron	Kalamatha Nishibok	*Nycticorax nycticorax*	Ardeidae	LC	LC		√			√	√						√		√	√		√	
5	Brown Shrike	Khoira Latora	*Lanius cristatus*	Laniidae	LC	LC	√									√	√	√	√	√	√	√	√	√
6	Long-tailed Shrike	Lenja Latora	*Lanius schach*	Laniidae	LC	LC	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
7	Grey-backed Shrike	Meteypith Latora	*Lanius tephronotus*	Laniidae	LC	LC										√	√				√	√		√
8	Barn Swallow	Pati Ababeel	*Hirundo rustica*	Hirundinidae	LC	LC		√	√	√	√	√				√	√	√	√	√	√	√	√	√
9	Sand Martin	Bali Nakuti	*Riparia riparia*	Hirundinidae	LC	LC										√		√	√		√	√		
10	Dusky Warbler	Kalche Futki	*Phylloscopus fuscatus*	Sylvidae	LC	LC	√	√		√	√		√	√			√	√	√	√	√	√	√	√
11	Inornate Warbler	Holdevru Futki	*Phylloscopus inornatus*	Sylvidae	LC	LC								√			√	√	√	√	√	√	√	√
12	White Wagtail	Dhola Khonjon	*Motacilla alba*	Motacilidae	LC	LC			√			√	√	√	√			√		√	√		√	√
13	Ashy Drongo	Metey Fingey	*Dicrurus leucophaeus*	Dicruridiae	LC	LC	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√
14	Lesser Whistling Duck	Pati Shorali	*Dendrocygna javanica*	Anatidae	LC	LC	√		√	√		√	√		√		√		√	√		√	√	

S/N	English Name	Local Name	Scientific Name	Family	IUCN Red List Status		Dry Season									Wet Season								
					National*	Global**	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
15	Indian Spot-billed Duck	Deshi Meteyhansh	*Anas poecilorhyncha*	Anatidae	LC	LC	√						√	√	√	√	√	√	√	√	√	√	√	√
16	Red-throated Pipit	Lalgola Tulika	*Anthus cervinus*	Motacilidae	LC	LC	√		√	√		√	√	√	√		√	√		√	√		√	
17	Common Hoopoe	Pati Hudhud	*Upupa epops*	Upupidae	LC	LC	√		√				√	√	√			√	√	√	√	√	√	√
18	Common Kestrel	Pati Kestrel	*Falco tinnunculus*	Falconidae	LC	LC	√		√					√	√	√	√	√	√	√	√	√	√	√
19	Common Snipe	Pati Chega	*Gallinago gallinago*	Scolopacidae	LC	LC	√					√	√	√	√		√	√	√	√	√	√	√	√
20	Rock Dove	Gola Paira	*Columba livia*	Columbidae	LC	LC	√					√	√		√	√		√		√	√		√	
21	Eastern Spotted Dove	Tila Ghughu	*Spilopelia chinensis*	Columbidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
22	Eurasian Collared Dove	Eureshio Konthighughu	*Streptopelia decaocto*	Columbidae	LC	LC	√						√	√	√	√	√	√	√	√	√	√	√	√
23	Asian Koel	Eshio Kokil	*Eudynamys scolopaceus*	Cuculidae	LC	LC	√		√				√	√	√	√	√	√	√	√	√	√	√	√
24	Little Cormorant	Cchoto Pankouri	*Microcarbo niger*	Phalacrocoracidae	LC	LC	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√
25	Oriental Darter	Udoyee Goyar	*Anhinga melanogaster*	Anhingidae	NT	NT								√		√	√	√	√	√	√	√	√	√
26	Indian Pond Heron	Deshi Kanibok	*Ardeola grayii*	Ardeidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
27	Little Egret	Cchoto Boga	*Egretta garzetta*	Ardeidae	LC	LC	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√
28	Intermediate Egret	Majhla Boga	*Ardea intermedia*	Ardeidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
29	Black Kite	Bhubon Cheel	*Milvus migrans*	Accipitridae	LC	LC	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√

S/N	English Name	Local Name	Scientific Name	Family	IUCN Red List Status		Dry Season									Wet Season								
					National*	Global**	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
30	Brahminy Kite	Shonkho Cheel	*Haliastur indus*	Accipitridae	LC	LC	√		√	√		√	√	√	√		√	√	√	√	√	√	√	√
31	Spotted Owlet	Khuruley Pecha	*Athene brama*	Strigidae	LC	LC	√		√	√				√	√	√	√	√	√	√	√	√	√	√
32	Common Kingfisher	Pati Macchranga	*Alcedo atthis*	Alcedinidae	LC	LC	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√
33	White-breasted Kingfisher	Dholagola Macchranga	*Halcyon smyrnensis*	Alcedinidae	LC	LC	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√
34	Black-rumped Flameback	Bangla Kath-thokra	*Dinopium benghalense*	Picidae	LC	LC	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√
35	Black Drongo	Kala Fingey	*Dicrurus macrocercus*	Dicruridiae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
36	House Crow	Pati Kak	*Corvus splendens*	Corvidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
37	Jungle Crow	Dar Kak	*Corvus macrorhynchos*	Corvidae	LC	LC	√			√		√	√	√	√	√	√	√	√	√	√	√	√	√
38	Common Tailorbird	Pati Tuntuni	*Orthotomus sutorius*	Sylvidae	LC	LC	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√
39	Ashy Woodswallow	Metey Bonababil	*Artamus fuscus*	Artamidae	LC	LC	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√
40	Red-vented Bulbul	Bangla Bulbul	*Pycnonotus cafer*	Pycnonotidae	LC	LC	√		√			√	√	√	√	√	√	√	√	√	√	√	√	√
41	Asian Pied Starling	Pakra Shalik	*Gracupica contra*	Sturnidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
42	Chestnut-tailed Starling	Khoiralej Kathshalik	*Sturnia malabarica*	Sturnidae	LC	LC	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√

S/N	English Name	Local Name	Scientific Name	Family	IUCN Red List Status		Dry Season									Wet Season								
					National*	Global**	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
43	Common Myna	Bhat Shalik	*Acridotheres tristis*	Sturnidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
44	Oriental Magpie-robin	Udoi Doel	*Copsychus saularis*	Muscicapidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
45	House Sparrow	Pati Chorui	*Passer domesticus*	Passeridae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
46	Asian Openbill	Eshio Shamkhol	*Anastomus oscitans*	Ciconidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
47	Common Iora	Pati Fotikjal	*Aegithina tiphia*	Aegithinidae	LC	LC	√		√	√		√	√		√	√	√		√			√		
48	Rufous Treepie	Khoira Harichacha	*Dendrocitta vagabunda*	Corvidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
49	Lesser Coucal	Bangla Kubo	*Centropus bengalensis*	Cuculidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
50	Striated Grassbird	Dagi Ghashpakhi	*Megalurus palustris*	Sylvidae	LC	LC	√		√	√		√	√		√			√		√	√		√	
51	Paddyfield Pipit	Dhani Tulika	*Anthus rufulus*	Motacilidae	LC	LC	√		√	√		√	√		√		√			√			√	
52	Plaintive Cuckoo	Korun Papia	*Cacomantis merulinus*	Cuculidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
53	Common Hawk-Cuckoo	Pati Chokhgelo	*Hierococcyx varius*	Cuculidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
54	Black-hooded Oriole	Kalamatha Benebou	*Oriolus xanthornus*	Oriolidae	LC	LC	√		√	√		√	√		√	√	√		√	√	√	√	√	√
55	Common Greenshank	Pati Shobujpa	*Tringa nebularia*	Scolopacidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√

S/N	English Name	Local Name	Scientific Name	Family	IUCN Red List Status		Dry Season									Wet Season								
					National*	Global**	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
56	Little Pratincole	Cchoto Babubatan	*Glareola lactea*	Glareolidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
57	Taiga Flycatcher	Taiga Chutki	*Ficedula albicilla*	Muscicapidae	LC	LC	√		√	√		√	√		√	√	√	√	√	√	√	√	√	√
58	Pied Harrier	Pakra Kapashi	*Circus melanoleucos*	Accipitridae	LC	LC											√		√		√		√	
59	Asian Palm Swift	Eshio Talbatashi	*Cypsiurus balasiensis*	Apodidae	LC	LC	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
60	Grey-headed Lapwing	Meteymatha Titi	*Vanellus cinereus*	Charadriidae	LC	LC	√		√			√			√	√	√	√	√	√	√	√	√	√
61	Baya Weaver	Deshi Babui	*Ploceus philippinus*	Ploceidae	LC	LC	√				√				√			√	√		√	√		

Source: Field Survey; August 2025

*IUCN Bangladesh. 2015. Red List of Bangladesh Volume 3: Birds

**IUCN 2022. The IUCN Red List of Threatened Species. Version 2024-2. (https://www.iucnredlist.org/). Status Code: LC=Least Concern, NT=Near Threatened, VU=Vulnerable, EN=Endangered, CR=Critically Endangered

A = Gurmar Haor, B = Halir Haor, C = Chaptir Haor, D = Naluar Haor, E = Mrigar Haor, F = Kazir Kola Boro Haor, G = Pathor Chauli Haor, H = Muktarpur Haor, I = Hail Haor

Appendix D-3: List of Migratory Birds in the Study Area

SN	English Name	Local Name	Scientific Name	Family	IUCN Red List Status	
					National	Global
1.	Common Sandpiper	Pati Batan	*Actitis hypoleucos*	Scolopacidae	LC	LC
2.	Wood Sandpiper	Bon Batan	*Tringa glareola*	Scolopacidae	LC	LC
3.	Spotted Redshank	Tila Lalpa	*Tringa erythropus*	Scolopacidae	LC	LC
4.	Grey-headed Lapwing	Metematha Titi	*Vanellus cinereus*	Charadriidae	LC	LC
5.	Common Snipe	Pati Chega	*Gallinago gallinago*	Scolopacidae	LC	LC
6.	Eurasian Coot	Kalo Koot	*Fulica atra*	Rallidae	LC	LC
7.	Gadwall	Piang Hash	*Mareca strepera*	Anatidae	LC	LC
8.	Common Teal	Pati tilihash	*Anas crecca*	Anatidae	LC	LC
9.	Garganey	Giria Hash	*Spatula querquedula*	Anatidae	LC	LC
10.	Northern Pintail	UttureyLenjahash	*Anas acuta*	Anatidae	LC	LC
11.	Great Cormorant	Boro Pankouri	*Phalacrocorax carbo*	Phalacrocoracidae	LC	LC
12.	Great Crested Grebe	Boro Khopaduburi	*Podiceps cristatus*	Podicipedidae	LC	LC
13.	Oriental Darter	Udoyee Goyar	*Anhinga melanogaster*	Anhingidae	NT	LC
14.	Brown-headed Gull	KhoiramathaGangchil	*Larus brunnicephalus*	Laridae	LC	LC
15.	Glossy Ibis	Khaira Kasteychora	*Plegadisfalcinellus*	Threskiornithidae	LC	LC
16.	Osprey	Machmural	*Pandion haliaetus*	Pandionidae	LC	LC
17.	Eastern Marsh Harrier	PuberPankapashi	*Circus spilonotus*	Accipitridae	LC	LC
18.	White Wagtail	Dhola Khonjon	*Motacilla alba*	Motacillidae	LC	LC
19.	Yellow Wagtail	PoshchimaHoldeyKhonjon	*Motacilla flava*	Motacillidae	LC	LC
20.	Citrine Wagtail	Sitrin Khonjon	*Motacilla citreola*	Motacillidae	LC	LC

SN	English Name	Local Name	Scientific Name	Family	IUCN Red List Status	
					National	Global
21.	Baer's Pochard	Baerer Bhutihash	*Aythya baeri*	Anatidae	CR	CR
22.	Pallas's Fish Eagle	Pallasi Kura-eegol	*Haliaeetus leucoryphus*	Accipitridae	EN	EN
23.	Rufous-rumped Grassbird	Bangla Ghashpakhi	*Graminicola bengalensis*	Sylviidae	EN	NT
24.	Lesser White-fronted Goose	Boro Dholakopal Rajhash	*Anser erythropus*	Anatidae	VU	VU
25.	Eastern Imperial Eagle	Eshio Shahi-eegol	*Aquila heliaca*	Accipitridae	VU	VU
26.	Black-necked Stork	Kalagola Manikjor	*Ephippiorhynchus asiaticus*	Ciconidae	EN	LC
27.	Greater Spotted Eagle	Boro Guti-eegol	*Clanga clanga*	Accipitridae	VU	VU
28.	Falcated Duck	Phuluri Hash	*Mareca falcata*	Anatidae	NT	LC
29.	Ferruginous Duck	Morcherong Bhutihash	*Aythya nyroca*	Anatidae	NT	NT
30.	Bristled Grassbird	Shatadagi Ghashpakhi	*Chaetornis striata*	Sylvidae	EN	VU

Source: ebirds

*IUCN Bangladesh. 2015. Red List of Bangladesh Volume 3: Birds

**IUCN 2022. The IUCN Red List of Threatened Species. Version 2024-2. (https://www.iucnredlist.org/). Status Code: LC=Least Concern, NT=Near Threatened, VU=Vulnerable, EN=Endangered, CR=Critically Endangered

Appendix D-4: List of Herpetofauna in the Study Area

S/N	English Name	Local Name	Scientific Name	Family	IUCN Red List Status		Dry Season									Wet Season								
					National*	Global **	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
Amphibians																								
1	Asian Common Toad	Kuno Bang	*Duttaphrynus melanostictus*	Bufonidae	LC	LC	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
2	Skipper Frog	Katkati Bang	*Euphlyctis cyanophlyctis*	Dicroglossidae	LC	LC										√	√	√	√	√	√	√	√	√
3	Indian Bullfrog	Sona Bang	*Hoplobatrachus tigerinus*	Dicroglossidae	LC	LC	√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
4	Asmat's Cricket Frog	Asmater Jhi-jhi Bang	*Fejervarya asmati*	Dicroglossidae	LC	NE										√	√	√	√	√	√	√	√	√
5	Common Tree Frog	Dorakata Gecho Bang	*Polypedates leucomystax*	Rhacophoridae	LC	LC	√	√	√	√		√	√	√	√	√			√	√		√	√	
6	Ornate Microhylid Frog	Choto Laubichi Bang	*Microhyla ornata*	Microhylidae	LC	LC										√	√	√	√	√	√	√	√	√
7	Marbled Toad	Marble Kuno Bang	*Duttaphrynus stomaticus*	Bufonidae	LC	LC	√	√	√	√	√	√	√	√	√									
8	Green Frog	Shobuj Bang	*Euphlyctis hexadactylus*	Dicroglossidae	LC	LC	√	√	√	√	√	√	√	√	√									
Reptiles																								
1	Banded Krait	Shankhini	*Bungarus fasciatus*	Elapidae	LC	LC	√	√	√	√	√	√	√	√	√									
2	Checkered Keelback	Dhora Shap	*Xenochrophis piscator*	Natricidae	LC	NE	√	√	√	√	√	√	√	√	√	√	√		√	√	√		√	√

S/N	English Name	Local Name	Scientific Name	Family	IUCN Red List Status		Dry Season									Wet Season								
					National*	Global **	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
3	Common House Gecko	Mosrin Tiktiki	*Hemidactylus frenatus*	Gekkonidae	LC	LC	√	√	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√
4	Common Garden Lizard	Roktochosa	*Calotes versicolor*	Agamidae	LC	NE										√	√	√	√	√	√	√	√	√
5	Bronze Grass Skink	Tamatey Anjon	*Eutropis macularia*	Scincidae	LC	NE	√		√	√	√		√	√	√		√	√		√	√	√		√
6	Keeled Grass Skink	Anjon	*Eutropis carinata*	Scincidae	LC	LC	√		√	√	√	√	√	√	√									
7	Peacock Soft-shelled Turtle	Dhum Kachchim	*Nilssonia hurum*	Trionychidae	LC	EN	√																	

Source: Field Survey, August 2025

*IUCN Bangladesh. 2015. Red List of Bangladesh Volume 4: Reptiles and Amphibians

**IUCN 2022. The IUCN Red List of Threatened Species. Version 2024-2. (https://www.iucnredlist.org/). Status Code: LC=Least Concern, NT=Near Threatened, VU=Vulnerable, EN=Endangered, CR=Critically Endangered

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Appendix D-5: List of Terrestrial Mammals in the Study Area

S/N	English Name	Local Name	Scientific Name	Family	IUCN Red List Status		Dry Season									Wet Season								
					National *	Global**	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
Primary Survey Result																								
1	House Mouse	Nengti Idur	*Mus musculus*	Muridae	LC	LC	√	√				√												
2	Indian Flying Fox	Baro Badur	*Pteropus giganteus*	Pteropodidae	LC	LC		√			√		√			√	√	√	√	√	√	√	√	√
3	Indian Pipistrelle	Chamchika	*Pipistrellus coromandra*	Vespertilionidae	LC	LC										√	√	√	√	√	√	√	√	√
4	Golden Jackal	Pati Shial	*Canis aureus*	Canidae	LC	LC										√		√	√		√	√	√	
5	Lesser Bandicoot Rat	Metho-indur	*Bandicota bengalensis*	Muridae	LC	LC		√					√			√	√	√	√	√	√	√	√	√
6	Greater Bandicoot Rat	Dhari Indur	*Bandicota indica*	Muridae	LC	LC										√	√	√	√	√	√	√	√	√
7	Common House Rat	Indur	*Rattus rattus*	Muridae	LC	LC	√	√			√	√				√	√	√	√	√	√	√	√	√
8	Asian House Shrew	Chika	*Suncus murinus*	Soricidae	LC	LC	√			√						√	√	√	√	√	√	√	√	√
9	Small Indian Mongoose	Chhoto Beji	*Herpestes auropunctatus*	Herpestidae	LC	LC										√	√	√	√	√	√	√	√	√
10	Greater Shortnosed fruit bat	Kola Badur	*Cynopterus sphinx*	Pteropodidae	LC	LC	√	√	√	√	√		√	√	√									
11	Common Giant Flying squirrel	Boro Uranta Kathbirali	*Petaurista petaurista*	Sciuridae	DD	LC	√	√	√	√	√		√	√	√									

S/N	English Name	Local Name	Scientific Name	Family	IUCN Red List Status		Dry Season									Wet Season								
					National*	Global**	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
12	White-toothed pygmy shrew	Baman Chika	*Suncus etruscus*	Soricidae	NE	LC	√	√	√	√		√	√	√	√									
Secondary Source Data																								
13	Bengal Fox	Khek Shial	*Vulpes bengalensis*	Canidae	VU	LC																		
14	Fishing Cat	Mechho Biral	*Prionailurus viverrinus*	Felidae	EN	VU																		
15	Eurasian Otter	Mustelidae	*Lutra lutra*	Mustelidae	CR	NT																		

Source: Field Survey, August 2025

*IUCN Bangladesh. 2015. Red List of Bangladesh Volume 2: Mammals.

**IUCN 2022. The IUCN Red List of Threatened Species. Version 2024-2. (https://www.iucnredlist.org/).

Status Code: LC=Least Concern, NT=Near Threatened, VU=Vulnerable, EN=Endangered, CR=Critically Endangered

A = Gurmar Haor, B = Halir Haor, C = Chaptir Haor, D = Naluar Haor, E = Mrigar Haor, F = Kazir Kola Boro Haor, G = Pathor Chauli Haor, H = Muktarpur Haor, I = Hail Haor

Appendix D-6: List of Recorded Fish and Crustacean Species in the Study Area

S/N	Local Name	English Name	Scientific Name	Family	IUCN Red List Status		Occurrence of Species	
					National*	Global**	Dry Season	Wet Season
1.	Madhu pabda	Pabda catfish	*Ompok pabda*	Siluridae	EN	NT	√	√
2.	Chital	Humped Featherback	*Chitala chitala*	Notopteridae	EN	NT		√
3.	Bata	Bata Labeo	*Labeo bata*	Cyprinidae	LC	LC	√	
4.	Gutum	Guntea Loach	*Lepidocephalichthys guntea*	Cobitidae	LC	LC		√
5.	Chapila	Indian river shad	*Gudusia chapra*	Dorosomatidae	VU	LC	√	
6.	Shol	Snakehead	*Channa striatas*	Channidae	LC	LC	√	√
7.	Foli	Humped feathered back	*Notopterus notopterus*	Notopteridae	VU	LC	√	
8.	Gonia	Kuria labeo	*Labeo gonius*	Cyprinidae	NT	LC		√
9.	Guchi	Stripped Spinyeel	*Macrognathus pancalus*	Mastacembelidae	LC	LC		√
10.	Boal	Freshwater shark	*Wallago attu*	Siluridae	VU	NT	√	√
11.	Puti	Olive barb	*Puntius sarana*	Cyprinidae	NE	LC	√	√
12.	Golda Chingri	Giant Freshwater Shrimp	*Macrobrachium rosenbergii*	Palaemonidae	LC	LC		√
13.	Chela	Silver razorbelly minnow	*Salmostoma acinaces*	Cyprinidae	LC	LC		√
14.	Mola	Mola Carplet	*Amblypharyngodon mola*	Cyprinidae	LC	LC	√	√
15.	Teri punti	One spot barb	*Puntius terio*	Cyprinidae	LC	LC		√
16.	Jat punti	Spotfin swamp barb	*Puntius sophore*	Cyprinidae	LC	LC	√	√
17.	Chola punti	Swamp barb	*Puntius chola*	Cyprinidae	LC	LC		√
18.	Bele	Fresh Water Goby	*Glossogobius giuris*	Gobiidae	LC	LC	√	√
19.	Tara Baim	One-stripe Spinyeel	*Macrognathus aculeatus*	Mastacembelidae	NT	NE	√	√
20.	Sal Baim	Tire-track Spinyeel	*Mastacembelus armatus*	Mastacembelidae	EN	NE	√	√
21.	Kucho Chingri		*Macrobrachium japonicum*	Palaemonidae	NE	LC		√

S/N	Local Name	English Name	Scientific Name	Family	IUCN Red List Status		Occurrence of Species	
					National*	Global**	Dry Season	Wet Season
22.	Nuna Tengra	Long-whiskered Catfish	*Mystus gulio*	Bagridae	NT	LC		√
23.	Bujuri Tengra	Tengara Mystus	*Mystus tengara*	Bagridae	LC	LC		√
24.	Rita	Rita	*Rita rita*	Bagridae	EN	LC		√
25.	Meni	Mud Perch	*Nandus nandus*	Nandidae	NT	LC		√
26.	Gulsha Tengra	Bleeker's Mystus	*Mystus bleekeri*	Bagridae	LC	LC	√	√
27.	Rui	Rohu	*Labeo rohita*	Cyprinidae	LC	LC	√	√
28.	Katol	Catla	*Catla catla*	Cyprinidae	LC	NE	√	√
29.	Mrigal	Mrigal Carp	*Cirrhinus cirrhosus*	Cyprinidae	NT	VU	√	√
30.	Shing	Stinging Catfish	*Heteropneustes fossilis*	Heteropneustidae	LC	LC	√	√
31.	Koi mach	Climbing Perch	*Anabas testudineus*	Anabantidae	LC	LC	√	√
32.	Napit koi	Blue perch	*Badis badis*	Badidae	NT	LC	√	
33.	Tilapia	Nile tilapia	*Oreochromis niloticus*	Cichlidae	NE	LC		√
34.	Pangas	Pungas	*Pangasius pangasius*	Pangasiidae	EN	LC		√
35.	Ayre	Long-whiskered Catfish	*Sperata aor*	Bagridae	VU	LC	√	√
36.	Bhangon Bata	Bata Labeo	*Labeo bata*	Cyprinidae	LC	LC		√
37.	Gol chanda	Glass perchlet	*Chanda nama*	Ambassidae	NE	NE	√	√
38.	Lal chanda	Highfin Glassy Perchlet	*Pseudambassis lala*	Ambassidae	LC	NE		√
39.	Darkina	Flying barb	*Esomus danricus*	Cyprinidae	LC	LC		√
40.	Kajuli	Gangetic Ailia	*Ailia coila*	Schilbeidae	LC	NT	√	√
41.	Khalisha		*Colisa fasciata*	Osphronemidae	LC	NE		√
42.	Kajuli	Jamuna Ailia	*Ailia punctata*	Schilbeidae	LC	NE		√
43.	Kachki	Ganges River-sprat	*Corica soborna*	Clupeidae	LC	LC	√	√

S/N	Local Name	English Name	Scientific Name	Family	IUCN Red List Status		Occurrence of Species	
					National*	Global**	Dry Season	Wet Season
44.	Taki	Spotted Snakehead	*Channa punctatus*	Channidae	LC	LC	√	√
45.	Phulo Chela	Finescale Razorbelly Minnow	*Salmostoma phulo*	Cyprinidae	NT	LC		√
46.	Gajar	Giant Snakehead	*Channa marulius*	Channidae	EN	LC		√
47.	Kalibaos	Orangefin labeo	*Labeo calbasu*	Cyprinidae	LC	LC	√	√
48.	Magur	Walking Catfish	*Clarias batrachus*	Clariidae	LC	LC	√	√
49.	Kuchia	Gangetic mudeel	*Monopterus cuchia*	Synbranchidae	VU	LC		√
50.	Kala Bata	Gangetic Latia	*Crossocheilus latius*	Cyprinidae	EN	LC		√
51.	Rani Mach	Bengal Loach	Botia dario	Cobitidae	EN	LC		√
52.	Gutum	Peppered Loach	Lepidocephalichthys guntea	Cobitidae	LC	LC	√	
53.	Potka	Milkspotted puffer	*Chelonodon patoca*	Tetraodontidae	DD	NE		√
54.	Bhout bele	Duckbill Sleeper	Butis butis	Eleotridae	LC	LC		√
55.	Khalisha	Thick-lipped Gourami	*Trichogaster labiosus*	Osphronemidae	LC	LC		√
56.	Tengra	Striped Dwarf Catfish	Mystus vittatus	Bagridae	LC	LC		√

Source: Field Survey, August 2025

*IUCN Bangladesh. 2015. Red List of Bangladesh Volume 5: Freshwater Fishes;

**IUCN 2022. The IUCN Red List of Threatened Species. Version 2024-2. (https://www.iucnredlist.org/)

Status Code: LC=Least Concern, CR= Critically Endangered, NT=Near Threatened; VU=Vulnerable, EN= Endangered; CR=Critically Endangered, NE=Not Evaluated, DD=Data Deficient

A = Gurmar Haor, B = Halir Haor, C = Chaptir Haor, D = Naluar Haor, E = Mrigar Haor, F = Kazir Kola Boro Haor, G = Pathor Chauli Haor, H = Muktarpur Haor, I = Hail Haor

Appendix D-7: List of Phytoplankton found in the Study Area

S/N	Class	Genus	Dry Season	Wet Season
1.	Bacillariophyta	*Melosira sp.*		√
2.	Bacillariophyta	*Synedra sp.*	√	√
3.	Bacillariophyta	*Navicula sp.*	√	√
4.	Bacillariophyta	*Spirogyra sp.*		√
5.	Bacillariophyta	*Volvox sp.*		√
6.	Chlorophyta	*Cladophora spp.*	√	
7.		*Chlorella spp.*	√	√
8.		*Scenedesmus spp.*	√	
9.		*Microspora sp.*		√
10.		*Pediastrum spp*	√	
11.		*Clostrium sp.*		√
12.	Bacillariophyceae	*Fragilaria spp.*	√	
13.	Mediophyceae	*Cyclotella spp.*	√	
14.	Chlorophyta	*Ulothrix sp.*		√
15.	Cyanophyceae	Microcystis spp.	√	
16.	Cyanophyceae	Anabaena spp.	√	√
17.	Cyanophyceae	Oscillatoria spp.	√	√
18.	Cyanophyceae	Aphanizomenon spp.	√	
19.	Cyanophyceae	Dolichospermum spp.	√	
20.	Euglenophyta	*Euglena sp.*	√	√
21.	Pyrrophyta	*Ceratium sp.*	√	√
22.	Dinophyceae	*Peridinium spp.*	√	
23.		*Gymnodinium spp.*	√	

Source: Study team Laboratory Analysis, 2025

Appendix D-8: List of Zooplankton Found in the Study Area

S/N	Group/Order	Genus	Family	Dry Season	Wet Season
24.	Cladocera	*Alonella* sp.	Bosminidae	√	
25.		*Bosmina sp.*		√	√
26.		*Simocephalus sp.*	Daphniidae		√
27.		*Daphnia sp.*		√	√
28.		*Waterflea daphnia*		√	
29.		*Moina sp.*	Moinidae		√
30.		*Diaphanosoma sp.*	Sididae	√	√
31.	Copepods	*Cyclops sp.*	Cyclopidae		√
32.		*Cyclops nauplius*		√	√
33.		*Cyclops sp.*		√	√
34.		*Cyclops varicans*		√	
35.		*Diaptomas sp.*	Diaptomidae	√	
36.		*Diaptomus sp.*			√
37.	Ostracod	*Cypris sp.*	Cyprididae	√	√
38.		*Hypetocypris sp.*		√	
39.		*Cyclocypris sp.*		√	√
40.		*Ostracod sp.*		√	
41.	Rotifers	*Brachionus sp.*	Brachionidae		√
42.		*Trichocerca sp.*	Trichocercidae	√	√
43.		*Eosphora anthadis*	Notommatidae	√	
44.		*Notommata copeus*		√	√
45.		*Brachionus foicicula*	Brachiomidae	√	
46.		*Brachionus caudatus*		√	√
47.	Protozoa	*Keratella sp.*	*Testudinellidae*	√	√
48.		*Testudinellapatina patina*		√	√
49.		*Rotaria sp.*	Philodinidae	√	
50.		*Centropyxis sp.*	*Centropyxidae*	√	√
51.		*Phacus sp.*	*Phacaceae*	√	
52.		*Arcelia sp.*	*Arcellidae*	√	
53.		*Difilugia sp.*	*Difflugiidae*	√	√

Source: Study team Laboratory Analysis, 2025

Appendix D-9: List of Benthic Organisms Identified in the Study Area

S/N	Scientific Name	Group	Dry Season	Wet Season
1.	*Fasciola hepatica*	Platyhelminthes	√	√
2.	*Polycelis* sp.		√	
3.	*Dorylaimuss* sp.	Nematoda	√	√
4.	*Rhabdolaimus* sp.		√	√
5.	*Aphelenchoides* sp.		√	
6.	*Whitmania* sp.	Annelida	√	√
7.	*Chaetogaster* sp.		√	
8.	*Tubifex* sp.		√	√
9.	*Dero* sp.		√	√
10.	*Eiseniella* sp.		√	
11.	*Aeolosoma* sp.		√	√
12.	*Nais* sp.		√	√
13.	*Branchiura* sp.	Arthopoda	√	√
14.	*Chironomus* sp.		√	
15.	*Canthocamptus* sp.		√	√
16.	*Hydracarina* sp.		√	
17.	*Pila globosa*	Mollusca		√
18.	*Viviparus* sp.		√	
19.	*Pila globosa*		√	
20.	*Melania sp.*			√
21.	*Bellamya sp.*			√
22.	*Corbicula* sp.		√	
23.	*Melania sp.*			√

Source: Study Team Laboratory Analysis, 2025

*n = Number of individuals per sample (Grab area = 0.0225 m^2); N = Number of individuals/m^2

Appendix D-10: List of Aquatic Flora Identified in the Study Area

S/N	Local Name	Scientific Name	Family	Dry Season									Wet Season							
				A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
1.	Amrul shak	*Oxalis corniculata*	Oxalidaceae	√		√	√	√		√	√	√									
2.	Arail	*Leersia hexandra*	Poaceae	√			√	√		√	√	√	√		√		√	√	√		
3.	Arrowhead	*Sagittaria sagittifolia*	Alismataceae	√		√		√		√				√	√	√	√	√	√	√	√
4.	Bhuiokra	*Lippia javanica*	Verbenaceae	√	√	√	√		√	√	√	√									
5.	Binna	*Chrysopogon zizanioides*	Poaceae	√	√	√	√	√	√	√	√	√									
6.	Bishkatali	*Polygonum hydropiper*	Polygonaceae										√	√	√	√	√	√	√	√	
7.	Morning glory	*Ipomoea cairica*	Convolvulaceae		√				√		√			√				√		√	
8.	Crested floating heart	*Nymphoides hydrophylla*	Menyanthaceae										√	√	√	√	√	√	√	√	√
9.	Dhol Kalmi	*Ipomoea fistulosa*	Convolvulaceae	√		√		√			√	√	√		√		√			√	√
10.	Edurkanipana	*Wolffia arrhiza*	Araceae	√	√		√	√		√	√	√	√	√		√	√	√		√	
11.	Helencha	*Enhydra fluctuans*	Asteraceae	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
12.	Hogla	*Typha elephantina*	Typhaceae										√	√	√	√	√	√	√	√	√
13.	Indian fern	*Ceratopteris thalictroides*	Pteridaceae		√	√		√		√				√		√	√	√		√	√
14.	Kachu	*Colocasia esculenta*	Araceae	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
15.	Kachuripana	*Eichhornia crassipes*	Pontederiaceae	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
16.	Kalmilata	*Ipomoea aquatica*	Convolvulaceae	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
17.	Kanaibashi	*Commelina benghalensis*	Commelinaceae	√	√		√		√		√	√	√		√		√	√		√	√
18.	Kash	*Saccharum spontaneum*	Poaceae	√	√	√	√	√	√	√	√	√									
19.	Keshordam	*Jussiaea ripens*	Onagraceae		√		√				√		√	√	√		√	√		√	√
20.	Khagra	*Phragmites karka*	Poaceae	√	√	√	√	√	√	√	√	√									

S/N	Local Name	Scientific Name	Family	Dry Season									Wet Season							
				A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
21.	Khudipana	*Lemna minor*	Araceae	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
22.	Kutipana	*Azolla pinnata*	Azollaceae		√		√			√				√		√			√		
23.	Lalshapla	*Nymphaea rubra*	Nymphaeaceae										√	√		√		√	√	√	√
24.	Malancha	*Enhydra sp.*	Asteraceae	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√	√
25.	Najas	*Najas najas*	Hydrocharitaceae										√	√	√	√	√		√	√	√
26.	Nilshapla	*Nymphaea stellata*	Nymphaeaceae										√		√		√		√		√
27.	Panikola	*Ludwigia adscendens*	Onagraceae	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
28.	Ruffled sword plant	*Aponogeton echinatus*	Aponogetonaceae										√	√	√	√	√	√	√	√	√
29.	Shakata chechra	*Scirpus actus*	Cyperaceae	√	√	√	√	√	√	√	√	√		√	√		√	√			√
30.	Shapla	*Nymphaea nouchali*	Nymphaeaceae								√		√	√	√	√	√	√	√	√	√
31.	Sheola	*Hydrilla verticillata*	Hydrocharitaceae										√	√	√	√	√	√	√	√	√
32.	Sheola	*Potamogeton crispus*	Potamogetonaceae										√	√	√	√	√	√	√	√	√
33.	Sheola	*Ottelia alismoides*	Hydrocharitaceae	√		√		√	√		√	√	√	√	√	√	√	√	√	√	√
34.	Shon	*Imperata cylindrica*	Poaceae	√	√	√	√	√	√	√	√	√									
35.	Shusnishak	*Marsilea quadrifolia*	Marsileaceae			√	√		√	√		√	√		√	√		√	√		√
36.	Topapana	*Pistia stratiotes*	Araceae										√	√	√	√	√	√	√	√	√
37.	Water spinach	*Ipomoea aquatica*	Convolvulaceae										√	√	√	√	√	√	√	√	√

Source: Field Survey, 2025

A = Gurmar Haor, B = Halir Haor, C = Chaptir Haor, D = Naluar Haor, E = Mrigar Haor, F = Kazir Kola Boro Haor, G = Pathor Chauli Haor, H = Muktarpur Haor, I = Hail Haor

APPENDIX E

Appendix E: Photographs of Recorded Floral and Faunal Species

Appendix E-1: Photographs of Tree Species Recorded from the Study Area

		
Karanja *(Pongamia pinnata)*	Jarul *(Lagerstroemia speciosa)*	Neem *(Azadirachta indica)*
		
Dumur (*Ficus racemosa*)	Peyara (*Psidium guajava)*	Kadam *(Neolamarckia cadamba)*
		
Jambura (*Citrus maxima*)	Kathal *(Artocarpus heterophyllus)*	Akashmoni (*Acacia auriculiformis*)
		
Elephant Apple (*Dillenia indica*)	Boroi *(Ziziphus mauritiana)*	Mahagony *(Swietenia mahagoni)*

Appendix E-2: Photographs of Observed Bird Species Recorded from Study Area

		
Brahminy Kite (*Haliastur indus*)	Asian Pied Starling (*Sturnus contra*)	Spotted Dove (*Streptopelia chinensis*)
		
Indian Pond Heron (*Ardeola grayii*)	Cattle Egret (*Bubulcus ibis*)	Little Cormorant (*Microcarbo niger*)
		
House Sparrow (*Passer domesticus)*	Black Drongo (*Dicrurus macrocercus*)	House Crow (*Corvus splendens)*
		
Red-vented Bulbul (*Pycnonotus cafer*)	White-breasted Kingfisher (*Halcyon smyrnensis)*	Baya Weaver (*Ploceus philippinus)*

Appendix E-3: Photographs of Observed Herpetofauna Species Recorded from the Study Area

		
Indian Skipper Frog (*Euphlyctis cyanophlyctis*)	Checkered Keelback (*Xenochrophis piscator*)	Indian Green Pond Frog (*Euphlyctis hexadactylus*)

Appendix E-4: Photographs of Some Observed Fish, Prawn, and Shrimp Species from the Study Area

		
Meni (*Nandus nandus*)	Sal Baim (*Mastacembelus armatus*)	Gutum (*Lepidocephalichthys guntea*)
		
Climbing Perch (*Anabas testudineus*)	Pabda (*Ompok pabda*)	Taki *(Channa punctata)*
		
Magur (*Clarias batrachus*)	Potka (*Chelonodon patoca*)	Bhout Bele *(Butis butis)*
		
Tengra (*Mystus vittatus)*	Lal Chanda (*Pseudambassis lala*)	Khalisha *(Trichogaster labiosus)*

		
Shing (*Heteropneustes fossilis*)	Kuchia (*Monopterus cuchia*)	Puti (*Puntius sarana*)

Appendix E-5: Photographs of Different Types of Terrestrial Habitats within the Study Area

		
Homestead Vegetation at Hail Haor	Homestead Vegetation at Halir Haor	Homestead Vegetation at Chaptir Haor
		
Agricultural Land at Hail Haor	Agricultural Land at Muktarpur Haor	Agricultural Land at Pathor Chauli Haor
		
Roadside Plantation at Hail Haor	Roadside Plantation at Chaptir Haor	Roadside Plantation at Gurmar Haor

Appendix E-6: Photographs of Different Aquatic Habitats in the Study Area



Ponds at Muktarpur Haor, Osmaninagar, Sylhet





Riparain Vegetation at Mosha Khola Village at Muktarpur Haor, Osmaninagar, Sylhet



Muktarpur Haor at Muktarpur Haor, Osmaninagar, Sylhet



Chaptir Haor



Kalni River

Appendix E-7: Photographs of Some Observed Aquatic Macrophytes of the Study Area

		
Common Water Hyacinth (*Eichhornia crassipes*)	Alligator Weed (*Alternanthera philoxeroides*)	Water Lettuce (*Pistia stratiotes*)
		
Water Lily *(Nymphaea nouchali)*	Pink Morning Glory (*Ipomoea carnea*)	Taro (*Colocasia esculenta*)
		
Torpedo Grass (*Panicum repens*)	Mixed Aquatic Vegetation [Taro (*Colocasia esculenta*) Alligator Weed (*Alternanthera philoxeroides*), Common Water Hyacinth (*Eichhornia crassipes*), etc.]	Asian Watergrass (*Hygroryza aristata*)

APPENDIX F

Appendix F: Applicable Environmental Standards

The applicable environmental standards for the project are presented in the following subsections.

Appendix F-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 F-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 F-3: Noise Level Standards/Guidelines

Appendix F-3.1: WHO Ambient Noise Level Standards

Category of Area/Receptor	IFC-WHO[36]	
	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.

Appendix F-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, 2025

[36] Guidelines values are for noise levels measured out of doors.

Appendix F-4: Standards for Water Quality

Appendix F-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)

Appendix F-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
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 areas 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.

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						

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)

Appendix F-4.3: Standards for Drinking Water

S/N	Parameters	Unit	Bangladesh Standards	WHO Guideline
1	Aldrin and Dieldrin	µg/L	0.03	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	1.3
7	Benzene (C_6H_6)	mg/L	0.01	0.01
8	Boron (B)	mg/L	1.0	2.4
9	Cadmium (Cd)	mg/L	0.003	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	0.004
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	0.03
15	Tetrachloroethane ($C_2H_2Cl_2$)	mg/L	0.04	0.04
16	Trichloroethane ($C_2H_3Cl_3$)	mg/L	0.02	0.02
	Chlorinated Phenols			
17	Pentachlorophenol	mg/L	0.009	0.009
18	2,4,6 Trichlorophenol	mg/L	0.20	0.2
19	Chlorine (Free Residual)	mg/L	0.20	5
20	Chloroform ($CHCl_3$)	mg/L	0.09	0.3
21	Chromium (Total Cr)	mg/L	0.05	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	2.0
26	Cyanide (CN)	mg/L	0.05	0.0006
27	Fluoride	mg/L	1.0	1.5
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	-

S/N	Parameters	Unit	Bangladesh Standards	WHO Guideline
31	Lead (Pb)	mg/L	0.01	0.01
32	Magnesium (Mg)	mg/L	30–35	-
33	Manganese (Mn)	mg/L	0.40	-
34	Mercury (Hg)	mg/L	0.001	0.006
35	Nickel (Ni)	mg/L	0.05	0.07
36	Nitrate (NO_3^-)	mg/L	45	50
37	Nitrite (NO_2^-)	mg/L	1.0	3.0
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	0.04
46	Silver (Ag)	mg/L	0.02	-
47	Sodium (Na)	mg/L	200	50
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 coastal areas, the standard for chlorine is 1000 mg/L.

Source: The Environment Conservation Rules, 2023 (Schedule-2) and WHO Guidelines for Drinking-water Quality, 2017

Appendix F-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

S/N	Parameter	Unit	Standard Limit
4	COD	mg/L	125
5	Suspended Solids (SS)	mg/L	100
6	Oil and Grease	mg/L	10
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 F-6: Standards for Waste from Industrial Units or Projects

S/N	Parameter	Unit	Guideline Values		
			National Standards		
			Place 1[37]	Place 2[38]	Place 3[39]
1	Ammoniacal Nitrogen (as elementary N)	mg/L	50	50	50
2	Ammonia (as free ammonia)	mg/L	5	5	5
3	Arsenic (as As)	mg/L	0.2	0.2	0.2
4	BOD_5 at 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
7	Chloride (Cl^-)	mg/L	600	600	-
8	Chromium (as total Cr)	mg/L	0.5	1.0	1.0
9	COD	mg/L	200	400	250
10	Chromium (as hexavalent Cr)	mg/L	0.1	2.0	1.0
11	Copper (as Cu)	mg/L	3.0	3.0	3.0
14	Fluoride (as F)	mg/L	2	15	10
15	Sulfide (as S)	mg/L	1	-	5
16	Iron (as Fe)	mg/L	3	3	3
17	Iron	mg/L	-	-	-
18	Total Kjeldahl Nitrogen (as N)	mg/L	100	-	100
19	Total Nitrogen	mg/L	-	-	-
20	Lead (as Pb)	mg/L	0.1	1.0	2.0
21	Manganese (as Mn)	mg/L	2.0	2.0	2.0

[37] Inland surface water.

[38] Public sewerage system connected to treatment at second stage.

[39] Coastal areas.

S/N	Parameter	Unit	Guideline Values		
			National Standards		
			Place 1[37]	Place 2[38]	Place 3[39]
22	Mercury (as Hg)	mg/L	0.01	0.01	0.01
23	Nickel (as Ni)	mg/L	1.0	2.0	5.0
24	Nitrate (as elementary N)	mg/L	10.0	-	20.0
25	Oil and Grease	mg/L	10	20	20
26	Phenolic Compounds (as C_6H_5OH)	mg/L	1.0	5.0	5.0
27	Dissolved Phosphorus (as P)	mg/L	5.0	-	-
28	Total Phosphorus	mg/L	-	-	-
29	Radioactive substance a. Alpha particle radiation b. Beta particle adiation	µCi/L	To be specified by Bangladesh Atomic Energy Commission		
30	pH	-	6-9	6-9	6-9
31	Selenium (as Se)	mg/L	0.05	0.05	0.05
32	Zinc (as Zn)	mg/L	5	15	15
34	Temperature	°C	Not more than 5°C of waterbody temperature	-	Not more than 5°C of waterbody temperature
36	Suspended Solids (SS)	mg/L	100	500	100
37	Cyanide (as Cn)	mg/L	0.1	2.0	0.2
38	Cyanide (free)	mg/L	-	-	-
39	Cyanide (total)	mg/L	-	-	-
40	Total Residual Chlorine	mg/L	1.0	-	1.2
41	Bioassay test[40]	-	90% of fisheries can survive in treated wastewater even after 96 hours		

Source: The Environment Conservation Rules, 2023 (Schedule-4)

[40] Only applicable for pesticide and pharmaceutical industries.

APPENDIX G

Appendix G: Laboratory Analysis Reports

Appendix G-1: Laboratory Analysis Report of Ambient Air Quality

Adroit Environment Consultants Ltd.

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AECL LABORATORY ANALYSIS REPORT
AMBIENT AIR QUALITY TEST REPORT

Project Name : **Baseline Survey for Preparatory Survey for Haor Area Resilience & Development Project**
Project Location : **Kishoreganj, Habiganj, Netrokona, Sunamganj, Sylhet & Moulvibazar**

Description of Sample : Ambient Air
Sample Collector : Adroit Environment Consultants Ltd. (Monitoring team)
Sampling date : 24th May– 01st June, 2025
Reporting date : 16th June, 2025

Description of Analysis

SN	Locations	Parameters						
		$PM_{2.5}$	PM_{10}	SPM	SO_2	NO_x	CO	O_3
1.	Gurmar Haor	30.47	63.21	98.16	1.01	1.37	0.5	15.36
2.	Halir Haor	35.37	62.48	100.76	1.22	1.23	1	19.55
3.	Chaptir Haor	33.14	60.43	98.51	1.28	1.37	1	18.21
4.	Naluar Haor	34.76	64.14	104.28	1.52	1.01	1	22.17
5.	Mrigar Haor	30.61	61.29	96.34	1.06	1.23	0.5	14.56
6.	Kazir Kola Boro Haor	36.19	68.55	108.93	1.13	1.24	1	13.74
7.	Pathor Chauli Haor	30.19	63.34	97.27	1.23	1.21	1	10.89
8.	Muktarpur Haor	32.25	60.34	96.43	1.09	1.12	1	16.14
9.	Hail Haor	33.62	62.98	99.87	1.17	1.07	0.5	14.98
Unit		$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	PPM	$\mu g/m^3$
Test Duration (hour)		24	24	24	24	24	1	8
Method		Gravimetric	Gravimetric	Gravimetric	West-Geake	Jacob and Hochheiser	CO Meter	O_3 Meter
Air Pollution Control Rules, 2022		65	150	NF	80	80	20	100
IFC/WB Standard		75	150	NF	125	NF	NF	160

(NF – not found)

Comment: *From the aforementioned results it is discernible that all the parameters are inside the allowable limits.*

Md. Faisal Bin Mahmud
Sr. Chemist

Shanjana Haider
Chief Operating Officer

House 01, Road 16, Sector 07, Uttara, Dhaka-1230 Tel: +88-02-9116712-13
Mob: 01733376609-10, Fax: +88-02-9116714, Email: nukhan05@gmail.com, aecldhaka@gmail.com
www.aecl-bd.org

Appendix G-2: Laboratory Analysis Report of Ambient Noise Level

Adroit Environment Consultants Ltd.

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AECL LABORATORY ANALYSIS REPORT
AMBIENT NOISE QUALITY TEST REPORT

Project Name : **Baseline Survey for Preparatory Survey for Haor Area Resilience & Development Project**
Project Location : **Kishoreganj, Habiganj, Netrokona, Sunamganj, Sylhet & Moulvibazar**

Description of Sample : Ambient Noise
Sample Collector : Adroit Environment Consultants Ltd. (Monitoring team)
Sampling date : 24th May– 01st June, 2025
Reporting date : 16th June, 2025

Description of Analysis

SN.	Sample ID	Concentration present (LA_{eq}) dBA.					
		Day Time			Night Time		
		Minimum	Maximum	LA_{eq}	Minimum	Maximum	LA_{eq}
1.	Gurmar Haor	38.2	60.1	44.2	36.1	53.3	40.1
2.	Halir Haor	39.7	62.4	45.2	38.3	56.1	42.5
3.	Chaptir Haor	38.9	60.2	43.3	35.4	54.0	41.4
4.	Naluar Haor	37.2	56.0	42.4	36.3	52.4	39.8
5.	Mrigar Haor	41.7	60.2	45.3	37.4	50.1	41.1
6.	Kazir Kola Boro Haor	40.0	63.7	44.7	39.1	53.8	41.7
7.	Pathor Chauli Haor	39.5	61.3	43.2	36.6	52.3	40.9
8.	Muktarpur Haor	38.4	57.4	45.2	37.3	53.2	40.2
9.	Hail Haor	38.8	58.6	42.1	36.7	52.4	41.3
DoE (Bangladesh) Standard for Residential area		**55**			**45**		
IFC/International Standard for Residential; institutional; educational		**55**			**45**		

Note: *This noise data was usually accomplished by – CEM Sound Level Meter (Model – DT 8850)*

Md. Faisal Bin Mahmud
Sr. Chemist

Shanjana Haider
Chief Operating Officer

House 01, Road 16, Sector 07, Uttara, Dhaka-1230 Tel: +88-02-9116712-13
Mob: 01733376609-10, Fax: +88-02-9116714, Email: nukhan05@gmail.com, aecldhaka@gmail.com
www.aecl-bd.org

Appendix G-3: Laboratory Analysis Report of Surface Water Quality

Appendix G-3.1: Laboratory Analysis Report of Surface Water Quality during Dry Season

Adroit Environment Consultants Ltd.
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AECL LABORATORY ANALYSIS REPORT
SURFACE WATER QUALITY TEST REPORT

Project Name : **Baseline Survey for Preparatory Survey for Haor Area Resilience & Development Project**
Project Location : **Kishoreganj, Habiganj, Netrokona, Sunamganj, Sylhet & Moulvibazar**

Description of Sample : Surface Water Quality
Sample Collector : Adroit Environment Consultants Ltd. (Monitoring team)
Sampling date : 24th May– 01st June, 2025
Reporting date : 15th June, 2025

Description of Analysis

Locations	Concentration Present				
	Temp.	**pH**	**DO**	**TDS**	**EC**
Gurmar Haor	22.3	7.05	5.23	70	110
Halir Haor	20.2	7.09	6.19	84	88
Chaptir Haor	22.8	6.91	5.55	69	96
Naluar Haor	21.6	7.12	5.98	77	106
Mrigar Haor	20.8	7.03	6.28	81	114
Kazir Kola Boro Haor	21.1	7.18	6.11	92	124
Pathor Chauli Haor	21.8	7.00	6.27	111	122
Muktarpur Haor	22.4	6.87	5.98	102	119
Hail Haor	22.5	7.11	5.42	89	88
Unit	°C	-	mg/l	mg/l	µS/cm
Method	Mercury filled thermometer	pH Meter	USEPA 360.1:1971, SM 4500-O (23rd Edition)	TDS meter	USEPA 120.1:1982
DoE Standard according to ECR, 2023 (Schedule 2-Ka-1)	NF	6-9	≥5	1000	NF

(ECR – Environment Conservation Rules, 2023; DoE – Department of Environment
USEPA – U. S. Environmental Protection Agency; SM – Standard Methods set by National Environmental Method Index, United States)

Md. Faisal Bin Mahmud
Sr. Chemist

Shanjana Haider
Chief Operating Officer

House 01, Road 16, Sector 07, Uttara, Dhaka-1230 Tel: +88-02-9116712-13
Mob: 01733376609-10, Fax: +88-02-9116714, Email: nukhan05@gmail.com, aecldhaka@gmail.com
www.aecl-bd.org

BUETCE 056 1373

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/

ENVIRONMENTAL ENGINEERING LABORATORY

BRTC

Bureau of Research, Testing & Consultation

BRTC No. : 1103-54208 /24-25/CE; Dt: 3/6/2025 Ref. No.: AECL/Lab/2025/06/132; Dt: 1/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Surface Water

Sample Id : SW1 Source: Surface Water

Date of Test : 3/6/2025 - 28/6/2025 Location: Gurmar Haor, Sunamganj

8F9BHCKZQ

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TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Inland Surface Water use for Fisheries (ECR 2023)	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	13.50	---	SM 2130 B	0.01
2	Chloride (Cl-)	mg/l	7	---	SM 4500-Cl-	1
3	Ammonia (NH3)	mg/l	0.38	---	SM 4500 – NH3 B	0.017
4	Nitrate (NO3)	mg/l	1.77	---	SM 4500-NO3-N-F	---
5	Total Suspended Solids (TSS)	mg/l	16	---	SM 2540 B - D	5
6	Biochemical Oxygen Demand (BOD5)	mg/l	1.5	<6.0	SM 5210 B; SM 5210 D	0.2
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	27	50	SM 5220 D	0.2
8	Total Coliform(TC)	CFU/100ml	340	<5000	SM 9221 E	0
9	---	---	---	---	---	---
10	---	---	---	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Department of Civil Engineering ★ BUET, Dhaka-1000, Bangladesh

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed By:
28/06/25

Dr. Rowshan Mamtaz
Professor,Dept. of Civil Engg., BUET, Dhaka-1000

Page 1

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)
DEPARTMENT OF CIVIL ENGINEERING
Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/
ENVIRONMENTAL ENGINEERING LABORATORY

BRTC Bureau of Research, Testing & Consultation

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BRTC No. : 1103-54208 /24-25/CE; Dt: 3/6/2025 **Ref. No.:** AECL/Lab/2025/06/133; Dt: 1/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Surface Water
Sample Id : SW1 **Source:** Surface Water
Date of Test : 3/6/2025 - 28/6/2025 **Location:** Halir Haor, Sunamganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Inland Surface Water use for Fisheries (ECR 2023)	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	7.71	---	SM 2130 B	0.01
2	Chloride (Cl-)	mg/l	6	---	SM 4500-Cl-	1
3	Ammonia (NH3)	mg/l	0.22	---	SM 4500 – NH3 B	0.017
4	Nitrate (NO3)	mg/l	1.77	---	SM 4500-NO3-N-F	---
5	Total Suspended Solids (TSS)	mg/l	7	---	SM 2540 B - D	5
6	Biochemical Oxygen Demand (BOD5)	mg/l	4.5	<6.0	SM 5210 B; SM 5210 D	0.2
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	36	50	SM 5220 D	0.2
8	Total Coliform(TC)	CFU/100ml	390	<5000	SM 9221 E	0
9	---	---	---	---	---	---
10	---	---	---	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed By:
28/06/25
Dr. Rowshan Mamtaz
Professor,Dept. of Civil Engg., BUET, Dhaka-1000

Department of Civil Engineering ★ BUET, Dhaka-1000, Bangladesh ★

Page 1

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/

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HTRX8HKJg

BRTC No. : 1103-54208 /24-25/CE; Dt: 3/6/2025 **Ref. No.:** AECL/Lab/2025/06/141; Dt: 1/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Surface Water **Source:** Surface Water

Sample Id : SW1 **Location:** Chaptir Haor, Sunamganj

Date of Test : 3/6/2025 - 28/6/2025

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Inland Surface Water use for Fisheries (ECR 2023)	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	1.52	---	SM 2130 B	0.01
2	Chloride (Cl-)	mg/l	7	---	SM 4500-Cl-	1
3	Ammonia (NH3)	mg/l	0.27	---	SM 4500 – NH3 B	0.017
4	Nitrate (NO3)	mg/l	1.77	---	SM 4500-NO3-N-F	---
5	Total Suspended Solids (TSS)	mg/l	<MDL	---	SM 2540 B - D	5
6	Biochemical Oxygen Demand (BOD5)	mg/l	2	<6.0	SM 5210 B; SM 5210 D	0.2
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	32	50	SM 5220 D	0.2
8	Total Coliform(TC)	CFU/100ml	280	<5000	SM 9221 E	0
9	---	---	---	---	---	---
10	---	---	---	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed By:
28/06/25

Dr. Rowshan Mamtaz
Professor,Dept. of Civil Engg., BUET, Dhaka-1000

Department of Civil Engineering * BUET, Dhaka-1000, Bangladesh

Page 1

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/

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BRTC No. : **1103-54208 /24-25/CE; Dt: 3/6/2025** **Ref. No.:** AECL/Lab/2025/06/135; Dt: 1/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Surface Water

Sample Id : **SW1** **Source:** Surface Water

Date of Test : 3/6/2025 - 28/6/2025 **Location:** Naluar Haor, Sunamganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Inland Surface Water use for Fisheries (ECR 2023)	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	3.29	---	SM 2130 B	0.01
2	Chloride (Cl-)	mg/l	7	---	SM 4500-Cl-	1
3	Ammonia (NH3)	mg/l	2.77	---	SM 4500 – NH3 B	0.017
4	Nitrate (NO3)	mg/l	1.77	---	SM 4500-NO3-N-F	---
5	Total Suspended Solids (TSS)	mg/l	9	---	SM 2540 B - D	5
6	Biochemical Oxygen Demand (BOD5)	mg/l	2	<6.0	SM 5210 B; SM 5210 D	0.2
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	38	50	SM 5220 D	0.2
8	Total Coliform(TC)	CFU/100ml	240	<5000	SM 9221 E	0
9	---	---	---	---	---	---
10	---	---	---	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed By:
28/06/25

Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

Department of Civil Engineering * BUET, Dhaka-1000, Bangladesh

Page 1

BUETCE 0551122

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/

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BRTC No. : **1103-54208 /24-25/CE; Dt: 3/6/2025** **Ref. No.:** AECL/Lab/2025/06/136; Dt: 1/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Surface Water

Sample Id : **SW1** **Source:** Surface Water

Date of Test : 3/6/2025 - 28/6/2025 **Location:** Mrigar Haor, Kishoreganj

34 fhLmXmWgR

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Inland Surface Water use for Fisheries (ECR 2023)	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	**4.79**	---	SM 2130 B	0.01
2	Chloride (Cl-)	mg/l	**8**	---	SM 4500-Cl-	1
3	Ammonia (NH3)	mg/l	**0.27**	---	SM 4500 – NH3 B	0.017
4	Nitrate (NO3)	mg/l	**1.77**	---	SM 4500-NO3-N-F	---
5	Total Suspended Solids (TSS)	mg/l	**7**	---	SM 2540 B - D	5
6	Biochemical Oxygen Demand (BOD5)	mg/l	**2.5**	<6.0	SM 5210 B; SM 5210 D	0.2
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	**27**	50	SM 5220 D	0.2
8	Total Coliform(TC)	CFU/100ml	**200**	<5000	SM 9221 E	0
9	---	---	**---**	---	---	---
10	---	---	**---**	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned *by*:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed By:
Rowshan Mamtaz 28/06/25

Dr. Rowshan Mamtaz
Professor,Dept. of Civil Engg., BUET, Dhaka-1000

Department of Civil Engineering BUET, Dhaka-1000, Bangladesh

BRTC BUET

BUETCE 056137B

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/

BRTC Bureau of Research, Testing & Consultation

ENVIRONMENTAL ENGINEERING LABORATORY

BRTC No. : **1103-54208 /24-25/CE; Dt: 3/6/2025** **Ref. No.:** AECL/Lab/2025/06/137; Dt: 1/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Surface Water

Sample Id : **SW1** **Source:** Surface Water

Date of Test : 3/6/2025 - 28/6/2025 **Location:** Kazir Kola Boro Haor, Kishoreganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Inland Surface Water use for Fisheries (ECR 2023)	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	14.40	---	SM 2130 B	0.01
2	Chloride (Cl-)	mg/l	8	---	SM 4500-Cl-	1
3	Ammonia (NH3)	mg/l	0.33	---	SM 4500 – NH3 B	0.017
4	Nitrate (NO3)	mg/l	2.21	---	SM 4500-NO3-N-F	---
5	Total Suspended Solids (TSS)	mg/l	36	---	SM 2540 B - D	5
6	Biochemical Oxygen Demand (BOD5)	mg/l	1	<6.0	SM 5210 B; SM 5210 D	0.2
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	21	50	SM 5220 D	0.2
8	Total Coliform(TC)	CFU/100ml	190	<5000	SM 9221 E	0
9	---	---	---	---	---	---
10	---	---	---	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed by:

Dr. Rowshan Mamtaz 28/06/25
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

Department of Civil Engineering ★ BUET, Dhaka-1000, Bangladesh

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DEPARTMENT OF CIVIL ENGINEERING
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36
T6d7PbNRN

BRTC No. : 1103-54208 /24-25/CE; Dt: 3/6/2025 **Ref. No.:** AECL/Lab/2025/06/138; Dt: 1/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Surface Water **Source:** Surface Water
Sample Id : SW1 **Location:** Pathor Chauli Haor, Sylhet
Date of Test : 3/6/2025 - 28/6/2025

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Inland Surface Water use for Fisheries (ECR 2023)	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	7.85	---	SM 2130 B	0.01
2	Chloride (Cl-)	mg/l	6	---	SM 4500-Cl-	1
3	Ammonia (NH3)	mg/l	0.31	---	SM 4500 – NH3 B	0.017
4	Nitrate (NO3)	mg/l	1.77	---	SM 4500-NO3-N-F	---
5	Total Suspended Solids (TSS)	mg/l	17	---	SM 2540 B - D	5
6	Biochemical Oxygen Demand (BOD5)	mg/l	2	<6.0	SM 5210 B; SM 5210 D	0.2
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	25	50	SM 5220 D	0.2
8	Total Coliform(TC)	CFU/100ml	1110	<5000	SM 9221 E	0
9	---	---	---	---	---	---
10	---	---	---	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed By:

Dr. Rowshan Mamtaz 28/06/25
Professor,Dept. of Civil Engg., BUET, Dhaka-1000

Department of Civil Engineering ★ BUET, Dhaka-1000, Bangladesh ★

Page 1

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/

ENVIRONMENTAL ENGINEERING LABORATORY

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37

ASYAMEAWG

BRTC No. : **1103-54208 /24-25/CE; Dt: 3/6/2025** **Ref. No.:** AECL/Lab/2025/06/139; Dt: 1/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Surface Water **Source:** Surface Water

Sample Id : **SW1** **Location:** Muktarpur Haor, Sylhet

Date of Test : 3/6/2025 - 28/6/2025

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Inland Surface Water use for Fisheries (ECR 2023)	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	1.28	---	SM 2130 B	0.01
2	Chloride (Cl-)	mg/l	8	---	SM 4500-Cl-	1
3	Ammonia (NH3)	mg/l	0.36	---	SM 4500 – NH3 B	0.017
4	Nitrate (NO3)	mg/l	1.33	---	SM 4500-NO3-N-F	---
5	Total Suspended Solids (TSS)	mg/l	5	---	SM 2540 B - D	5
6	Biochemical Oxygen Demand (BOD5)	mg/l	2	<6.0	SM 5210 B; SM 5210 D	0.2
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	30	50	SM 5220 D	0.2
8	Total Coliform(TC)	CFU/100ml	1260	<5000	SM 9221 E	0
9	---	---	---	---	---	---
10	---	---	---	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed By:

Dr. Rowshan Mamtaz 28/06/25
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

Department of Civil Engineering ★ BUET, Dhaka-1000, Bangladesh ★

Page 1

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/

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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC No. : **1103-54208 /24-25/CE; Dt: 3/6/2025** **Ref. No.:** AECL/Lab/2025/06/151; Dt: 1/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Surface Water

Sample Id : **SW1** **Source:** Surface Water

Date of Test : 3/6/2025 - 28/6/2025 **Location:** Hail Haor, Moulvibazar

TgbbnBnCM

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Inland Surface Water use for Fisheries (ECR 2023)	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	27.40	---	SM 2130 B	0.01
2	Chloride (Cl-)	mg/l	2	---	SM 4500-Cl-	1
3	Ammonia (NH3)	mg/l	0.92	---	SM 4500 – NH3 B	0.017
4	Nitrate (NO3)	mg/l	2.66	---	SM 4500-NO3-N-F	---
5	Total Suspended Solids (TSS)	mg/l	18	---	SM 2540 B - D	5
6	Biochemical Oxygen Demand (BOD5)	mg/l	2	<6.0	SM 5210 B; SM 5210 D	0.2
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	26	50	SM 5220 D	0.2
8	Total Coliform(TC)	CFU/100ml	1370	<5000	SM 9221 E	0
9	---	---	---	---	---	---
10	---	---	---	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed By:

Dr. Rowshan Mamtaz 28/06/25
Professor,Dept. of Civil Engg., BUET, Dhaka-1000

Department of Civil Engineering ★ BUET, Dhaka-1000, Bangladesh ★

Page 1

Appendix G-3.2: Laboratory Analysis Report of Surface Water Quality during Wet Season

Form No. QSF-22 Revision No. 14 Revision Date: 04 November, 2024

জীবনের জন্য বিজ্ঞান

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-427 of Analytical Service Cell, BCSIR, 14/09/2025

Lab/Sample ID : A-362-370

Client's Details : Md. Shazedur Rahman, Consultant EQMS

Number of Sample : 09 (Nine)

Sample Description : Request for Testing Surface Water Quality, Date: 31 August 2025

Test Commencement Date : 14/09/2025

Test Completion Date : 19/10/2025

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-362	Surface Water (SW-1, Gurmar Haor)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
		Total Coliform (MPN/100 ml)	< 1.8*	9221B-C
		Chloride (Cl)	1.89 mg/L	4110.B
A-363	Surface Water (SW-2, Halir Haor)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
		Total Coliform (MPN/100 ml)	2.0	9221B-C
		Chloride (Cl)	1.22 mg/L	4110.B
A-364	Surface Water (SW-3, Chaptir Haor)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
		Total Coliform (MPN/100 ml)	< 1.8*	9221B-C
		Chloride (Cl)	3.18 mg/L	4110.B
A-365	Surface Water (SW-4, Naular Haor)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
		Total Coliform (MPN/100 ml)	< 1.8*	9221B-C
		Chloride (Cl)	2.15 mg/L	4110.B

Page 1 of 2

Note:

a. The results reported here are based only on the supplied samples in this laboratory.
b. Any complain about test report will not be acceptable after one month from the date of issuing of the said report.
c. This report/result shall not be reproduced/published without prior approval of the authority.

Analytical Service Cell
Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
Telephone: 9671108, Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Wedsite: www.bcsir.gov.bd

Form No. QSF-22 Revision No. 14 Revision Date: 04 November, 2024

জীবনের জন্য বিজ্ঞান

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-366	Surface Water (SW-5, Mrigar Haor)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
		Total Coliform (MPN/100 ml)	< 1.8*	9221B-C
		Chloride (Cl)	2.38 mg/L	4110.B
A-367	Surface Water (SW-6, Kazir Kola Boro Haor	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
		Total Coliform (MPN/100 ml)	< 1.8*	9221B-C
		Chloride (Cl)	19.7 mg/L	4110.B
A-368	Surface Water (SW-7, Pathor Chauli Haor	BOD (Biological Oxygen Demand)	0.24 mg/L	5210.B
		Total Coliform (MPN/100 ml)	4.0	9221B-C
		Chloride (Cl)	8.71 mg/L	4110.B
A-369	Surface Water (SW-8, Muktarpur Haor)	BOD (Biological Oxygen Demand)	0.40 mg/L	5210.B
		Total Coliform (MPN/100 ml)	9.3	9221B-C
		Chloride (Cl)	1.60 mg/L	4110.B
A-370	Surface Water (SW-9, Hail Haor)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
		Total Coliform (MPN/100 ml)	2.0	9221B-C
		Chloride (Cl)	6.16 mg/L	4110.B

*As per MPN (most probable number) chart (APHA-22nd edition), MPN <1.8 indicates absence of test organism in the supplied sample.

19.10.25
Analyst
Md. Al-Amin
Scientific Officer
Institute of National Analytical Research and Service (INARS)
BCSIR, Dhaka-1205

19.10.25
Supervisor
Dr. Muhammad Abdullah Al-Mansur
Principal Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka-1205

19/10/25
Director
Dr. Md. Salim Khan
Director (Additional In-Charge)
Institute of National Analytical Research and Service (INARS)
BCSIR, Dhaka-1205.

Note:
a. The results reported here are based only on the supplied samples in this laboratory.
b. Any complain about test report will not be acceptable after one month from the date of issuing of the said report.
c. This report/result shall not be reproduced/published without prior approval of the authority.

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Telephone: 9671108, Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Wedsite: www.bcsir.gov.bd

Ref: EQMS/Water Quality/ 20251221974

EQMS WET LABORATORY

Test Results of Surface Water Quality

Project Name : Environmental Impact Assessment for the Haor Area Resilience and Development Project (HARD Project)
Description of Sample : Surface Water (SW-1) / Gurmar Haor
Sample Collector : Tofazzal Hossain & Syed Galib Shah
Sampling Date : 20.08.2025 - 30.08.2025
Reporting Date : 22.10.2025

Description of Analysis:

Properties	SL	Testing Specification	Method	Unit	Test Result	Bangladesh Standard
Physical Property		Temperature	Ion electrode method	°C	25.6	--
		Electric Conductivity	Ion electrode method	µS/cm	50	--
Chemical Properties		DO	Ion electrode method	mg/L	6.4	≥5
		pH	Ion electrode method	--	6.03	6-9
		COD	USEPA 410.4	mg/L	0.9	50
		TSS	Gravimetric Analysis	mg/L	8.0	--
		TDS	Ion electrode method	ppm	30	--
		Ammonia	Nassler method	mg/L	0.02	0.3
		Nitrate	Cadmium Reduction	mg/L	1.3	7.0
		Turbidity	Turbidimetric Photoelectric Method	NTU	11.1	--

**Bangladesh Environment Conservation Rules, 2023 [Schedule 2(A)]; DO: Dissolved Oxygen; TSS: Total Suspended Solids; TDS: Total Dissolved Solids; COD: Chemical Oxygen Demand.*

EQMS Consulting Limited

Prepared By
Laboratory Technical Manager
Ahmed Jubaer

Test Performed By
Laboratory Chemist
Al- Hasan Kabir

Approved By
Laboratory Quality Manager
Md. Saifur Rahman

Head Office: H # 53, R # 04, B # C, Banani, Dhaka -1213, Bangladesh
Lab Office: Flat # F1, House # Ta-134/A, Boishakhi Sarani, Gulshan-Badda Link Road, Dhaka – 1212
Toronto Office: 7 Arnot Street, Scarborough Ontario, M1K4B5 Canada

Ref: EQMS/Water Quality/ 20251221975

EQMS WET LABORATORY

Test Results of Surface Water Quality

Project Name : Environmental Impact Assessment for the Haor Area Resilience and Development Project (HARD Project)
Description of Sample : Surface Water (SW-2)/ Halir Haor
Sample Collector : Tofazzal Hossain & Syed Galib Shah
Sampling Date : 20.08.2025 - 30.08.2025
Reporting Date : 22.10.2025

Description of Analysis:

Properties	SL	Testing Specification	Method	Unit	Test Result	Bangladesh Standard
Physical Property		Temperature	Ion electrode method	°C	25.4	--
		Electric Conductivity	Ion electrode method	µS/cm	60	--
Chemical Properties		DO	Ion electrode method	mg/L	6.6	≥5
		pH	Ion electrode method	--	6.04	6-9
		COD	USEPA 410.4	mg/L	0.7	50
		TSS	Gravimetric Analysis	mg/L	6.5	--
		TDS	Ion electrode method	ppm	30	--
		Ammonia	Nassler method	mg/L	0.01	0.3
		Nitrate	Cadmium Reduction	mg/L	1.1	7.0
		Turbidity	Turbidimetric Photoelectric Method	NTU	23.0	--

**Bangladesh Environment Conservation Rules, 2023 [Schedule 2(A)]; DO: Dissolved Oxygen; TSS: Total Suspended Solids; TDS: Total Dissolved Solids; COD: Chemical Oxygen Demand.*

EQMS Consulting Limited

Prepared By
Laboratory Technical Manager
Ahmed Jubaer

Test Performed By
Laboratory Chemist
Al- Hasan Kabir

Approved By
Laboratory Quality Manager
Md. Saifur Rahman

Head Office: H # 53, R # 04, B # C, Banani, Dhaka -1213, Bangladesh
Lab Office: Flat # F1, House # Ta-134/A, Bolshakhi Sarani, Gulshan-Badda Link Road, Dhaka – 1212
Toronto Office: 7 Arnot Street, Scarborough Ontario, M1K4B5 Canada

Ref: EQMS/Water Quality/ 20251221976

EQMS WET LABORATORY

Test Results of Surface Water Quality

Project Name : Environmental Impact Assessment for the Haor Area Resilience and Development Project (HARD Project)
Description of Sample : Surface Water (SW-3)/ Chaptir Haor
Sample Collector : Tofazzal Hossain & Syed Galib Shah
Sampling Date : 20.08.2025 - 30.08.2025
Reporting Date : 22.10.2025

Description of Analysis:

Properties	SL	Testing Specification	Method	Unit	Test Result	Bangladesh Standard
Physical Property		Temperature	Ion electrode method	°C	25.4	--
		Electric Conductivity	Ion electrode method	µS/cm	50	--
Chemical Properties		DO	Ion electrode method	mg/L	6.5	≥5
		pH	Ion electrode method	--	6.05	6-9
		COD	USEPA 410.4	mg/L	0.8	50
		TSS	Gravimetric Analysis	mg/L	6.8	--
		TDS	Ion electrode method	ppm	30	--
		Ammonia	Nassler method	mg/L	0.01	0.3
		Nitrate	Cadmium Reduction	mg/L	1.2	7.0
		Turbidity	Turbidimetric Photoelectric Method	NTU	19.2	--

**Bangladesh Environment Conservation Rules, 2023 [Schedule 2(A)]; DO: Dissolved Oxygen; TSS: Total Suspended Solids; TDS: Total Dissolved Solids; COD: Chemical Oxygen Demand.*

EQMS Consulting Limited

Prepared By
Laboratory Technical Manager
Ahmed Jubaer

Test Performed By
Laboratory Chemist
Al- Hasan Kabir

Approved By
Laboratory Quality Manager
Md. Saifur Rahman

Head Office: H # 53, R # 04, B # C, Banani, Dhaka -1213, Bangladesh
Lab Office: Flat # F1, House # Ta-134/A, Boishakhi Sarani, Gulshan-Badda Link Road, Dhaka – 1212
Toronto Office: 7 Arnot Street, Scarborough Ontario, M1K4B5 Canada

EQMS

Ref: EQMS/Water Quality/ 20251221977

EQMS WET LABORATORY

Test Results of Surface Water Quality

Project Name : Environmental Impact Assessment for the Haor Area Resilience and Development Project (HARD Project)
Description of Sample : Surface Water (SW-4)/ Naluar Haor
Sample Collector : Tofazzal Hossain & Syed Galib Shah
Sampling Date : 20.08.2025 - 30.08.2025
Reporting Date : 22.10.2025

Description of Analysis:

Properties	SL	Testing Specification	Method	Unit	Test Result	Bangladesh Standard
Physical Property		Temperature	Ion electrode method	°C	25.4	--
		Electric Conductivity	Ion electrode method	µS/cm	60	--
Chemical Properties		DO	Ion electrode method	mg/L	6.2	≥5
		pH	Ion electrode method	--	6.01	6-9
		COD	USEPA 410.4	mg/L	0.7	50
		TSS	Gravimetric Analysis	mg/L	5.2	--
		TDS	Ion electrode method	ppm	30	--
		Ammonia	Nassler method	mg/L	0.01	0.3
		Nitrate	Cadmium Reduction	mg/L	1.3	7.0
		Turbidity	Turbidimetric Photoelectric Method	NTU	7.6	--

**Bangladesh Environment Conservation Rules, 2023 [Schedule 2(A)]; DO: Dissolved Oxygen; TSS: Total Suspended Solids; TDS: Total Dissolved Solids; COD: Chemical Oxygen Demand.*

EQMS Consulting Limited

Prepared By
Laboratory Technical Manager
Ahmed Jubaer

Test Performed By
Laboratory Chemist
Al- Hasan Kabir

Approved By
Laboratory Quality Manager
Md. Saifur Rahman

Head Office: H # 53, R # 04, B # C, Banani, Dhaka -1213, Bangladesh
Lab Office: Flat # F1, House # To-134/A, Boishakhi Sarani, Gulshan-Badda Link Road, Dhaka – 1212
Toronto Office: 7 Arnot Street, Scarborough Ontario, M1K4B5 Canada

Ref: EQMS/Water Quality/ 20251221978

EQMS WET LABORATORY

Test Results of Surface Water Quality

Project Name : Environmental Impact Assessment for the Haor Area Resilience and Development Project (HARD Project)
Description of Sample : Surface Water (SW-5)/ Mrigar Haor
Sample Collector : Tofazzal Hossain & Syed Galib Shah
Sampling Date : 20.08.2025 - 30.08.2025
Reporting Date : 22.10.2025

Description of Analysis:

Properties	SL.	Testing Specification	Method	Unit	Test Result	Bangladesh Standard
Physical Property		Temperature	Ion electrode method	°C	25.6	--
		Electric Conductivity	Ion electrode method	µS/cm	50	--
Chemical Properties		DO	Ion electrode method	mg/L	6.2	≥5
		pH	Ion electrode method	--	5.98	6-9
		COD	USEPA 410.4	mg/L	1.1	50
		TSS	Gravimetric Analysis	mg/L	6.8	--
		TDS	Ion electrode method	ppm	30	--
		Ammonia	Nassler method	mg/L	0.08	0.3
		Nitrate	Cadmium Reduction	mg/L	1.2	7.0
		Turbidity	Turbidimetric Photoelectric Method	NTU	1.2	--

**Bangladesh Environment Conservation Rules, 2023 [Schedule 2(A)]; DO: Dissolved Oxygen; TSS: Total Suspended Solids; TDS: Total Dissolved Solids; COD: Chemical Oxygen Demand.*

EQMS Consulting Limited

Prepared By
Laboratory Technical Manager
Ahmed Jubaer

Test Performed By
Laboratory Chemist
Al- Hasan Kabir

Approved By
Laboratory Quality Manager
Md. Saifur Rahman

Head Office: H # 53, R # 04, B # C, Banani, Dhaka -1213, Bangladesh
Lab Office: Flat # F1, House # Ta-134/A, Boishakhi Sarani, Gulshan-Badda Link Road, Dhaka – 1212
Toronto Office: 7 Arnot Street, Scarborough Ontario, M1K4B5 Canada

Ref: EQMS/Water Quality/ 20251221979

EQMS WET LABORATORY

Test Results of Surface Water Quality

Project Name : Environmental Impact Assessment for the Haor Area Resilience and Development Project (HARD Project)
Description of Sample : Surface Water (SW-6)/ Kazir Kola Boro Haor
Sample Collector : Tofazzal Hossain & Syed Galib Shah
Sampling Date : 20.08.2025 - 30.08.2025
Reporting Date : 22.10.2025

Description of Analysis:

Properties	SL	Testing Specification	Method	Unit	Test Result	Bangladesh Standard
Physical Property		Temperature	Ion electrode method	°C	25.6	--
		Electric Conductivity	Ion electrode method	µS/cm	50	--
Chemical Properties		DO	Ion electrode method	mg/L	6.6	≥5
		pH	Ion electrode method	--	6.15	6-9
		COD	USEPA 410.4	mg/L	1.0	50
		TSS	Gravimetric Analysis	mg/L	6.0	--
		TDS	Ion electrode method	ppm	30	--
		Ammonia	Nassler method	mg/L	0.06	0.3
		Nitrate	Cadmium Reduction	mg/L	1.1	7.0
		Turbidity	Turbidimetric Photoelectric Method	NTU	3.6	--

**Bangladesh Environment Conservation Rules, 2023 [Schedule 2(A)]; DO: Dissolved Oxygen; TSS: Total Suspended Solids; TDS: Total Dissolved Solids; COD: Chemical Oxygen Demand.*

EQMS Consulting Limited

Prepared By
Laboratory Technical Manager
Ahmed Jubaer

Test Performed By
Laboratory Chemist
Al- Hasan Kabir

Approved By
Laboratory Quality Manager
Md. Saifur Rahman

Head Office: H # 53, R # 04, B # C, Banani, Dhaka -1213, Bangladesh
Lab Office: Flat # F1, House # To-134/A, Boishakhi Sarani, Gulshan-Badda Link Road, Dhaka – 1212
Toronto Office: 7 Arnot Street, Scarborough Ontario, M1K4B5 Canada

EQMS

Ref: EQMS/Water Quality/ 20251221980

EQMS WET LABORATORY

Test Results of Surface Water Quality

Project Name	:	Environmental Impact Assessment for the Haor Area Resilience and Development Project (HARD Project)
Description of Sample	:	Surface Water (SW-7)/ Pathor Chauli Haor
Sample Collector	:	Tofazzal Hossain & Syed Galib Shah
Sampling Date	:	20.08.2025 - 30.08.2025
Reporting Date	:	22.10.2025

Description of Analysis:

Properties	SL.	Testing Specification	Method	Unit	Test Result	Bangladesh Standard
Physical Property		Temperature	Ion electrode method	°C	25.3	--
		Electric Conductivity	Ion electrode method	µS/cm	60	--
Chemical Properties		DO	Ion electrode method	mg/L	6.6	≥5
		pH	Ion electrode method	--	6.20	6-9
		COD	USEPA 410.4	mg/L	0.9	50
		TSS	Gravimetric Analysis	mg/L	6.5	--
		TDS	Ion electrode method	ppm	30	--
		Ammonia	Nassler method	mg/L	0.44	0.3
		Nitrate	Cadmium Reduction	mg/L	0.8	7.0
		Turbidity	Turbidimetric Photoelectric Method	NTU	3.5	--

**Bangladesh Environment Conservation Rules, 2023 [Schedule 2(A)]; DO: Dissolved Oxygen; TSS: Total Suspended Solids; TDS: Total Dissolved Solids; COD: Chemical Oxygen Demand.*

EQMS Consulting Limited

Prepared By	Test Performed By	Approved By
Laboratory Technical Manager	Laboratory Chemist	Laboratory Quality Manager
Ahmed Jubaer	Al- Hasan Kabir	Md. Saifur Rahman

Head Office: H # 53, R # 04, B # C, Banani, Dhaka -1213, Bangladesh
Lab Office: Flat # F1, House # Ta-134/A, Boishakhi Sarani, Gulshan-Badda Link Road, Dhaka – 1212
Toronto Office: 7 Arnot Street, Scarborough Ontario, M1K4B5 Canada

Ref: EQMS/Water Quality/ 20251221981

EQMS WET LABORATORY

Test Results of Surface Water Quality

Project Name : Environmental Impact Assessment for the Haor Area Resilience and Development Project (HARD Project)
Description of Sample : Surface Water (SW-8)/ Muktarpur Haor
Sample Collector : Tofazzal Hossain & Syed Galib Shah
Sampling Date : 20.08.2025 - 30.08.2025
Reporting Date : 22.10.2025

Description of Analysis:

Properties	SL.	Testing Specification	Method	Unit	Test Result	Bangladesh Standard
Physical Property		Temperature	Ion electrode method	°C	25.5	--
		Electric Conductivity	Ion electrode method	µS/cm	60	--
Chemical Properties		DO	Ion electrode method	mg/L	6.4	≥5
		pH	Ion electrode method	--	6.10	6-9
		COD	USEPA 410.4	mg/L	1.4	50
		TSS	Gravimetric Analysis	mg/L	7.2	--
		TDS	Ion electrode method	ppm	30	--
		Ammonia	Nassler method	mg/L	0.24	0.3
		Nitrate	Cadmium Reduction	mg/L	0.6	7.0
		Turbidity	Turbidimetric Photoelectric Method	NTU	13.3	--

**Bangladesh Environment Conservation Rules, 2023 [Schedule 2(A)]; DO: Dissolved Oxygen; TSS: Total Suspended Solids; TDS: Total Dissolved Solids; COD: Chemical Oxygen Demand.*

EQMS Consulting Limited

Prepared By
Laboratory Technical Manager
Ahmed Jubaer

Test Performed By
Laboratory Chemist
Al- Hasan Kabir

Approved By
Laboratory Quality Manager
Md. Saifur Rahman

Head Office: H # 53, R # 04, B # C, Banani, Dhaka -1213, Bangladesh
Lab Office: Flat # F1, House # Ta-134/A, Boishakhi Sarani, Gulshan-Badda Link Road, Dhaka – 1212
Toronto Office: 7 Arnot Street, Scarborough Ontario, M1K4B5 Canada

Ref: EQMS/Water Quality/ 20251221982

EQMS WET LABORATORY

Test Results of Surface Water Quality

Project Name : Environmental Impact Assessment for the Haor Area Resilience and Development Project (HARD Project)
Description of Sample : Surface Water (SW-9)/ Hail Haor
Sample Collector : Tofazzal Hossain & Syed Galib Shah
Sampling Date : 20.08.2025 - 30.08.2025
Reporting Date : 22.10.2025

Description of Analysis:

Properties	SL.	Testing Specification	Method	Unit	Test Result	Bangladesh Standard
Physical Property		Temperature	Ion electrode method	°C	25.5	--
		Electric Conductivity	Ion electrode method	µS/cm	50	--
Chemical Properties		DO	Ion electrode method	mg/L	6.3	≥5
		pH	Ion electrode method	--	6.08	6-9
		COD	USEPA 410.4	mg/L	0.6	50
		TSS	Gravimetric Analysis	mg/L	9.0	--
		TDS	Ion electrode method	ppm	30	--
		Ammonia	Nassler method	mg/L	0.18	0.3
		Nitrate	Cadmium Reduction	mg/L	0.9	7.0
		Turbidity	Turbidimetric Photoelectric Method	NTU	11.7	--

**Bangladesh Environment Conservation Rules, 2023 [Schedule 2(A)]; DO: Dissolved Oxygen; TSS: Total Suspended Solids; TDS: Total Dissolved Solids; COD: Chemical Oxygen Demand.*

EQMS Consulting Limited

Prepared By
Laboratory Technical Manager
Ahmed Jubaer

Test Performed By
Laboratory Chemist
Al- Hasan Kabir

Approved By
Laboratory Quality Manager
Md. Saifur Rahman

Head Office: H # 53, R # 04, B # C, Banani, Dhaka -1213, Bangladesh
Lab Office: Flat # F1, House # Ta-134/A, Boishakhi Sarani, Gulshan-Badda Link Road, Dhaka – 1212
Toronto Office: 7 Arnot Street, Scarborough Ontario, M1K4B5 Canada

Appendix G-4: Laboratory Analysis Report of Groundwater Quality

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AECL LABORATORY ANALYSIS REPORT
GROUND WATER QUALITY TEST REPORT

Project Name : **Baseline Survey for Preparatory Survey for Haor Area Resilience & Development Project**
Project Location : **Kishoreganj, Habiganj, Netrokona, Sunamganj, Sylhet & Moulvibazar**

Description of Sample : Ground Water Quality
Sample Collector : Adroit Environment Consultants Ltd. (Monitoring team)
Sampling date : 24th May– 01st June, 2025
Reporting date : 15th June, 2025

Description of Analysis

Locations	Concentration Present			
	Temp.	pH	TDS	EC
Gurmar Haor	25.6	6.89	113	178
Halir Haor	24.3	7.11	93	155
Chaptir Haor	25.5	7.07	124	207
Naluar Haor	23.6	6.92	111	189
Mrigar Haor	26.1	7.18	177	267
Kazir Kola Boro Haor	25.7	7.04	152	259
Pathor Chauli Haor	24.8	6.97	175	302
Muktarpur Haor	26.4	6.52	148	291
Hail Haor	23.9	7.04	140	275
Unit	°C	-	mg/l	µS/cm
Method	Mercury filled thermometer	pH Meter	TDS meter	USEPA 120.1:1982
DoE Standard according to ECR, 2023 (Schedule 2-Ka-1)	20-30	6.5-8.5	1000	NF

Comment: *From the aforementioned results it is discernible that all the parameters are inside the allowable limits.*

Md. Faisal Bin Mahmud
Sr. Chemist

Shanjana Haider
Chief Operating Officer

House 01, Road 16, Sector 07, Uttara, Dhaka-1230 Tel: +88-02-9116712-13
Mob: 01733376609-10, Fax: +88-02-9116714, Email: nukhan05@gmail.com, aecldhaka@gmail.com
www.aecl-bd.org

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DEPARTMENT OF CIVIL ENGINEERING
ENVIRONMENTAL ENGINEERING LABORATORY

BRTC Bureau of Research, Testing & Consultation

Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/

BRTC No. : 1103-54718 /24-25/CE; Dt: 18/6/2025 **Ref. No.:** AECL/Lab/2025/06/161; Dt: 14/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Ground Water

Sample Id : --- **Source:** Ground Water

Date of Test : 18/6/2025 - 23/6/2025 **Location:** Hail Haor, Moulvibazar

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Orthophosphate (PO4) or Reactive Phosphate	mg/l	0.10	---	---	SM 4500-PO4	0.04
2	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed by:
25/06/25
Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

Department of Civil Engineering ★ BUET, Dhaka-1000, Bangladesh

Page 1

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BRTC No. : 1103-54718 /24-25/CE; Dt: 18/6/2025 **Ref. No.:** AECL/Lab/2025/06/160; Dt: 14/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Ground Water **Source:** Ground Water

Sample Id : --- **Location:** Mukterpur Haor, Sylhet

Date of Test : 18/6/2025 - 23/6/2025

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Orthophosphate (PO4) or Reactive Phosphate	mg/l	4.50	---	---	SM 4500-PO4	0.04
2	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

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Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

51

BEJPFFGDH

Test Performed by:

Dr. Rowshan Mamtaz 25/06/25
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

Department of Civil Engineering ★ BUET, Dhaka-1000, Bangladesh ★

Page 1

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DEPARTMENT OF CIVIL ENGINEERING

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BRTC No. : **1103-54718 /24-25/CE; Dt: 18/6/2025** **Ref. No.:** AECL/Lab/2025/06/159; Dt: 14/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Ground Water

Sample Id : --- **Source:** Ground Water

Date of Test : 18/6/2025 - 23/6/2025 **Location:** Pathor Chauli Haor, Sylhet

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Orthophosphate (PO4) or Reactive Phosphate	mg/l	0.72	---	---	SM 4500-PO4	0.04
2	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

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Countersigned *by*:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

52 JNENBYCTH

Test Performed *by*:
Rowshan Mamtaz 25/06/25

Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

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Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : ---
Source: Ground Water
Date of Test : 18/6/2025 - 23/6/2025
Location: Kazir Kola Haor, Kishoreganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Orthophosphate (PO4) or Reactive Phosphate	mg/l	5.30	---	---	SM 4500-PO4	0.04
2	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

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Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed by:

Dr. Rowshan Mamtaz 25/06/25
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

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DEPARTMENT OF CIVIL ENGINEERING
Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/
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BRTC No. : 1103-54718 /24-25/CE; Dt: 18/6/2025 Ref. No.: AECL/Lab/2025/06/157; Dt: 14/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : ---
Source: Ground Water
Date of Test : 18/6/2025 - 23/6/2025
Location: Mrigar Haor, Kishoreganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Orthophosphate (PO4) or Reactive Phosphate	mg/l	1.21	---	---	SM 4500-PO4	0.04
2	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

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Comments : 1. Sample was supplied by CLIENT
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Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

54

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Test Performed by:
Rowshan Mamtaz 25/06/25
Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)
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ENVIRONMENTAL ENGINEERING LABORATORY

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BRTC No. : **1103-54718 /24-25/CE; Dt: 18/6/2025** **Ref. No.:** AECL/Lab/2025/06/156; Dt: 14/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water **Source:** Ground Water
Sample Id : --- **Location:** Naluar Haor, Sunamganj
Date of Test : 18/6/2025 - 23/6/2025

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Orthophosphate (PO_4) or Reactive Phosphate	mg/l	26.00	---	---	SM 4500-PO4	0.04
2	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

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Countersigned by:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed by:
25/06/25
Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

Knjh2JDXR

Department of Civil Engineering ★ BUET, Dhaka-1000, Bangladesh ★

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BRTC No. : **1103-54718 /24-25/CE; Dt: 18/6/2025** **Ref. No.:** AECL/Lab/2025/06/155; Dt: 14/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Ground Water

Sample Id : ---

Source: Ground Water

Date of Test : 18/6/2025 - 23/6/2025

Location: Chaptir Haor, Sunamganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Orthophosphate (PO4) or Reactive Phosphate	mg/l	**0.10**	---	---	SM 4500-PO4	0.04
2	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

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Department of Civil Engineering ★ BUET, Dhaka-1000, Bangladesh ★

Countersigned *by*:

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

56 SEXNh7dQR

Test Performed *by*:
Rowshan Mamtaz 25/06/25

Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

BUETCE 0551049

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

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BRTC No. : **1103-54718 /24-25/CE; Dt: 18/6/2025** **Ref. No.:** AECL/Lab/2025/06/154; Dt: 14/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Ground Water

Sample Id : ---

Source: Ground Water

Date of Test : 18/6/2025 - 23/6/2025

Location: Halir Haor, Sunamganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Orthophosphate (PO4) or Reactive Phosphate	mg/l	0.21	---	---	SM 4500-PO4	0.04
2	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Department of Civil Engineering BUET, Dhaka-1000, Bangladesh

Countersigned *by* :

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed *by* :

Rowshan Mamtaz 25/06/25

Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

BUETCE 056 1050

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/

ENVIRONMENTAL ENGINEERING LABORATORY

BRTC Bureau of Research, Testing & Consultation

BRTC No. : **1103-54718 /24-25/CE; Dt: 18/6/2025** **Ref. No.:** AECL/Lab/2025/06/153; Dt: 14/6/2025

Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd

Project : Analysis of Ground Water

Sample Id : ---

Source: Ground Water

Date of Test : 18/6/2025 - 23/6/2025

Location: Gurmar Haor, Sunamganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Orthophosphate (PO4) or Reactive Phosphate	mg/l	4.70	---	---	SM 4500-PO4	0.04
2	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by :

Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

Test Performed by : Rowshan Mamtaz 25/06/25

Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

tbzXn6mCK

Page 1

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BRTC
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BRTC No. : 1103-54207 /24-25/CE; Dt: 3/6/2025 Ref. No.: AECL/Lab/2025/06/142; Dt: 1/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : Sample # GW1 Source: Ground Water
Date of Test : 14/6/2025 - 23/6/2025 Location: Gurmar Haor, Sunamganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	2.74	5	5	SM 2130 B	0.01
2	Total Hardness (as CaCO3)	mg/l	90	500	500	SM 2340 C	0.2
3	Chloride (Cl-)	mg/l	11	250 (1000 Coastal Area)	250	SM 4500-Cl-	1
4	Fluoride (F)	mg/l	0.4	1	1.5	SM 4500-F	0.05
5	Nitrate (NO3)	mg/l	25.45	45	50	SM 4500-NO3-N-F	---
6	Sulphate (SO4)	mg/l	<MDL	250	250	SM 4500-SO4	7
7	Arsenic (As)	mg/l	0.016	0.05	0.01	SM 3113 B	0.001
8	Total Coliform(TC)	CFU/100ml	0	0	0	SM 9221 E	0
9	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

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Countersigned by:
Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg , BUET, Dhaka-1000

13 FN27ZKBrQ

Test Performed by:
Rowshan Mamtaz 25/06/25
Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

Page 1

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BRTC No. : 1103-54207 /24-25/CE; Dt: 3/6/2025 Ref. No.: AECL/Lab/2025/06/143; Dt: 1/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : Sample # GW1 Source: Ground Water
Date of Test : 14/6/2025 - 23/6/2025 Location: Halir Haor, Sunamganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	0.32	5	5	SM 2130 B	0.01
2	Total Hardness (as CaCO3)	mg/l	162	500	500	SM 2340 C	0.2
3	Chloride (Cl-)	mg/l	90	250 (1000 Coastal Area)	250	SM 4500-Cl-	1
4	Fluoride (F)	mg/l	0.74	1	1.5	SM 4500-F	0.05
5	Nitrate (NO3)	mg/l	2.98	45	50	SM 4500-NO3-N-F	---
6	Sulphate (SO4)	mg/l	<MDL	250	250	SM 4500-SO4	7
7	Arsenic (As)	mg/l	0.005	0.05	0.01	SM 3113 B	0.001
8	Total Coliform(TC)	CFU/100ml	0	0	0	SM 9221 E	0
9	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
10	---	---	---	---	---	---	---

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
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Countersigned by:
Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg , BUET, Dhaka-1000

14 2jbPHbTb4

Test Performed by:
Rowshan Mamtaz 25/06/25
Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

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DEPARTMENT OF CIVIL ENGINEERING
Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/
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BRTC No. : 1103-54207 /24-25/CE; Dt: 3/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : Sample # GW1
Date of Test : 14/6/2025 - 23/6/2025

Ref. No.: AECL/Lab/2025/06/144; Dt: 1/6/2025
Source: Ground Water
Location: Chaptir Haor, Sunamganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	0.83	5	5	SM 2130 B	0.01
2	Total Hardness (as CaCO3)	mg/l	44	500	500	SM 2340 C	0.2
3	Chloride (Cl-)	mg/l	10	250 (1000 Coastal Area)	250	SM 4500-Cl-	1
4	Fluoride (F)	mg/l	2.05	1	1.5	SM 4500-F	0.05
5	Nitrate (NO3)	mg/l	3.54	45	50	SM 4500-NO3-N-F	—
6	Sulphate (SO4)	mg/l	<MDL	250	250	SM 4500-SO4	7
7	Arsenic (As)	mg/l	0.035	0.05	0.01	SM 3113 B	0.001
8	Total Coliform(TC)	CFU/100ml	0	0	0	SM 9221 E	0
9	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
10	—	—	—	—	—	—	—

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

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Countersigned by:
Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

15 DXMHFCd9Y

Test Performed by:
Rowshan Mamtaz 25/06/25
Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

Page 1

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DEPARTMENT OF CIVIL ENGINEERING
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BRTC No. : 1103-54207 /24-25/CE; Dt: 3/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : Sample # GW1
Date of Test : 14/6/2025 - 23/6/2025

Ref. No.: AECL/Lab/2025/06/145; Dt: 1/6/2025
Source: Ground Water
Location: Naluar Haor, Sunamganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	1.99	5	5	SM 2130 B	0.01
2	Total Hardness (as CaCO3)	mg/l	26	500	500	SM 2340 C	0.2
3	Chloride (Cl-)	mg/l	8	250 (1000 Coastal Area)	250	SM 4500-Cl-	1
4	Fluoride (F)	mg/l	0.07	1	1.5	SM 4500-F	0.05
5	Nitrate (NO3)	mg/l	1.33	45	50	SM 4500-NO3-N-F	—
6	Sulphate (SO4)	mg/l	15	250	250	SM 4500-SO4	7
7	Arsenic (As)	mg/l	0.002	0.05	0.01	SM 3113 B	0.001
8	Total Coliform(TC)	CFU/100ml	0	0	0	SM 9221 E	0
9	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
10	—	—	—	—	—	—	—

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
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Countersigned by:
Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

16 3HWFAL3XA

Test Performed by:
Rowshan Mamtaz 25/06/25
Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

Page 1

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DEPARTMENT OF CIVIL ENGINEERING
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BRTC No. : 1103-54207 /24-25/CE; Dt: 3/6/2025 Ref. No.: AECL/Lab/2025/06/146; Dt: 1/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : Sample # GW1 Source: Ground Water
Date of Test : 14/6/2025 - 23/6/2025 Location: Mrigar Haor, Kishoreganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	0.38	5	5	SM 2130 B	0.01
2	Total Hardness (as CaCO3)	mg/l	20	500	500	SM 2340 C	0.2
3	Chloride (Cl-)	mg/l	26	250 (1000 Coastal Area)	250	SM 4500-Cl-	1
4	Fluoride (F)	mg/l	0.83	1	1.5	SM 4500-F	0.05
5	Nitrate (NO3)	mg/l	3.67	45	50	SM 4500-NO3-N-F	—
6	Sulphate (SO4)	mg/l	<MDL	250	250	SM 4500-SO4	7
7	Arsenic (As)	mg/l	0.009	0.05	0.01	SM 3113 B	0.001
8	Total Coliform(TC)	CFU/100ml	0	0	0	SM 9221 E	0
9	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
10	—	—	—	—	—	—	—

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
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Countersigned by:
Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

17 BQ3ELFHE7

Test Performed by:
Rowshan Mamtaz 25/06/25
Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

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BRTC Bureau of Research, Testing & Consultation

BRTC No. : 1103-54207 /24-25/CE; Dt: 3/6/2025 Ref. No.: AECL/Lab/2025/06/147; Dt: 1/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : Sample # GW1 Source: Ground Water
Date of Test : 14/6/2025 - 23/6/2025 Location: Kazir Kola Haor, Kishoreganj

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	0.71	5	5	SM 2130 B	0.01
2	Total Hardness (as CaCO3)	mg/l	24	500	500	SM 2340 C	0.2
3	Chloride (Cl-)	mg/l	23	250 (1000 Coastal Area)	250	SM 4500-Cl-	1
4	Fluoride (F)	mg/l	0.96	1	1.5	SM 4500-F	0.05
5	Nitrate (NO3)	mg/l	26.78	45	50	SM 4500-NO3-N-F	—
6	Sulphate (SO4)	mg/l	<MDL	250	250	SM 4500-SO4	7
7	Arsenic (As)	mg/l	0.029	0.05	0.01	SM 3113 B	0.001
8	Total Coliform(TC)	CFU/100ml	0	0	0	SM 9221 E	0
9	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
10	—	—	—	—	—	—	—

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
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Countersigned by:
Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

18 CXdFE2nKD

Test Performed by:
Rowshan Mamtaz 25/06/25
Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

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DEPARTMENT OF CIVIL ENGINEERING
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BRTC No. : 1103-54207 /24-25/CE; Dt: 3/6/2025 Ref. No.: AECL/Lab/2025/06/148; Dt: 1/6/2025
Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : Sample # GW1 Source: Ground Water
Date of Test : 14/6/2025 - 23/6/2025 Location: Pathor Chauli Haor, Sylhet

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	22.00	5	5	SM 2130 B	0.01
2	Total Hardness (as CaCO3)	mg/l	32	500	500	SM 2340 C	0.2
3	Chloride (Cl-)	mg/l	10	250 (1000 Coastal Area)	250	SM 4500-Cl-	1
4	Fluoride (F)	mg/l	0.14	1	1.5	SM 4500-F	0.05
5	Nitrate (NO3)	mg/l	1.77	45	50	SM 4500-NO3-N-F	—
6	Sulphate (SO4)	mg/l	<MDL	250	250	SM 4500-SO4	7
7	Arsenic (As)	mg/l	0.002	0.05	0.01	SM 3113 B	0.001
8	Total Coliform(TC)	CFU/100ml	0	0	0	SM 9221 E	0
9	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
10	—	—	—	—	—	—	—

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
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Countersigned by:
Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

19 Kg9dNG5r6

Test Performed by:
Dr. Rowshan Mamtaz 25/06/25
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

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Sent by : Mr. Shahriar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : Sample # GW1 Source: Ground Water
Date of Test : 14/6/2025 - 23/6/2025 Location: Muktarpur Haor, Sylhet

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	5.11	5	5	SM 2130 B	0.01
2	Total Hardness (as CaCO3)	mg/l	60	500	500	SM 2340 C	0.2
3	Chloride (Cl-)	mg/l	5	250 (1000 Coastal Area)	250	SM 4500-Cl-	1
4	Fluoride (F)	mg/l	0.24	1	1.5	SM 4500-F	0.05
5	Nitrate (NO3)	mg/l	13.72	45	50	SM 4500-NO3-N-F	—
6	Sulphate (SO4)	mg/l	<MDL	250	250	SM 4500-SO4	7
7	Arsenic (As)	mg/l	0.069	0.05	0.01	SM 3113 B	0.001
8	Total Coliform(TC)	CFU/100ml	0	0	0	SM 9221 E	0
9	Fecal Coliform (FC)	CFU/100ml	0	0	0	SM 9222 G	0
10	—	—	—	—	—	—	—

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition

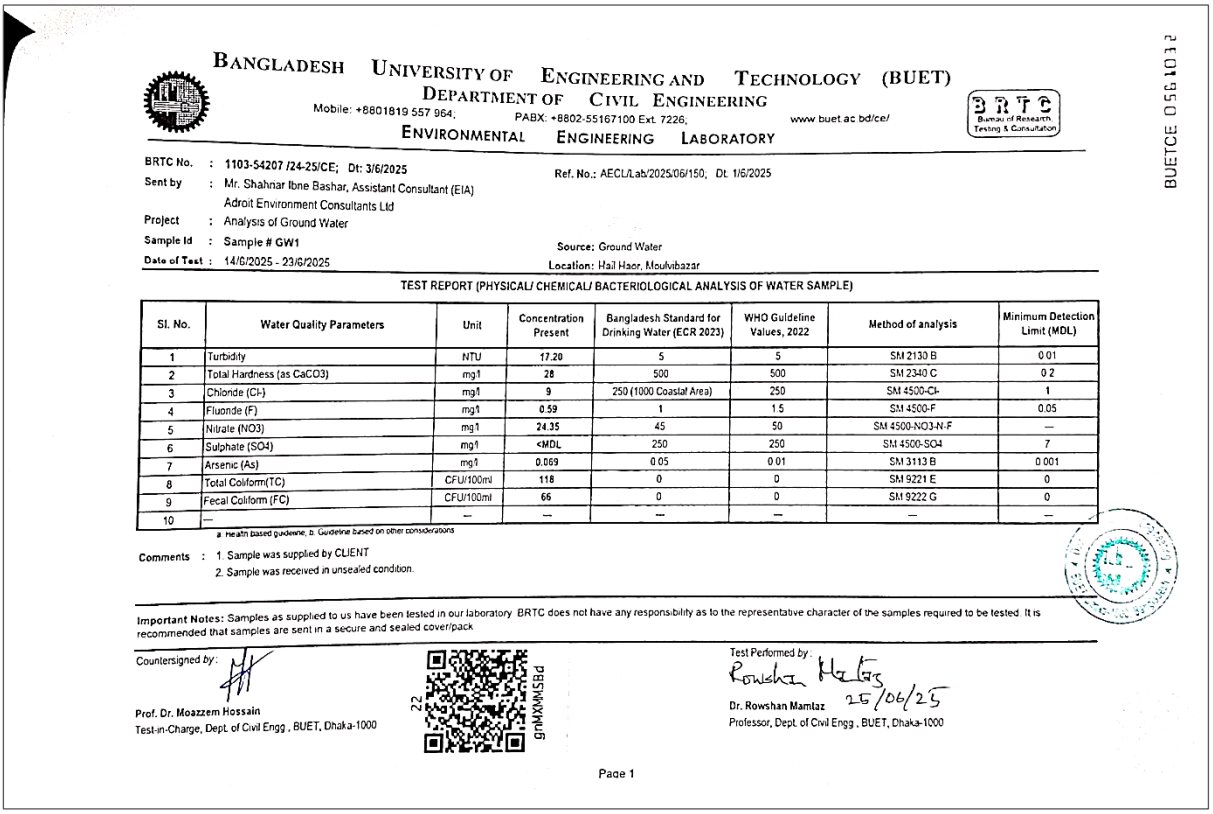
Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:
Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

20 n2XYBr6TB

Test Performed by:
Dr. Rowshan Mamtaz 25/06/25
Professor, Dept. of Civil Engg., BUET, Dhaka-1000

Page 1



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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)
DEPARTMENT OF CIVIL ENGINEERING
Mobile: +8801819 557 964; PABX: +8802-55167100 Ext. 7226; www.buet.ac.bd/ce/
ENVIRONMENTAL ENGINEERING LABORATORY

BRTC Bureau of Research Testing & Consultation

BRTC No. : 1103-54207 /24-25/CE; Dt: 3/6/2025
Ref. No.: AECL/Lab/2025/06/150; Dt. 1/6/2025
Sent by : Mr. Shahnar Ibne Bashar, Assistant Consultant (EIA)
Adroit Environment Consultants Ltd
Project : Analysis of Ground Water
Sample Id : Sample # GW1
Source: Ground Water
Date of Test : 14/6/2025 - 23/6/2025
Location: Hail Haor, Moulvibazar

TEST REPORT (PHYSICAL/ CHEMICAL/ BACTERIOLOGICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking Water (ECR 2023)	WHO Guideline Values, 2022	Method of analysis	Minimum Detection Limit (MDL)
1	Turbidity	NTU	17.20	5	5	SM 2130 B	0.01
2	Total Hardness (as CaCO3)	mg/l	28	500	500	SM 2340 C	0.2
3	Chloride (Cl-)	mg/l	9	250 (1000 Coastal Area)	250	SM 4500-Cl-	1
4	Fluoride (F)	mg/l	0.59	1	1.5	SM 4500-F	0.05
5	Nitrate (NO3)	mg/l	24.35	45	50	SM 4500-NO3-N-F	—
6	Sulphate (SO4)	mg/l	<MDL	250	250	SM 4500-SO4	7
7	Arsenic (As)	mg/l	0.069	0.05	0.01	SM 3113 B	0.001
8	Total Coliform(TC)	CFU/100ml	118	0	0	SM 9221 E	0
9	Fecal Coliform (FC)	CFU/100ml	66	0	0	SM 9222 G	0
10	—	—	—	—	—	—	—

a. Health based guideline, b. Guideline based on other considerations

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by:
Prof. Dr. Moazzem Hossain
Test-in-Charge, Dept. of Civil Engg., BUET, Dhaka-1000

22 P6SMXMJ6

Test Performed by:
Dr. Rowshan Mamtaz
Professor, Dept. of Civil Engg., BUET, Dhaka-1000
25/06/25

Page 1

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
কৃষি মন্ত্রণালয়
মৃত্তিকা সম্পদ উন্নয়ন ইনস্টিটিউট
বিভাগীয় গবেষণাগার, ঢাকা
মৃত্তিকা ভবন, কৃষি খামার সড়ক, ঢাকা-১২১৫।

প্রাপকঃ

মোঃ মেহেদী হাসান আপন
এড্রয়েট এনভায়রনমেন্ট কনসালটেন্ট লিমিটেড
হাউজ- ০১, রোড- ১৬
সেক্টর- ৭, উত্তরা, ঢাকা।

প্রেরিত পানি নমুনার বিশ্লেষিত ফলাফল

ক্রমিক নম্বর	ল্যাব নম্বর	উপাদানের নাম	
		লৌহ	ম্যাঙ্গানিজ
		সহজলভ্য	
		(ppm)	
১.	৯৯৫৯	০.১৭	০.১০
২.	৯৯৬০	০.১৮	০.১৯
৩.	৯৯৬১	০.৩৯	০.১১
৪.	৯৯৬২	০.২২	০.১১
৫.	৯৯৬৩	০.২১	০.১০
৬.	৯৯৬৪	০.৩৩	০.১০
৭.	৯৯৬৫	৩.৯৫	০.১১
৮.	৯৯৬৬	০.৩৮	০.১২
৯.	৯৯৬৭	৪.৮১	০.১৪

২৭/০৭/২৫
(ড. মাসুদা বেগম)
উর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
ফোন ঃ ০২-৪১০২৫০৬৬।

Appendix G-5: Laboratory Analysis Report of Soil Quality

Form No. QSF-22 Revision No. 14 Revision Date: 04 November, 2024

জীবনের জন্য বিজ্ঞান

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-267 of Analytical Service Cell, BCSIR, 04/06/2025

Lab/Sample ID : A-945-953

Client's Details : আইনুল হক

এড্রয়েট এনভায়রনমেন্ট কনসালটেন্ট লিমিটেড

Adroit Environment Consultants Ltd.

Head Office: House # 01 (2nd Floor), Road # 16, Sector # 07, Uttara, Dhaka-1230

Number of Sample : 09 (Nine), **Project Name: Beseline Survey for Preparatory Survey for Haor Area Resilience & Development Project.**

Sample Description : মৃত্তিকা নমুনা বিশ্লেষণ প্রসংগে, তারিখ: ০৪-০৬-২০২৫ ইং।

Test Commencement Date : 04/06/2025

Test Completion Date : 13/07/2025

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-945	**Soil** Sample: 01, Gurmar Haor	TOC (Total Organic Carbon)	40868 mg/kg	5310.B
		Total Phosphorus (P)	1670 mg/kg	4500-P.C
		Total Potassium (K)	757 mg/kg	3500-K B
A-946	**Soil** Sample: 02, Halir Haor	TOC (Total Organic Carbon)	30210 mg/kg	5310.B
		Total Phosphorus (P)	2280 mg/kg	4500-P.C
		Total Potassium (K)	710 mg/kg	3500-K B
A-947	**Soil** Sample: 03, Chaptir Haor	TOC (Total Organic Carbon)	20034 mg/kg	5310.B
		Total Phosphorus (P)	1711 mg/kg	4500-P.C
		Total Potassium (K)	403 mg/kg	3500-K B

Page 1 of 2

Note:
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c. This report/result shall not be reproduced/published without prior approval of the authority.

Analytical Service Cell
Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
Telephone: 9671108, Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Website: www.bcsir.gov.bd

Form No. QSF-22 Revision No. 14 Revision Date: 04 November, 2024

জীবনের জন্য বিজ্ঞান

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-948	**Soil** Sample: 04, Naluar Haor	TOC (Total Organic Carbon)	48016 mg/kg	5310.B
		Total Phosphorus (P)	3.37 mg/kg	4500-P.C
		Total Potassium (K)	305 mg/kg	3500-K B
A-949	**Soil** Sample: 05, Mrigar Haor	TOC (Total Organic Carbon)	15817 mg/kg	5310.B
		Total Phosphorus (P)	3.29 mg/kg	4500-P.C
		Total Potassium (K)	890 mg/kg	3500-K B
A-950	Soil Sample: 06, Kazir Kola Boro Haor	TOC (Total Organic Carbon)	11081 mg/kg	5310.B
		Total Phosphorus (P)	1517 mg/kg	4500-P.C
		Total Potassium (K)	1066 mg/kg	3500-K B
A-951	**Soil** Sample: 07, Pathor Chauli Haor	TOC (Total Organic Carbon)	17256 mg/kg	5310.B
		Total Phosphorus (P)	774 mg/kg	4500-P.C
		Total Potassium (K)	156 mg/kg	3500-K B
A-952	**Soil** Sample: 08, Muktarpur Haor	TOC (Total Organic Carbon)	17980 mg/kg	5310.B
		Total Phosphorus (P)	3.82 mg/kg	4500-P.C
		Total Potassium (K)	160 mg/kg	3500-K B
A-953	**Soil** Sample: 09, Hail Haor	TOC (Total Organic Carbon)	15919 mg/kg	5310.B
		Total Phosphorus (P)	3.78 mg/kg	4500-P.C
		Total Potassium (K)	206 mg/kg	3500-K B

13/07/2025 15/07/25 13/7/25

Analyst Supervisor Director

Md. Tanil Ahamed Shawon
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhanmondi, Dhaka-1205

Dr. Md. Ahedul Akbor
Principal Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka-1205

Dr. Md. Salim Khan
Director (Additional In-Charge)
Institute of National Analytical Research and Service (INARS)
BCSIR, Dhaka-1205.

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Telephone: 9671108, Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Website: www.bcsir.gov.bd

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
কৃষি মন্ত্রণালয়
মৃত্তিকা সম্পদ উন্নয়ন ইনস্টিটিউট
বিভাগীয় গবেষণাগার, ঢাকা
মৃত্তিকা ভবন, কৃষি খামার সড়ক, ঢাকা-১২১৫।

প্রাপকঃ

মোঃ মেহেদী হাসান আপন
এড্রয়েট এনভায়রনমেন্ট কনসালটেন্ট লিমিটেড
হাউজ- ০১, রোড- ১৬
সেক্টর- ৭, উত্তরা, ঢাকা।

প্রেরিত মৃত্তিকা নমুনার বিশ্লেষিত ফলাফল

ক্রমিক নম্বর	ল্যাব নম্বর	উপাদানের নাম			
		পিএইচ	বুনট		মোট নাইট্রোজেন (%)
১.	৯৯৩১	৫.৫	বেলে এটেল দোআঁশ	বালি- ৪৮.৮২% পলি- ২৩.৬৭% কর্দম- ২৭.৫১%	০.১৬
২.	৯৯৩২	৬.২	দোআঁশ বেলে	বালি- ৮০.৯৮% পলি- ১৫.১০% কর্দম- ৩.৯৩%	০.১৩
৩.	৯৯৩৩	৫.৬	দোআঁশ	বালি- ৪৩.৮০% পলি- ৪৩.০০% কর্দম- ১৩.২০%	০.১২
৪.	৯৯৩৪	৫.৮	দোআঁশ	বালি- ৩৭.৭৩% পলি- ৪২.৯৪% কর্দম- ১৯.৩৩%	০.২১
৫.	৯৯৩৫	৬.২	বেলে দোআঁশ	বালি- ৫৬.৭৩% পলি- ২৮.২৮% কর্দম- ১৪.৯৯%	০.১০
৬.	৯৯৩৬	৫.৯	দোআঁশ বেলে	বালি- ৮১.৬৬% পলি- ১৪.৫৫% কর্দম- ৩.৭৯%	০.১১
৭.	৯৯৩৭	৬.৩	দোআঁশ	বালি- ৩৫.২১% পলি- ৩৮.৯৩% কর্দম- ২৫.৮৬%	০.০৯
৮.	৯৯৩৮	৬.৪	দোআঁশ	বালি- ৪০.৬৯% পলি- ৩৭.২৩% কর্দম- ২২.০৮%	০.০৭
৯.	৯৯৩৯	৫.৭	দোআঁশ বেলে	বালি- ৮০.৫৯% পলি- ১০.৬৪% কর্দম- ৮.৭৭%	০.০৭

২৭/০৭/২৫
(ড. মাসুদা বেগম)
উর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
ফোন ঃ ০২-৪১০২৫০৬৬।

Appendix G-6: Laboratory Analysis Report of Riverbed Sediment Quality

Appendix G-6.1: Laboratory Analysis Report of Riverbed Sediment Quality during Dry Season

Form No. QSF-22 Revision No. 14 Revision Date: 04 November, 2024

জীবনের জন্য বিজ্ঞান

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-268 of Analytical Service Cell
BCSIR, 04/06/2025

Lab/Sample ID : A-954-962

Client's Details : আইনুল হক
এড্রয়েট এনভায়রনমেন্ট কনসালটেন্ট লিমিটেড
Adroit Environment Consultants Ltd.
Head Office: House # 01 (2nd Floor), Road # 16, Sector # 07,
Uttara, Dhaka-1230

Number of Sample : 09 (Nine), **Project Name: Beseline Survey for Preparatory Survey for Haor Area Resilience & Development Project.**

Sample Description : সেডিমেন্ট নমুনা বিশ্লেষণ প্রসংগে, তারিখ: ০৪-০৬-২০২৫ ইং।

Test Commencement Date : 04/06/2025

Test Completion Date : 13/07/2025

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-954	**Sediment** Sample: 01, Gurmar Haor	Temperature	24.8 °C	In-house
		Sulfide (S^{2-})	< 0.05 mg/kg	4500-S^{2-}
		Mercury (Hg)	0.56 mg/kg	3112.B
		Organic Phosphorus (P)	2253 mg/kg	4500-P.C
		Arsenic (As)	2.32 mg/kg	3114.C
		Fluoride (F)	< 0.5 mg/kg	4110.B
		Sodium (Na)	302 mg/kg	3500-Na B
		Chloride (Cl)	48.7 mg/kg	4110.B

Page 1 of 4

Note:
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Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
Telephone: 9671108, Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Wedsite: www.bcsir.gov.bd

Form No. QSF-22 Revision No. 14 Revision Date: 04 November, 2024

জীবনের জন্য বিজ্ঞান

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-955	**Sediment** Sample: 02, Halir Haor	Temperature	25.0 °C	In-house
		Sulfide (S^{2-})	< 0.05 mg/kg	4500-S^{2-}
		Mercury (Hg)	0.22 mg/kg	3112.B
		Organic Phosphorus (P)	3254 mg/kg	4500-P.C
		Arsenic (As)	4.75 mg/kg	3114.C
		Fluoride (F)	0.88 mg/kg	4110.B
		Sodium (Na)	119 mg/kg	3500-Na B
		Chloride (Cl)	2.27 mg/kg	4110.B
A-956	**Sediment** Sample: 03, Chaptir Hao	Temperature	25.2 °C	In-house
		Sulfide (S^{2-})	< 0.05 mg/kg	4500-S^{2-}
		Mercury (Hg)	0.28 mg/kg	3112.B
		Organic Phosphorus (P)	2884 mg/kg	4500-P.C
		Arsenic (As)	1.38 mg/kg	3114.C
		Fluoride (F)	0.93 mg/kg	4110.B
		Sodium (Na)	155 mg/kg	3500-Na B
		Chloride (Cl)	10.3 mg/kg	4110.B
A-957	**Sediment** Sample: 04, Naluar Haor	Temperature	24.7 °C	In-house
		Sulfide (S^{2-})	< 0.05 mg/kg	4500-S^{2-}
		Mercury (Hg)	0.52 mg/kg	3112.B
		Organic Phosphorus (P)	2717 mg/kg	4500-P.C
		Arsenic (As)	2.19 mg/kg	3114.C
		Fluoride (F)	0.95 mg/kg	4110.B
		Sodium (Na)	227 mg/kg	3500-Na B
		Chloride (Cl)	4.06 mg/kg	4110.B

Page 2 of 4

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Form No. QSF-22 Revision No. 14 Revision Date: 04 November, 2024

জীবনের জন্য বিজ্ঞান

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-958	**Sediment** Sample: 05, Mrigar Haor	Temperature	25.1 °C	In-house
		Sulfide (S^{2-})	< 0.05 mg/kg	4500-S^{2-}
		Mercury (Hg)	1.02 mg/kg	3112.B
		Organic Phosphorus (P)	1899 mg/kg	4500-P.C
		Arsenic (As)	3.06 mg/kg	3114.C
		Fluoride (F)	1.06 mg/kg	4110.B
		Sodium (Na)	131 mg/kg	3500-Na B
		Chloride (Cl)	6.48 mg/kg	4110.B
A-959	**Sediment** Sample: 06, Kazir Kola Boro Haor	Temperature	24.7 °C	In-house
		Sulfide (S^{2-})	< 0.05 mg/kg	4500-S^{2-}
		Mercury (Hg)	0.90 mg/kg	3112.B
		Organic Phosphorus (P)	1938 mg/kg	4500-P.C
		Arsenic (As)	1.11 mg/kg	3114.C
		Fluoride (F)	0.94 mg/kg	4110.B
		Sodium (Na)	122 mg/kg	3500-Na B
		Chloride (Cl)	1.23 mg/kg	4110.B
A-960	**Sediment** Sample: 07, Pathor Chauli Haor	Temperature	25.3 °C	In-house
		Sulfide (S^{2-})	< 0.05 mg/kg	4500-S^{2-}
		Mercury (Hg)	0.97 mg/kg	3112.B
		Organic Phosphorus (P)	2179 mg/kg	4500-P.C
		Arsenic (As)	1.68 mg/kg	3114.C
		Fluoride (F)	1.15 mg/kg	4110.B
		Sodium (Na)	150 mg/kg	3500-Na B
		Chloride (Cl)	4.42 mg/kg	4110.B

Page 3 of 4

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Telephone: 9671108, Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Website: www.bcsir.gov.bd

Form No. QSF-22 Revision No. 14 Revision Date: 04 November, 2024

জীবনের জন্য বিজ্ঞান

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-961	Sediment Sample: 08, Muktarpur Haor	Temperature	25.2 °C	In-house
		Sulfide (S^{2-})	< 0.05 mg/kg	4500-S^{2-}
		Mercury (Hg)	0.66 mg/kg	3112.B
		Organic Phosphorus (P)	1785 mg/kg	4500-P.C
		Arsenic (As)	1.11 mg/kg	3114.C
		Fluoride (F)	1.03 mg/kg	4110.B
		Sodium (Na)	169 mg/kg	3500-Na B
		Chloride (Cl)	7.93 mg/kg	4110.B
A-962	Sediment Sample: 09, Hail Haor	Temperature	24.7 °C	In-house
		Sulfide (S^{2-})	< 0.05 mg/kg	4500-S^{2-}
		Mercury (Hg)	0.35 mg/kg	3112.B
		Organic Phosphorus (P)	241 mg/kg	4500-P.C
		Arsenic (As)	1.68 mg/kg	3114.C
		Fluoride (F)	1.47 mg/kg	4110.B
		Sodium (Na)	81.6 mg/kg	3500-Na B
		Chloride (Cl)	1.89 mg/kg	4110.B

13/07/2025 — Analyst

Md. Ri... Scientifi... Institute of Nat... Research & Sc... BCSIR, D...

13.7.25 — Supervisor

Dr. ...h Al-Mansur ...ific Officer ...al Analytical ...ce (INARS) ...a-1205

13/07/25 — Director

Dr. M... Salim Khan ...ional In-Charge) ...national Analytical ...nd Service (INARS) BCSIR, Dhaka-1205

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গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
কৃষি মন্ত্রণালয়
মৃত্তিকা সম্পদ উন্নয়ন ইনস্টিটিউট
বিভাগীয় গবেষণাগার, ঢাকা
মৃত্তিকা ভবন, কৃষি খামার সড়ক, ঢাকা-১২১৫।

প্রাপকঃ

মোঃ মেহেদী হাসান আপন
এড্রয়েট এনভায়রনমেন্ট কনসালটেন্ট লিমিটেড
হাউজ- ০১, রোড- ১৬
সেক্টর- ৭, উত্তরা, ঢাকা।

প্রেরিত মৃত্তিকা নমুনার বিশ্লেষিত ফলাফল

ক্রমিক নম্বর	ল্যাব নম্বর	উপাদানের নাম										
		জৈব পদার্থ	মোট নাইট্রোজেন	ফসফরাস	ক্যালসিয়াম	ম্যাগনেসিয়াম	পটাসিয়াম	তামা	জিংক	লেড	ক্যাডমিয়াম	ক্রোমিয়াম
				সহজলভ্য	বিনিময়যোগ্য			সহজলভ্য		মোট		
		(%)		(ppm)	(meq/100g soil)			(ppm)				
১.	৯৯৬৮	০.৫২	০.০৩	১৬.৭৯	৪.৬৯	১.৮৩	০.১৯	১.৬৭	২.০৪	২০.০৩	০.৩০	৫১.৯৫
২.	৯৯৬৯	০.৭২	০.০৪	১১.৮১	১০.২৭	২.৩১	০.২৮	১.৮৪	১.৬০	৩২.২৬	০.৪৮	৬১.২৭
৩.	৯৯৭০	১.৬৫	০.০৯	৭৩.৪১	৬.৫৫	১.০৯	০.৫৪	১.৭২	৪.৭১	১৬.৭০	০.৪৮	৪৩.৬৬
৪.	৯৯৭১	১.৮৬	০.১০	৬৭.০৯	৫.৯৯	১.০৩	০.৫৫	১.৮২	৫.৬১	২০.০৩	০.৩৭	৪৫.৬১
৫.	৯৯৭২	১.১৪	০.০৬	২৮.৩৭	২.৭৮	১.২৪	০.২৫	১.৯৪	১.৬৬	১৭.৮১	০.১৭	৫৫.৮৭
৬.	৯৯৭৩	০.৬২	০.০৪	২৭.২০	৩.৬৪	১.১৪	০.৩৩	২.১০	০.৫৭	১৭.৮১	০.১৫	৫০.৯৮
৭.	৯৯৭৪	০.৫৬	০.০৩	১১.৯১	৫.০৬	২.৬২	০.১৯	২.০৮	০.৮৪	২৫.৫৯	০.৬৫	৫৬.৮৫
৮.	৯৯৭৫	০.৬২	০.০৩	৬.৯২	২.৩৯	২.৮০	০.১৭	১.৩৭	০.৫৯	২২.২৬	০.০৩	৫২.৯৩
৯.	৯৯৭৬	০.৪১	০.০২	৬.৭৫	০.৫৪	০.৯২	০.১০	০.২৭	০.৫৪	৬.৬৮	০.৬১	২৮.১৮

১৭/০৭/২৫
(ড. মাসুদা বেগম)
ঊর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
ফোন ঃ ০২-৪১০২৫০৬৬।

Appendix G-6.2: Laboratory Analysis Report of Riverbed Sediment Quality during Wet Season

Form No. QSF-22 Revision No. 14 Revision Date: 04 November, 2024

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-427 of Analytical Service Cell, BCSIR, 14/09/2025
Lab/Sample ID : A-353-361
Client's Details : Md. Shazedur Rahman, Consultant EQMS
Number of Sample : 09 (Nine)
Sample Description : Request for Testing Riverbed Sediment Quality, Date: 31 August 2025
Test Commencement Date : 14/09/2025
Test Completion Date : 19/10/2025

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-353	Riverbed Sediment (RBS-1, Gurmar Haor)	Organo phosphorus (Org-p)	< 0.002 mg/kg	6630.B
		Nitrogen (N)	0.13 %	Elemental Analyzer
		Chromium (Cr)	12.1 mg/kg	3113.B
		Arsenic (As)	2.69 mg/kg	3114.C
		Copper (Cu)	11.9 mg/kg	3113.B
		Zinc (Zn)	28.7 mg/kg	3111.B
		Fluoride (F)	5.06 mg/kg	4110.B
		Sodium (Na)	77.8 mg/kg	3500-Na B
		Potassium (K)	683 mg/kg	3500-K B
		Chloride (Cl)	639 mg/kg	4110.B
		Calcium (Ca)	1054 mg/kg	3110.B
		Magnesium (Mg)	282 mg/kg	3111.B
		Temperature	24.7 °C	In-house
		Sulfide (S^{2-})	< 1.0 mg/kg	In-house
		Organic Matter	30230 mg/kg	5520.B
		Mercury (Hg)	< 0.001 mg/kg	3112.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	7.29 mg/kg	3111.B

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-354	Riverbed Sediment (RBS-2, Halir Haor)	Organo phosphorus (Org-p)	< 0.002 mg/kg	6630.B
		Nitrogen (N)	Not detectable	Elemental Analyzer
		Chromium (Cr)	12.7 mg/kg	3113.B
		Arsenic (As)	2.57 mg/kg	3114.C
		Copper (Cu)	13.0 mg/kg	3113.B
		Zinc (Zn)	33.6 mg/kg	3111.B
		Fluoride (F)	6.50 mg/kg	4110.B
		Sodium (Na)	105 mg/kg	3500-Na B
		Potassium (K)	824 mg/kg	3500-K B
		Chloride (Cl)	22.4 mg/kg	4110.B
		Calcium (Ca)	750 mg/kg	3110.B
		Magnesium (Mg)	1909 mg/kg	3111.B
		Temperature	25.2 °C	In-house
		Sulfide (S^{2-})	< 1.0 mg/kg	In-house
		Organic Matter	18388 mg/kg	5520.B
		Mercury (Hg)	< 0.001 mg/kg	3112.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	4.15 mg/kg	3111.B

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-355	Riverbed Sediment (RBS-3, Chaptir Haor)	Organo phosphorus (Org-p)	< 0.002 mg/kg	6630.B
		Nitrogen (N)	Not detectable	Elemental Analyzer
		Chromium (Cr)	13.5 mg/kg	3113.B
		Arsenic (As)	4.53 mg/kg	3114.C
		Copper (Cu)	11.3 mg/kg	3113.B
		Zinc (Zn)	34.9 mg/kg	3111.B
		Fluoride (F)	10.7 mg/kg	4110.B
		Sodium (Na)	94.5 mg/kg	3500-Na B
		Potassium (K)	707 mg/kg	3500-K B
		Chloride (Cl)	17.6 mg/kg	4110.B
		Calcium (Ca)	282 mg/kg	3110.B
		Magnesium (Mg)	845 mg/kg	3111.B
		Temperature	25.0 °C	In-house
		Sulfide (S^{2-})	< 1.0 mg/kg	In-house
		Organic Matter	25224 mg/kg	5520.B
		Mercury (Hg)	< 0.001 mg/kg	3112.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	5.99 mg/kg	3111.B

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-356	Riverbed Sediment (RBS-4, Naular Haor)	Organo phosphorus (Org-p)	< 0.002 mg/kg	6630.B
		Nitrogen (N)	0.74 %	Elemental Analyzer
		Chromium (Cr)	179 mg/kg	3113.B
		Arsenic (As)	23.7 mg/kg	3114.C
		Copper (Cu)	17.9 mg/kg	3113.B
		Zinc (Zn)	34.8 mg/kg	3111.B
		Fluoride (F)	2.69 mg/kg	4110.B
		Sodium (Na)	170 mg/kg	3500-Na B
		Potassium (K)	551 mg/kg	3500-K B
		Chloride (Cl)	39.0 mg/kg	4110.B
		Calcium (Ca)	567 mg/kg	3110.B
		Magnesium (Mg)	628 mg/kg	3111.B
		Temperature	24.8 °C	In-house
		Sulfide (S^{2-})	< 1.0 mg/kg	In-house
		Organic Matter	32832 mg/kg	5520.B
		Mercury (Hg)	< 0.001 mg/kg	3112.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	22.2 mg/kg	3111.B

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-357	Riverbed Sediment (RBS-5, Mrigar Haor)	Organo phosphorus (Org-p)	< 0.002 mg/kg	6630.B
		Nitrogen (N)	0.56 %	Elemental Analyzer
		Chromium (Cr)	15.4 mg/kg	3113.B
		Arsenic (As)	1.96 mg/kg	3114.C
		Copper (Cu)	20.8 mg/kg	3113.B
		Zinc (Zn)	38.3 mg/kg	3111.B
		Fluoride (F)	4.80 mg/kg	4110.B
		Sodium (Na)	159 mg/kg	3500-Na B
		Potassium (K)	829 mg/kg	3500-K B
		Chloride (Cl)	29.4 mg/kg	4110.B
		Calcium (Ca)	560 mg/kg	3110.B
		Magnesium (Mg)	932 mg/kg	3111.B
		Temperature	25.1 °C	In-house
		Sulfide (S^{2-})	< 1.0 mg/kg	In-house
		Organic Matter	27837 mg/kg	5520.B
		Mercury (Hg)	< 0.001 mg/kg	3112.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	10.2 mg/kg	3111.B

Page 5 of 9

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-358	Riverbed Sediment (RBS-6, Kazir Kola Boro Haor)	Organo phosphorus (Org-p)	< 0.002 mg/kg	6630.B
		Nitrogen (N)	Not detectable	Elemental Analyzer
		Chromium (Cr)	12.6 mg/kg	3113.B
		Arsenic (As)	3.41 mg/kg	3114.C
		Copper (Cu)	11.2 mg/kg	3113.B
		Zinc (Zn)	31.3 mg/kg	3111.B
		Fluoride (F)	6.51 mg/kg	4110.B
		Sodium (Na)	122 mg/kg	3500-Na B
		Potassium (K)	981 mg/kg	3500-K B
		Chloride (Cl)	30.6 mg/kg	4110.B
		Calcium (Ca)	994 mg/kg	3110.B
		Magnesium (Mg)	2807mg/kg	3111.B
		Temperature	24.7 °C	In-house
		Sulfide (S^{2-})	< 1.0 mg/kg	In-house
		Organic Matter	16851 mg/kg	5520.B
		Mercury (Hg)	< 0.001 mg/kg	3112.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	3.07 mg/kg	3111.B

Page 6 of 9

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-359	Riverbed Sediment (RBS-7, Pathor Chauli Haor)	Organo phosphorus (Org-p)	< 0.002 mg/kg	6630.B
		Nitrogen (N)	Not detectable	Elemental Analyzer
		Chromium (Cr)	16.7 mg/kg	3113.B
		Arsenic (As)	1.51 mg/kg	3114.C
		Copper (Cu)	12.5 mg/kg	3113.B
		Zinc (Zn)	31.1 mg/kg	3111.B
		Fluoride (F)	3.75 mg/kg	4110.B
		Sodium (Na)	113 mg/kg	3500-Na B
		Potassium (K)	1038 mg/kg	3500-K B
		Chloride (Cl)	32.1 mg/kg	4110.B
		Calcium (Ca)	524 mg/kg	3110.B
		Magnesium (Mg)	1082 mg/kg	3111.B
		Temperature	24.8 °C	In-house
		Sulfide (S^{2-})	< 1.0 mg/kg	In-house
		Organic Matter	25884 mg/kg	5520.B
		Mercury (Hg)	< 0.001 mg/kg	3112.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	7.44 mg/kg	3111.B

Page 7 of 9

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-360	Riverbed Sediment (RBS-8, Muktarpur Haor)	Organo phosphorus (Org-p)	< 0.002 mg/kg	6630.B
		Nitrogen (N)	0.58 %	Elemental Analyzer
		Chromium (Cr)	10.6 mg/kg	3113.B
		Arsenic (As)	0.73 mg/kg	3114.C
		Copper (Cu)	12.0 mg/kg	3113.B
		Zinc (Zn)	34.9 mg/kg	3111.B
		Fluoride (F)	6.38 mg/kg	4110.B
		Sodium (Na)	93.3 mg/kg	3500-Na B
		Potassium (K)	661 mg/kg	3500-K B
		Chloride (Cl)	50.8 mg/kg	4110.B
		Calcium (Ca)	659 mg/kg	3110.B
		Magnesium (Mg)	877 mg/kg	3111.B
		Temperature	25.3 °C	In-house
		Sulfide (S^{2-})	< 1.0 mg/kg	In-house
		Organic Matter	59884 mg/kg	5520.B
		Mercury (Hg)	< 0.001 mg/kg	3112.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	6.92 mg/kg	3111.B

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Form No. QSF-22 Revision No. 14 Revision Date: 04 November, 2024

জীবনের জন্য বিজ্ঞান

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-361	Riverbed Sediment (RBS-9, Hail Haor)	Organo phosphorus (Org-p)	< 0.002 mg/kg	6630.B
		Nitrogen (N)	0.46 %	Elemental Analyzer
		Chromium (Cr)	8.94 mg/kg	3113.B
		Arsenic (As)	1.00 mg/kg	3114.C
		Copper (Cu)	30.0 mg/kg	3113.B
		Zinc (Zn)	35.8 mg/kg	3111.B
		Fluoride (F)	< 0.5 mg/kg	4110.B
		Sodium (Na)	58.8 mg/kg	3500-Na B
		Potassium (K)	574 mg/kg	3500-K B
		Chloride (Cl)	11.7 mg/kg	4110.B
		Calcium (Ca)	20522 mg/kg	3110.B
		Magnesium (Mg)	1488 mg/kg	3111.B
		Temperature	25.0 °C	In-house
		Sulfide (S^{2-})	< 1.0 mg/kg	In-house
		Organic Matter	59267 mg/kg	5520.B
		Mercury (Hg)	< 0.001 mg/kg	3112.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	7.50 mg/kg	3111.B

19.10.25
Analyst
Md. Al-Amin
Scientific Officer
Institute of National Analytical Research and Service (INARS)
BCSIR, Dhaka-1205

Supervisor 19.10.25
Dr. Muhammad Abdullah Al-Mansur
Principal Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka-1205

19/10/25
Director
Dr. Md. Salim Khan
Director (Additional In-Charge)
Institute of National Analytical Research and Service (INARS)
BCSIR, Dhaka-1205

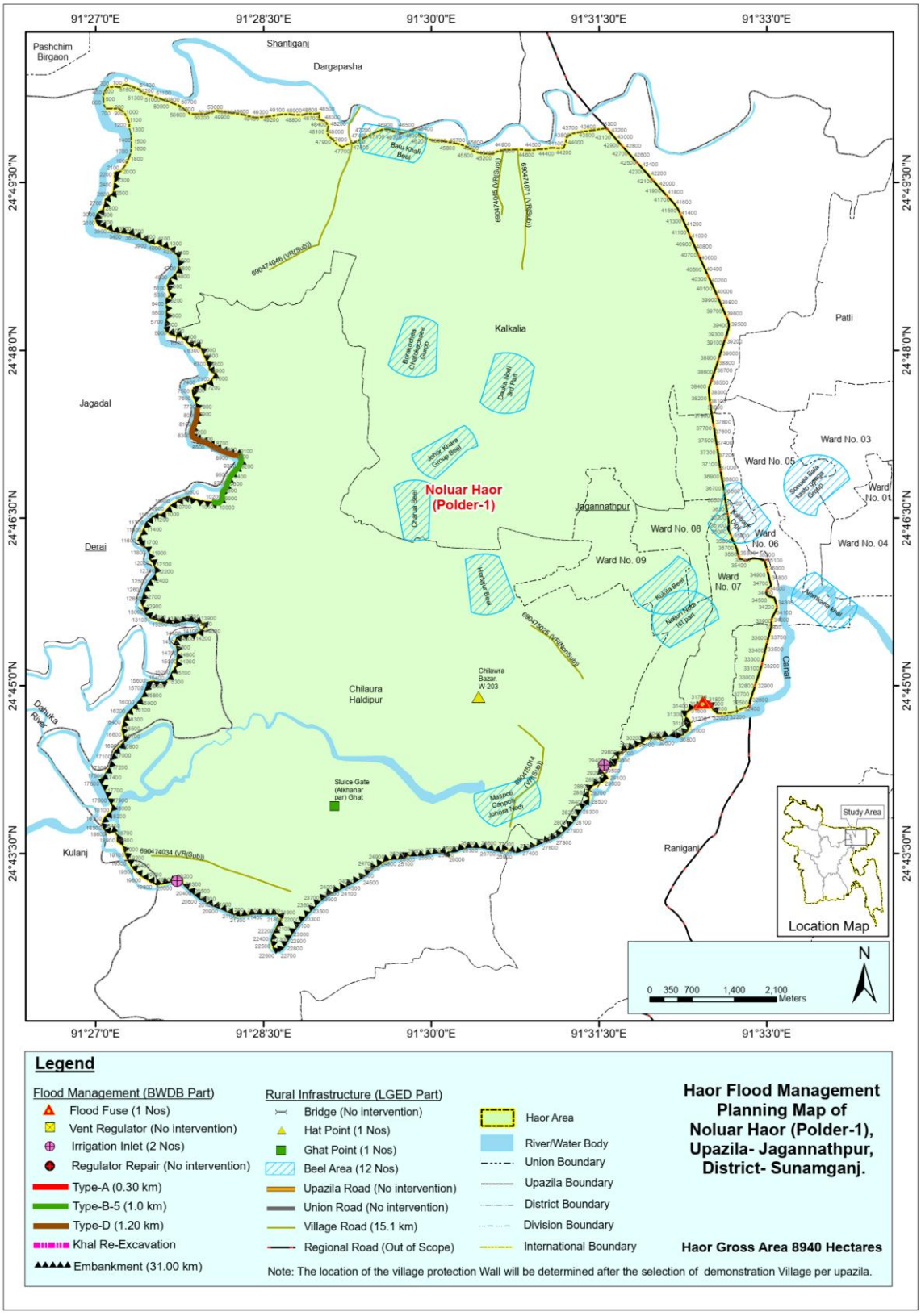
Page 9 of 9

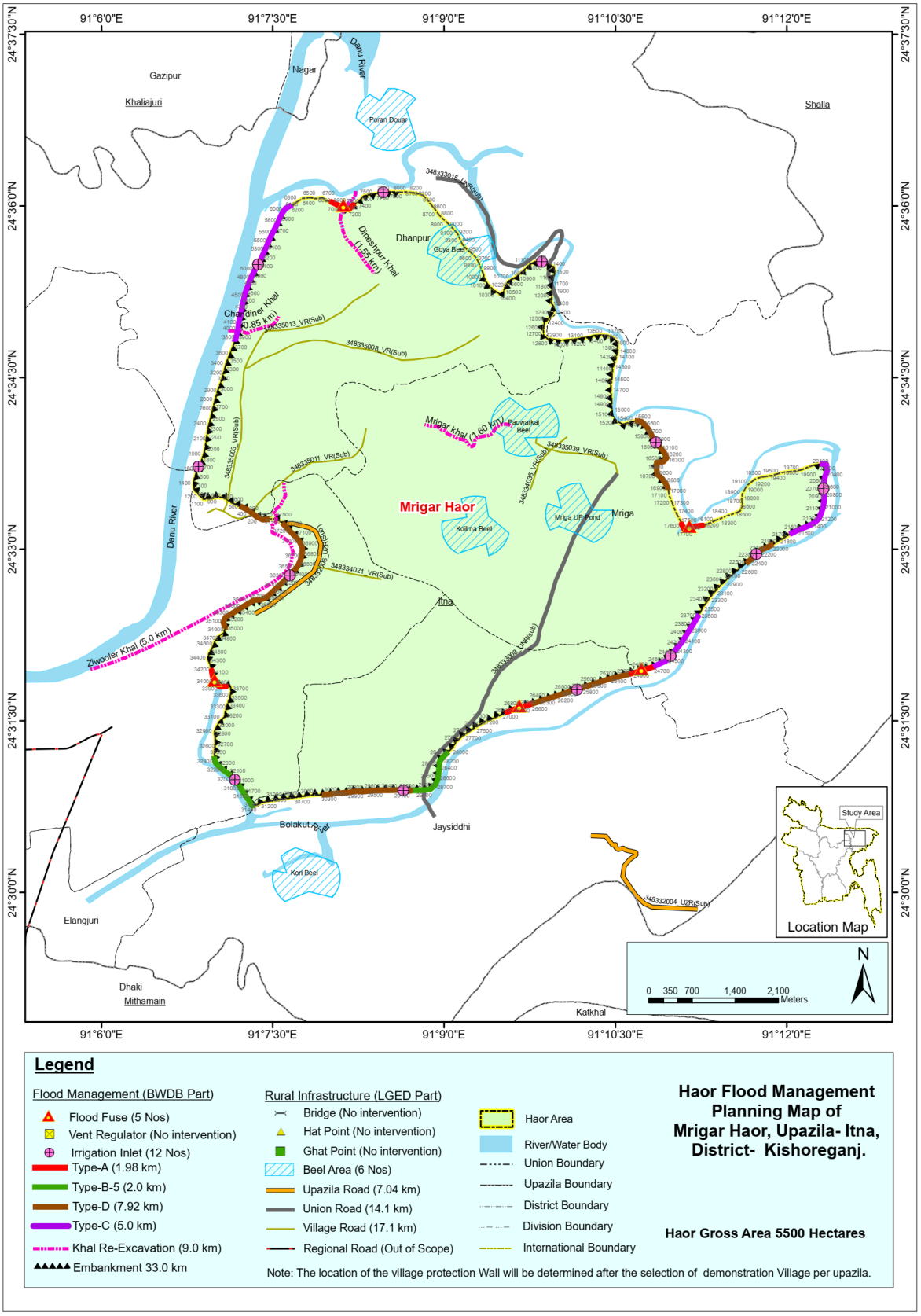
Note:
a. The results reported here are based only on the supplied samples in this laboratory.
b. Any complain about test report will not be acceptable after one month from the date of issuing of the said report.
c. This report/result shall not be reproduced/published without prior approval of the authority.

Analytical Service Cell
Dr, Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
Telephone: 9671108, Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Wedsite: www.bcsir.gov.bd

APPENDIX H

Appendix H: Haor Flood Management Planning Maps





Legend

Flood Management (BWDB Part)

- Flood Fuse (5 Nos)
- Vent Regulator (No intervention)
- Irrigation Inlet (12 Nos)
- Type-A (1.98 km)
- Type-B-5 (2.0 km)
- Type-D (7.92 km)
- Type-C (5.0 km)
- Khal Re-Excavation (9.0 km)
- Embankment 33.0 km

Rural Infrastructure (LGED Part)

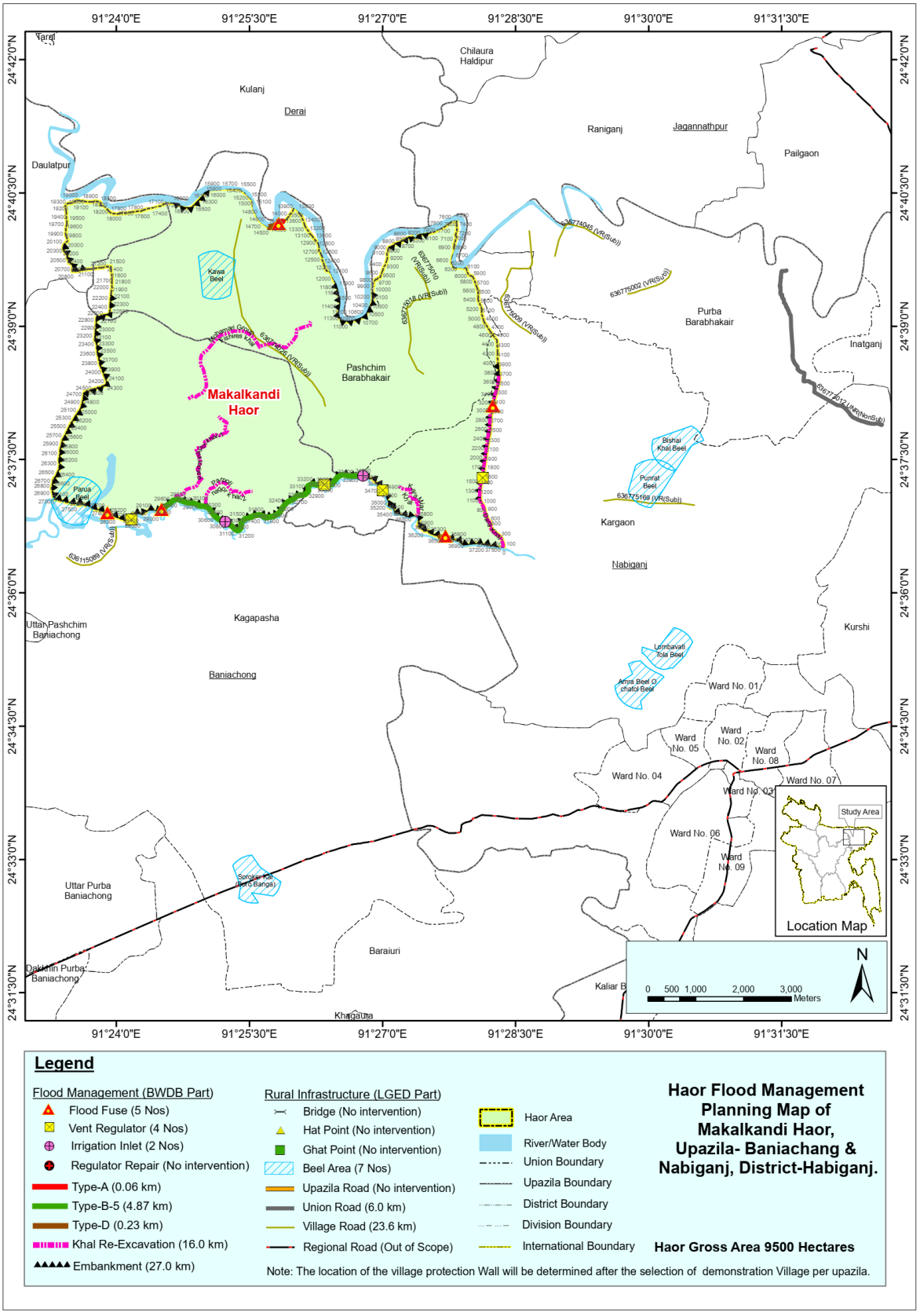
- Bridge (No intervention)
- Hat Point (No intervention)
- Ghat Point (No intervention)
- Beel Area (6 Nos)
- Upazila Road (7.04 km)
- Union Road (14.1 km)
- Village Road (17.1 km)
- Regional Road (Out of Scope)

- Haor Area
- River/Water Body
- Union Boundary
- Upazila Boundary
- District Boundary
- Division Boundary
- International Boundary

Haor Flood Management Planning Map of Mrigar Haor, Upazila- Itna, District- Kishoreganj.

Haor Gross Area 5500 Hectares

Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.



Legend

Flood Management (BWDB Part)
- Flood Fuse (5 Nos)
- Vent Regulator (4 Nos)
- Irrigation Inlet (2 Nos)
- Regulator Repair (No intervention)
- Type-A (0.06 km)
- Type-B-5 (4.87 km)
- Type-D (0.23 km)
- Khal Re-Excavation (16.0 km)
- Embankment (27.0 km)

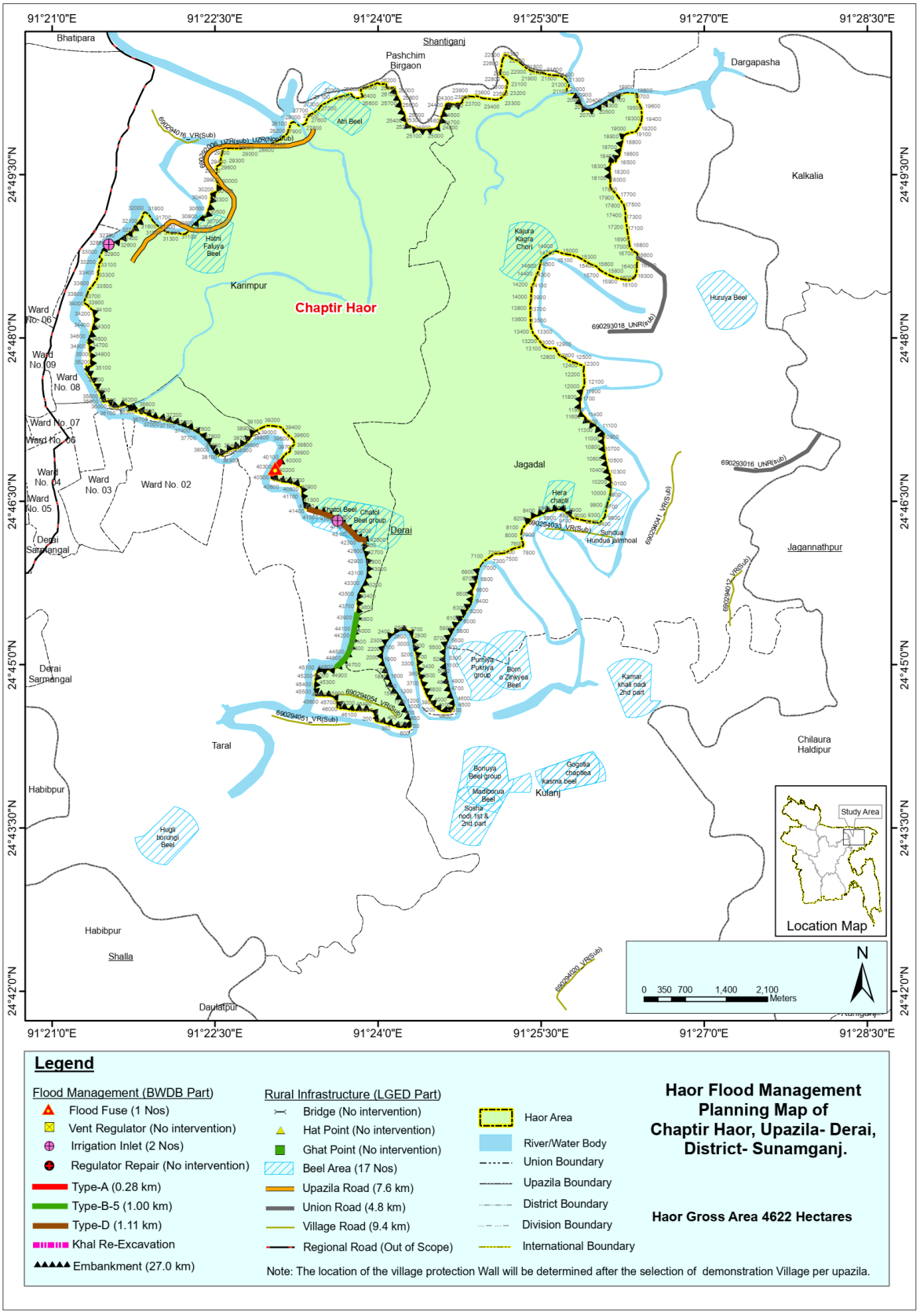
Rural Infrastructure (LGED Part)
- Bridge (No intervention)
- Hat Point (No intervention)
- Ghat Point (No intervention)
- Beel Area (7 Nos)
- Upazila Road (No intervention)
- Union Road (6.0 km)
- Village Road (23.6 km)
- Regional Road (Out of Scope)

- Haor Area
- River/Water Body
- Union Boundary
- Upazila Boundary
- District Boundary
- Division Boundary
- International Boundary

Haor Flood Management Planning Map of Makalkandi Haor, Upazila- Baniachang & Nabiganj, District-Habiganj.

Haor Gross Area 9500 Hectares

Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.



Legend

Flood Management (BWDB Part)

- Flood Fuse (1 Nos)
- Vent Regulator (No intervention)
- Irrigation Inlet (2 Nos)
- Regulator Repair (No intervention)
- Type-A (0.28 km)
- Type-B-5 (1.00 km)
- Type-D (1.11 km)
- Khal Re-Excavation
- Embankment (27.0 km)

Rural Infrastructure (LGED Part)

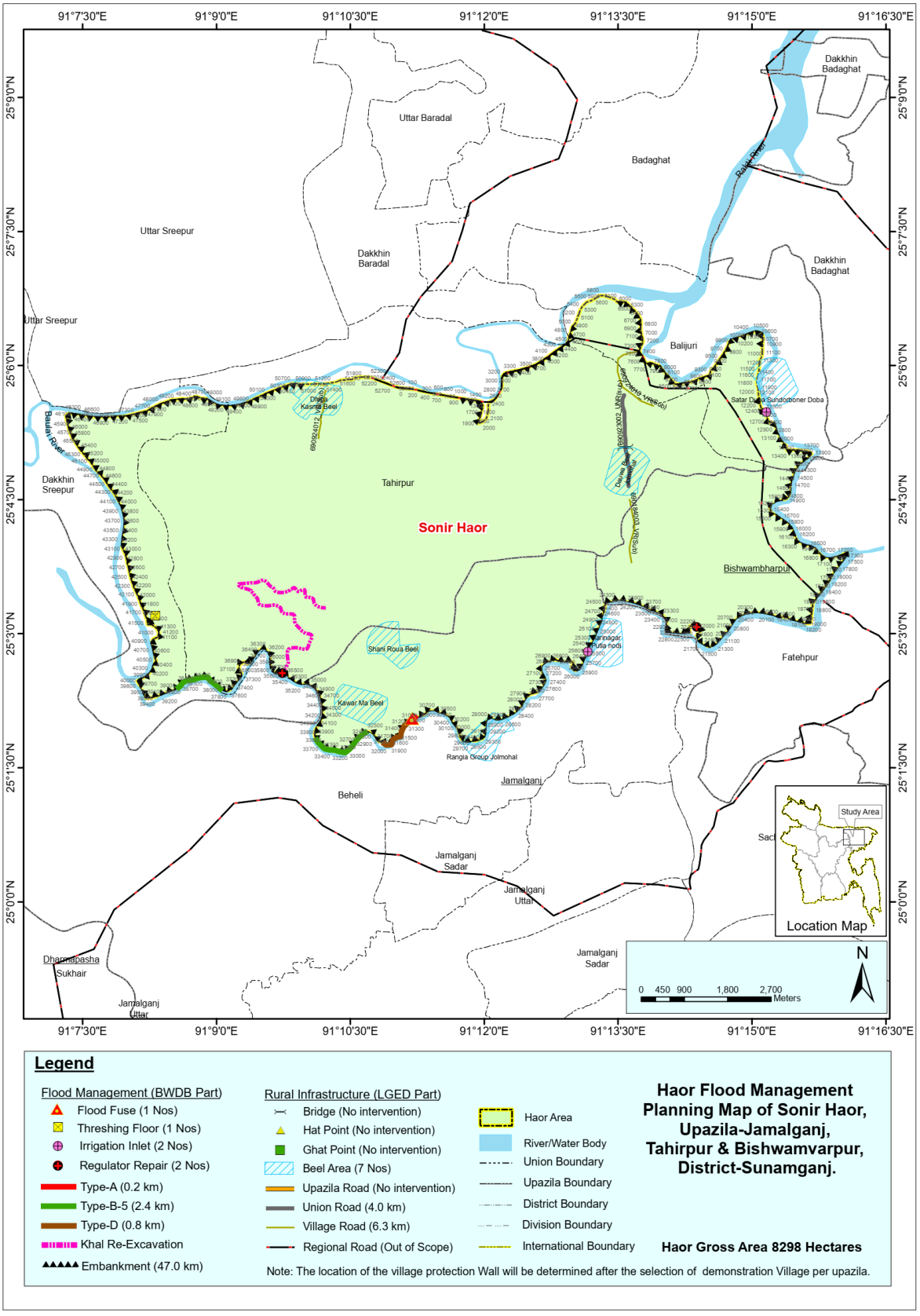
- Bridge (No intervention)
- Hat Point (No intervention)
- Ghat Point (No intervention)
- Beel Area (17 Nos)
- Upazila Road (7.6 km)
- Union Road (4.8 km)
- Village Road (9.4 km)
- Regional Road (Out of Scope)

- Haor Area
- River/Water Body
- Union Boundary
- Upazila Boundary
- District Boundary
- Division Boundary
- International Boundary

Haor Flood Management Planning Map of Chaptir Haor, Upazila- Derai, District- Sunamganj.

Haor Gross Area 4622 Hectares

Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.



Legend

Flood Management (BWDB Part)

- Flood Fuse (1 Nos)
- Threshing Floor (1 Nos)
- Irrigation Inlet (2 Nos)
- Regulator Repair (2 Nos)
- Type-A (0.2 km)
- Type-B-5 (2.4 km)
- Type-D (0.8 km)
- Khal Re-Excavation
- Embankment (47.0 km)

Rural Infrastructure (LGED Part)

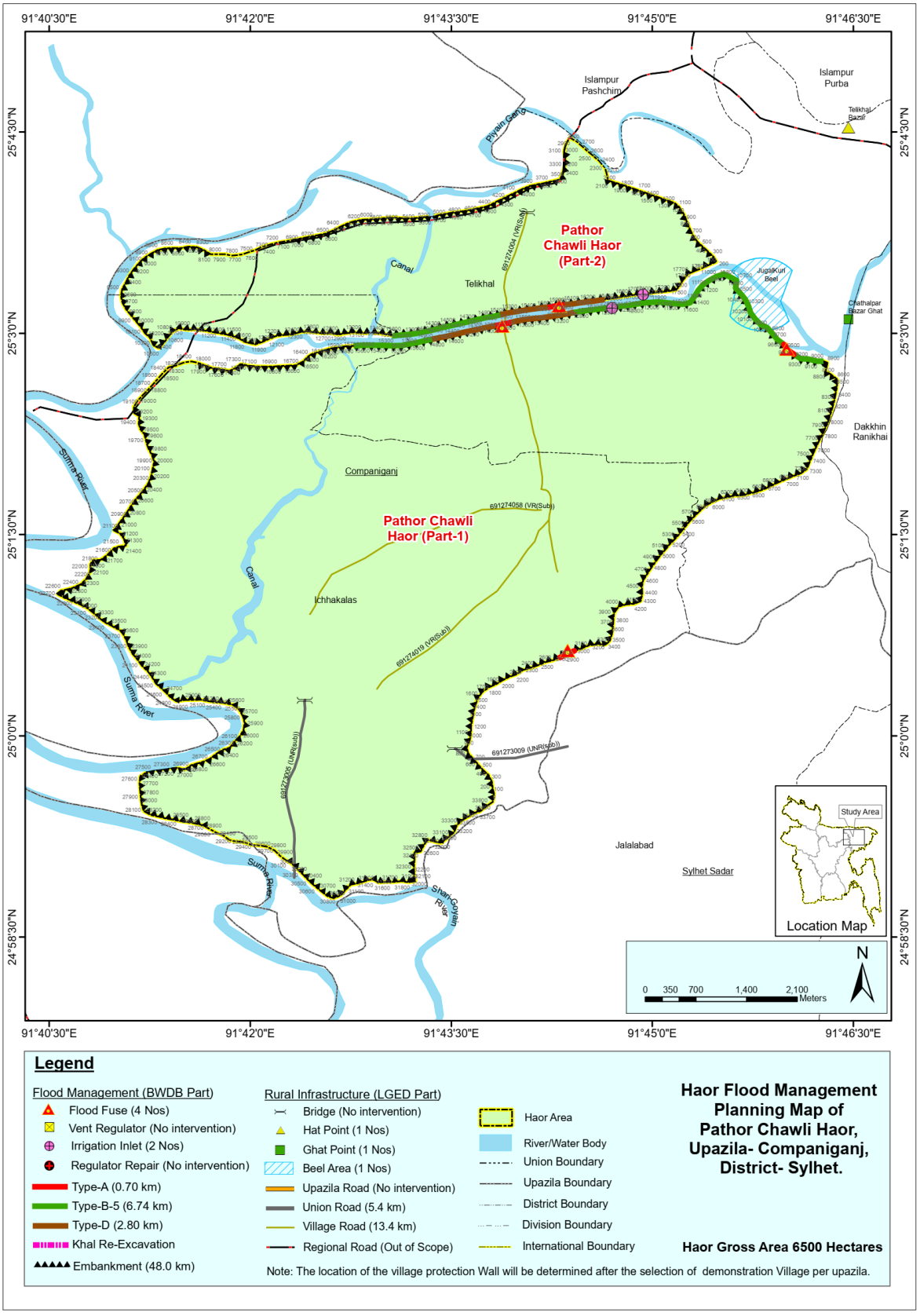
- Bridge (No intervention)
- Hat Point (No intervention)
- Ghat Point (No intervention)
- Beel Area (7 Nos)
- Upazila Road (No intervention)
- Union Road (4.0 km)
- Village Road (6.3 km)
- Regional Road (Out of Scope)

- Haor Area
- River/Water Body
- Union Boundary
- Upazila Boundary
- District Boundary
- Division Boundary
- International Boundary

Haor Flood Management Planning Map of Sonir Haor, Upazila-Jamalganj, Tahirpur & Bishwamvarpur, District-Sunamganj.

Haor Gross Area 8298 Hectares

Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.



Legend

Flood Management (BWDB Part)
- Flood Fuse (4 Nos)
- Vent Regulator (No intervention)
- Irrigation Inlet (2 Nos)
- Regulator Repair (No intervention)
- Type-A (0.70 km)
- Type-B-5 (6.74 km)
- Type-D (2.80 km)
- Khal Re-Excavation
- Embankment (48.0 km)

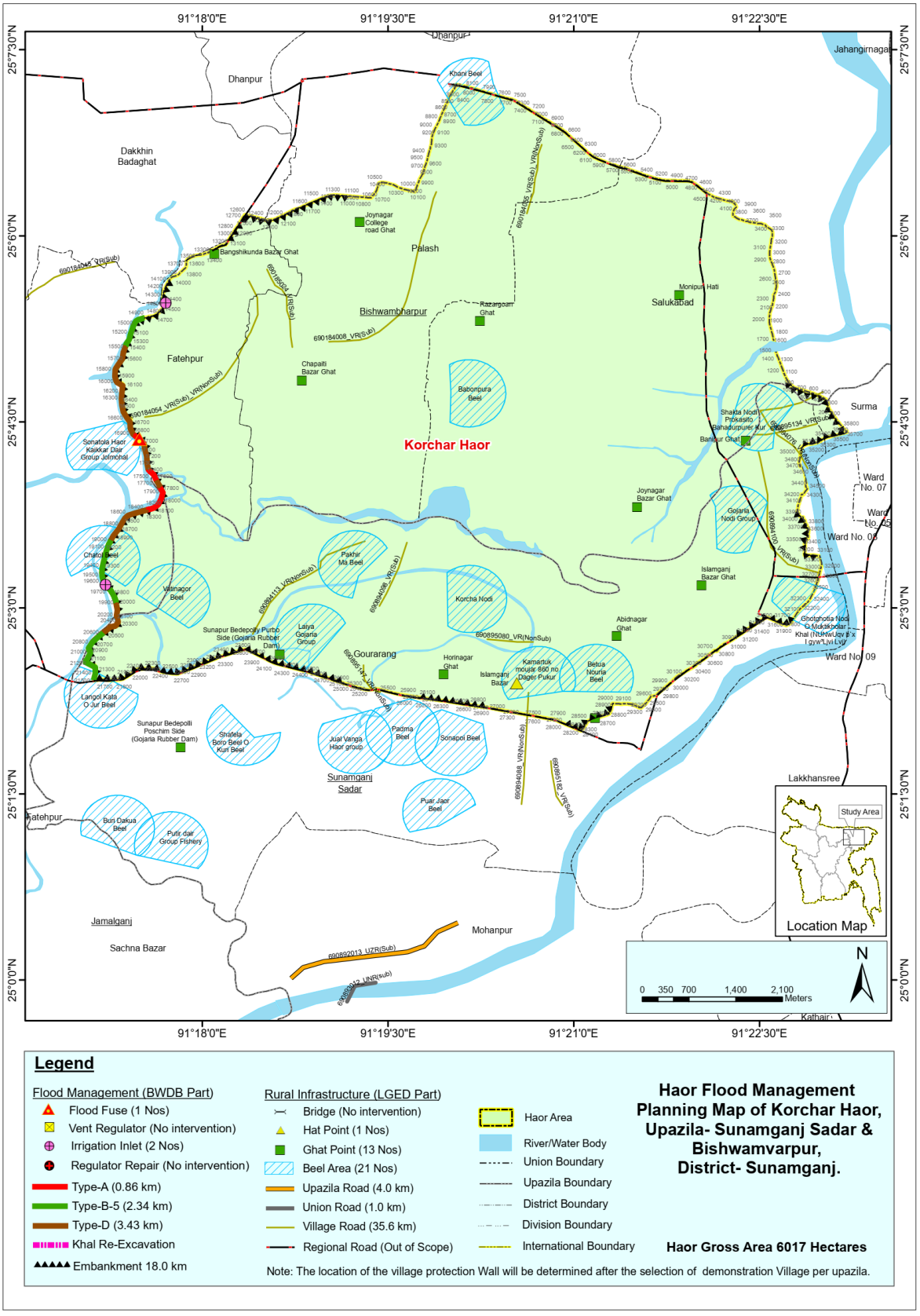
Rural Infrastructure (LGED Part)
- Bridge (No intervention)
- Hat Point (1 Nos)
- Ghat Point (1 Nos)
- Beel Area (1 Nos)
- Upazila Road (No intervention)
- Union Road (5.4 km)
- Village Road (13.4 km)
- Regional Road (Out of Scope)

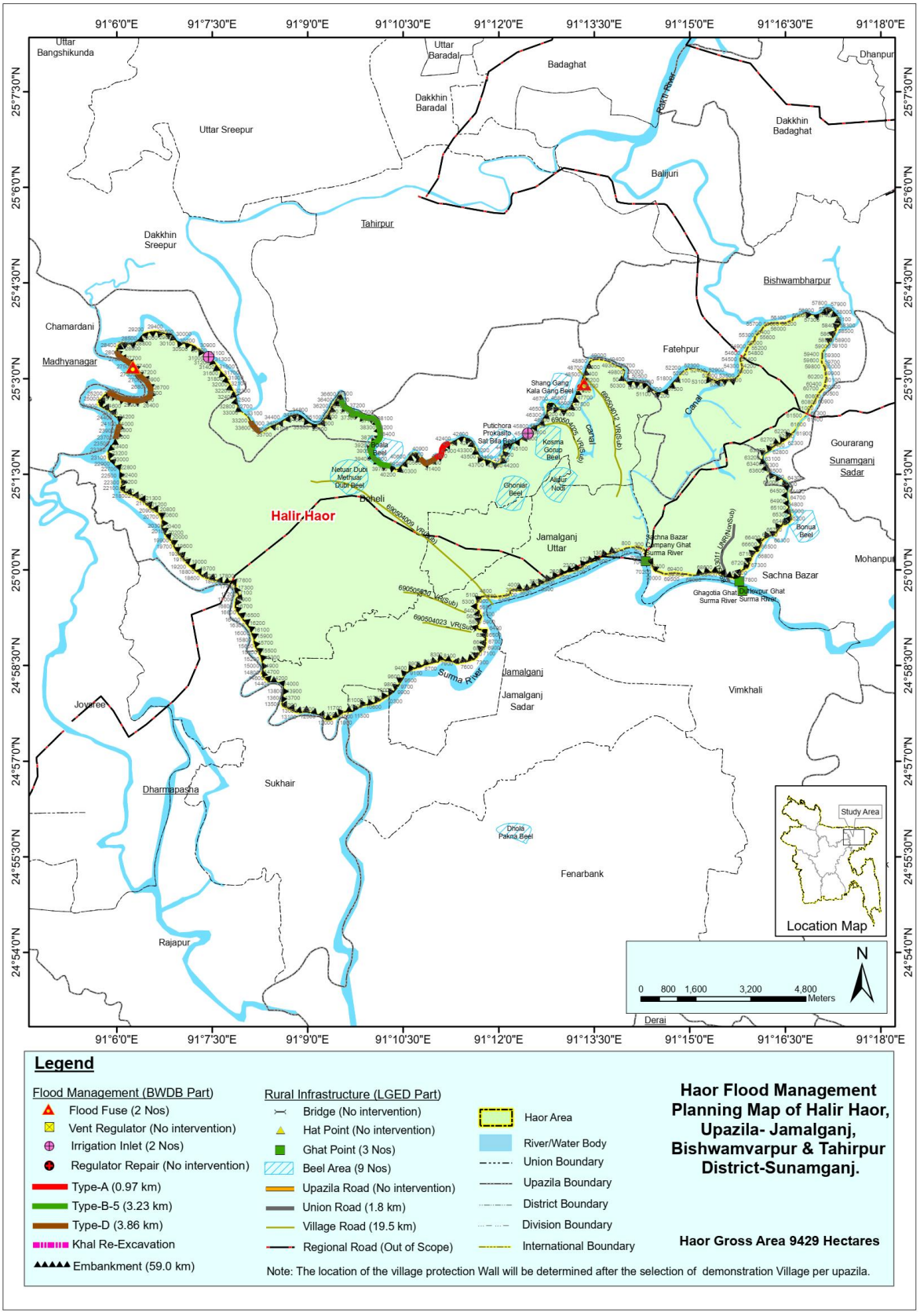
- Haor Area
- River/Water Body
- Union Boundary
- Upazila Boundary
- District Boundary
- Division Boundary
- International Boundary

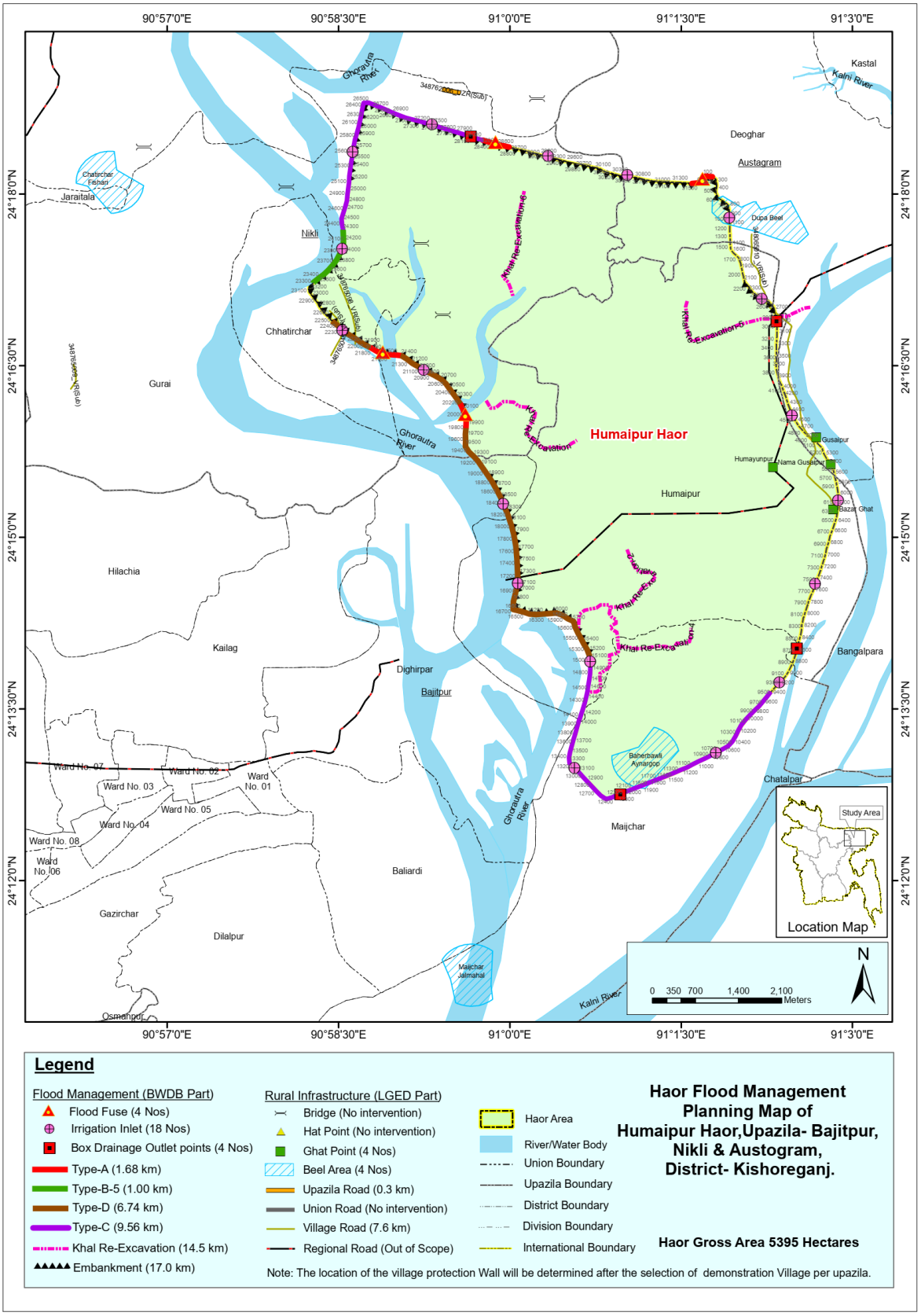
Haor Flood Management Planning Map of Pathor Chawli Haor, Upazila- Companiganj, District- Sylhet.

Haor Gross Area 6500 Hectares

Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.


91°18'0"E
91°19'30"E
91°21'0"E
91°22'30"E
25°7'30"N
25°6'0"N
25°4'30"N
25°3'0"N
25°1'30"N
25°0'0"N
Dhanpur
Jahangirnagar
Dakkhin Badaghat
Khari Beel
Joynagar College road Ghat
Palash
Bangshikunda Bazar Ghat
Bishwambharpur
Razargaon Ghat
Monipur Hati
Salukabad
Fatehpur
Chapaiti Bazar Ghat
Babonpura Beel
Korchar Haor
Surma
Shakta Nodi Prokasito Bahadurpurer Kur
Bahadurpur Ghat
Ward No. 07
Ward No. 05
Ward No. 08
Ward No. 09
Joynagar Bazar Ghat
Golaria Nodi Group
Islamganj Bazar Ghat
Sonatola Haor Kaikkar Dair Group Jamohal
Chatol Beel
Pakhir Ma Beel
Korcha Nodi
Abidnagar Ghat
Gourarang
Horinagar Ghat
Kamartuk mouja 860 no Digiri Fukur
Betua Nouria Beel
Langol Kata O Jur Beel
Sunapur Bedepolli Poschim Side (Gojaria Rubber Dam)
Shalela Boro Beel O Kuri Beel
Padma Beel
Sonapoi Beel
Sunamganj Sadar
Puar Jaor Beel
Lakhkhansree
Study Area
Location Map
Buri Oakua Beel
Puric dair Group Fishery
Jamalganj
Sachna Bazar
Mohanpur
0 350 700 1,400 2,100 Meters
N
Legend
Flood Management (BWDB Part)
Flood Fuse (1 Nos)
Vent Regulator (No intervention)
Irrigation Inlet (2 Nos)
Regulator Repair (No intervention)
Type-A (0.86 km)
Type-B-5 (2.34 km)
Type-D (3.43 km)
Khal Re-Excavation
Embankment 18.0 km
Rural Infrastructure (LGED Part)
Bridge (No intervention)
Hat Point (1 Nos)
Ghat Point (13 Nos)
Beel Area (21 Nos)
Upazila Road (4.0 km)
Union Road (1.0 km)
Village Road (35.6 km)
Regional Road (Out of Scope)
Haor Area
River/Water Body
Union Boundary
Upazila Boundary
District Boundary
Division Boundary
International Boundary
Haor Flood Management Planning Map of Korchar Haor, Upazila- Sunamganj Sadar & Bishwamvarpur, District- Sunamganj.
Haor Gross Area 6017 Hectares
Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.


Halir Haor
Uttar Bangshikunda
Uttar Baradal
Badaghat
Dhanpur
Dakkhin Baradal
Uttar Sreepur
Dakkhin Badaghat
Balijuri
Tahirpur
Dakkhin Sreepur
Bishwambharpur
Chamardani
Madhyanagar
Fatehpur
Gourarang
Sunamganj Sadar
Doheli
Jamalganj Uttar
Sachna Bazar
Mohanpur
Jamalganj
Jamalganj Sadar
Vimkhali
Jovaree
Dharmapasha
Sukhair
Fenarbank
Rajapur
Derai
Study Area
Location Map
N
0 800 1,600 3,200 4,800 Meters
Legend
Flood Management (BWDB Part)
Flood Fuse (2 Nos)
Vent Regulator (No intervention)
Irrigation Inlet (2 Nos)
Regulator Repair (No intervention)
Type-A (0.97 km)
Type-B-5 (3.23 km)
Type-D (3.86 km)
Khal Re-Excavation
Embankment (59.0 km)
Rural Infrastructure (LGED Part)
Bridge (No intervention)
Hat Point (No intervention)
Ghat Point (3 Nos)
Beel Area (9 Nos)
Upazila Road (No intervention)
Union Road (1.8 km)
Village Road (19.5 km)
Regional Road (Out of Scope)
Haor Area
River/Water Body
Union Boundary
Upazila Boundary
District Boundary
Division Boundary
International Boundary
Haor Flood Management Planning Map of Halir Haor, Upazila- Jamalganj, Bishwamvarpur & Tahirpur District-Sunamganj.
Haor Gross Area 9429 Hectares
Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.



Legend

Flood Management (BWDB Part)
- Flood Fuse (4 Nos)
- Irrigation Inlet (18 Nos)
- Box Drainage Outlet points (4 Nos)
- Type-A (1.68 km)
- Type-B-5 (1.00 km)
- Type-D (6.74 km)
- Type-C (9.56 km)
- Khal Re-Excavation (14.5 km)
- Embankment (17.0 km)

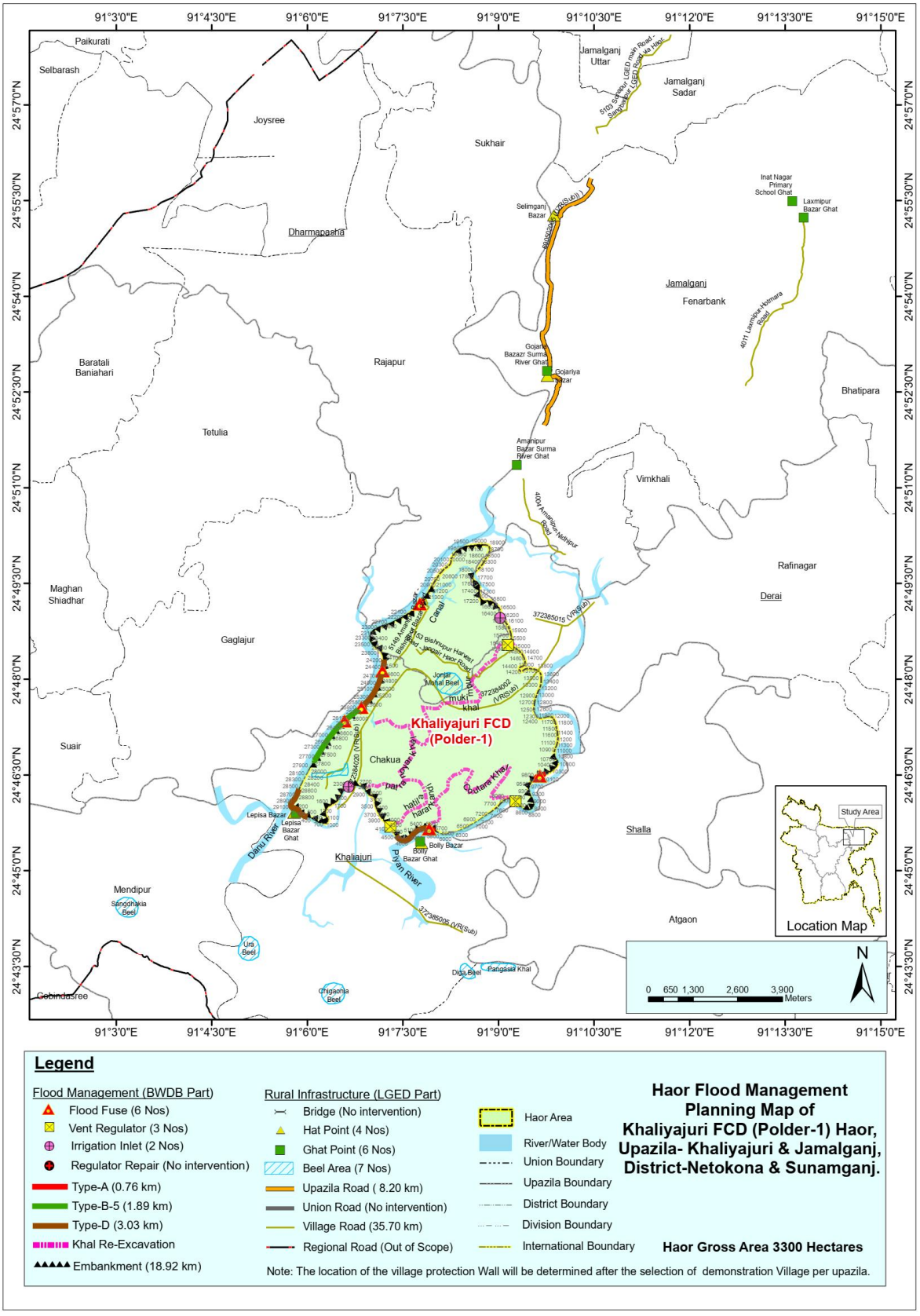
Rural Infrastructure (LGED Part)
- Bridge (No intervention)
- Hat Point (No intervention)
- Ghat Point (4 Nos)
- Beel Area (4 Nos)
- Upazila Road (0.3 km)
- Union Road (No intervention)
- Village Road (7.6 km)
- Regional Road (Out of Scope)

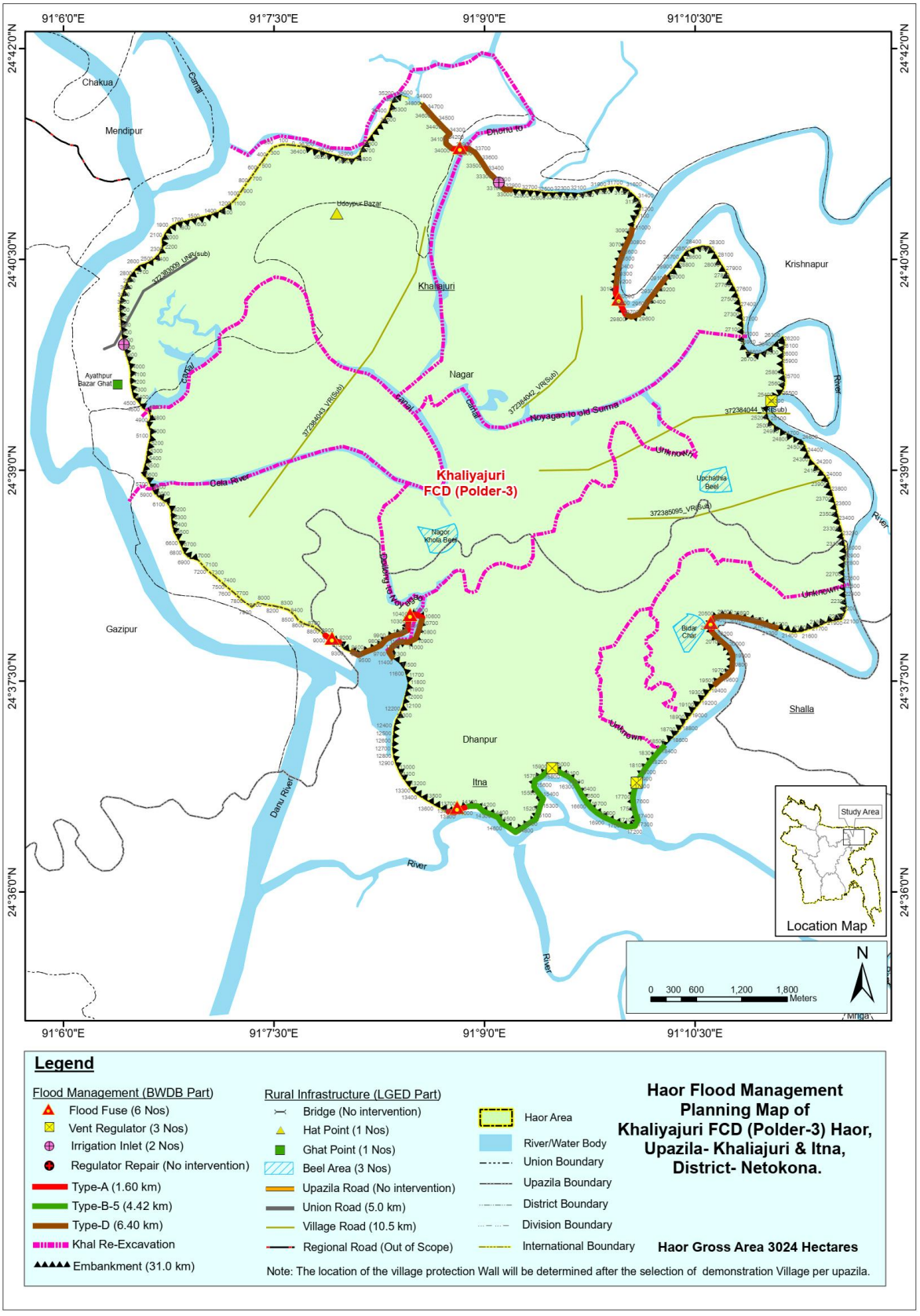
- Haor Area
- River/Water Body
- Union Boundary
- Upazila Boundary
- District Boundary
- Division Boundary
- International Boundary

Haor Flood Management Planning Map of Humaipur Haor,Upazila- Bajitpur, Nikli & Austogram, District- Kishoreganj.

Haor Gross Area 5395 Hectares

Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.


Khaliyajuri FCD (Polder-1)
Location Map
Study Area
N
0 650 1,300 2,600 3,900 Meters
Legend
Flood Management (BWDB Part)
Flood Fuse (6 Nos)
Vent Regulator (3 Nos)
Irrigation Inlet (2 Nos)
Regulator Repair (No intervention)
Type-A (0.76 km)
Type-B-5 (1.89 km)
Type-D (3.03 km)
Khal Re-Excavation
Embankment (18.92 km)
Rural Infrastructure (LGED Part)
Bridge (No intervention)
Hat Point (4 Nos)
Ghat Point (6 Nos)
Beel Area (7 Nos)
Upazila Road (8.20 km)
Union Road (No intervention)
Village Road (35.70 km)
Regional Road (Out of Scope)
Haor Area
River/Water Body
Union Boundary
Upazila Boundary
District Boundary
Division Boundary
International Boundary
Haor Flood Management Planning Map of Khaliyajuri FCD (Polder-1) Haor, Upazila- Khaliyajuri & Jamalganj, District-Netokona & Sunamganj.
Haor Gross Area 3300 Hectares
Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.



Legend

Flood Management (BWDB Part)
- Flood Fuse (6 Nos)
- Vent Regulator (3 Nos)
- Irrigation Inlet (2 Nos)
- Regulator Repair (No intervention)
- Type-A (1.60 km)
- Type-B-5 (4.42 km)
- Type-D (6.40 km)
- Khal Re-Excavation
- Embankment (31.0 km)

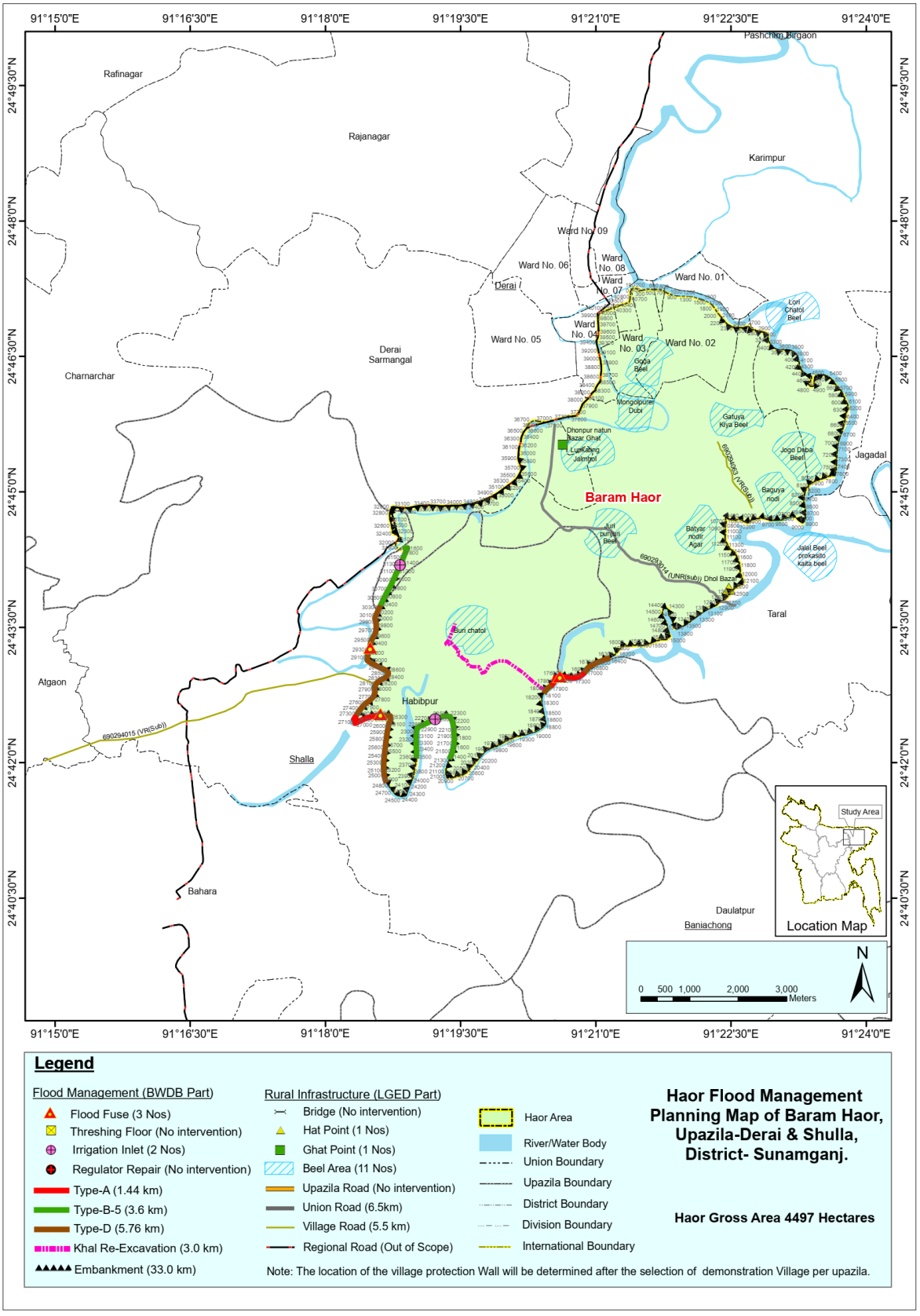
Rural Infrastructure (LGED Part)
- Bridge (No intervention)
- Hat Point (1 Nos)
- Ghat Point (1 Nos)
- Beel Area (3 Nos)
- Upazila Road (No intervention)
- Union Road (5.0 km)
- Village Road (10.5 km)
- Regional Road (Out of Scope)

- Haor Area
- River/Water Body
- Union Boundary
- Upazila Boundary
- District Boundary
- Division Boundary
- International Boundary

Haor Flood Management Planning Map of Khaliyajuri FCD (Polder-3) Haor, Upazila- Khaliajuri & Itna, District- Netokona.

Haor Gross Area 3024 Hectares

Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.



Legend

Flood Management (BWDB Part)

- Flood Fuse (3 Nos)
- Threshing Floor (No intervention)
- Irrigation Inlet (2 Nos)
- Regulator Repair (No intervention)
- Type-A (1.44 km)
- Type-B-5 (3.6 km)
- Type-D (5.76 km)
- Khal Re-Excavation (3.0 km)
- Embankment (33.0 km)

Rural Infrastructure (LGED Part)

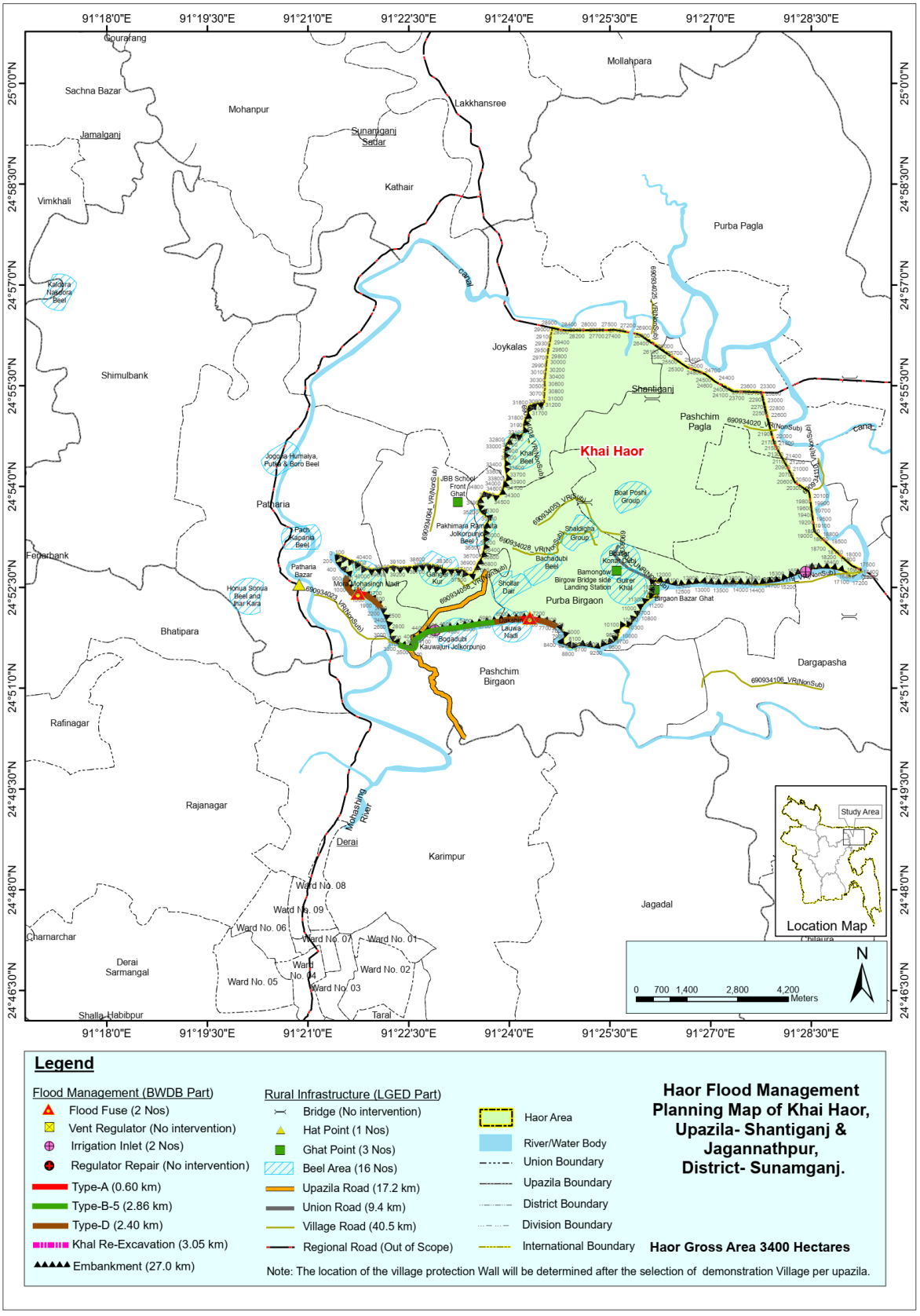
- Bridge (No intervention)
- Hat Point (1 Nos)
- Ghat Point (1 Nos)
- Beel Area (11 Nos)
- Upazila Road (No intervention)
- Union Road (6.5km)
- Village Road (5.5 km)
- Regional Road (Out of Scope)

- Haor Area
- River/Water Body
- Union Boundary
- Upazila Boundary
- District Boundary
- Division Boundary
- International Boundary

Haor Flood Management Planning Map of Baram Haor, Upazila-Derai & Shulla, District- Sunamganj.

Haor Gross Area 4497 Hectares

Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.



Legend

Flood Management (BWDB Part)
- Flood Fuse (2 Nos)
- Vent Regulator (No intervention)
- Irrigation Inlet (2 Nos)
- Regulator Repair (No intervention)
- Type-A (0.60 km)
- Type-B-5 (2.86 km)
- Type-D (2.40 km)
- Khal Re-Excavation (3.05 km)
- Embankment (27.0 km)

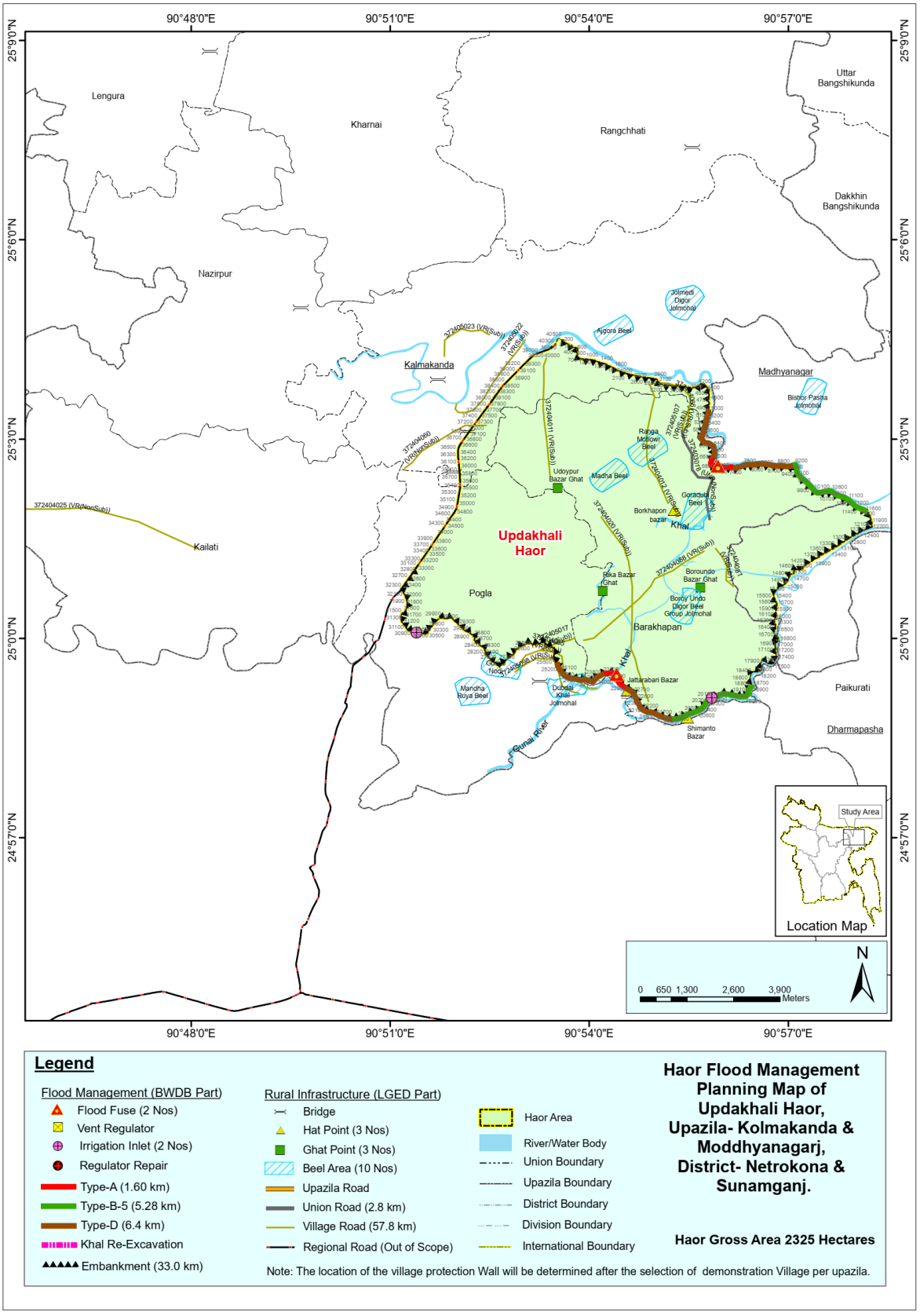
Rural Infrastructure (LGED Part)
- Bridge (No intervention)
- Hat Point (1 Nos)
- Ghat Point (3 Nos)
- Beel Area (16 Nos)
- Upazila Road (17.2 km)
- Union Road (9.4 km)
- Village Road (40.5 km)
- Regional Road (Out of Scope)

- Haor Area
- River/Water Body
- Union Boundary
- Upazila Boundary
- District Boundary
- Division Boundary
- International Boundary

Haor Flood Management Planning Map of Khai Haor, Upazila- Shantiganj & Jagannathpur, District- Sunamganj.

Haor Gross Area 3400 Hectares

Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.



Legend

Flood Management (BWDB Part)
- Flood Fuse (2 Nos)
- Vent Regulator
- Irrigation Inlet (2 Nos)
- Regulator Repair
- Type-A (1.60 km)
- Type-B-5 (5.28 km)
- Type-D (6.4 km)
- Khal Re-Excavation
- Embankment (33.0 km)

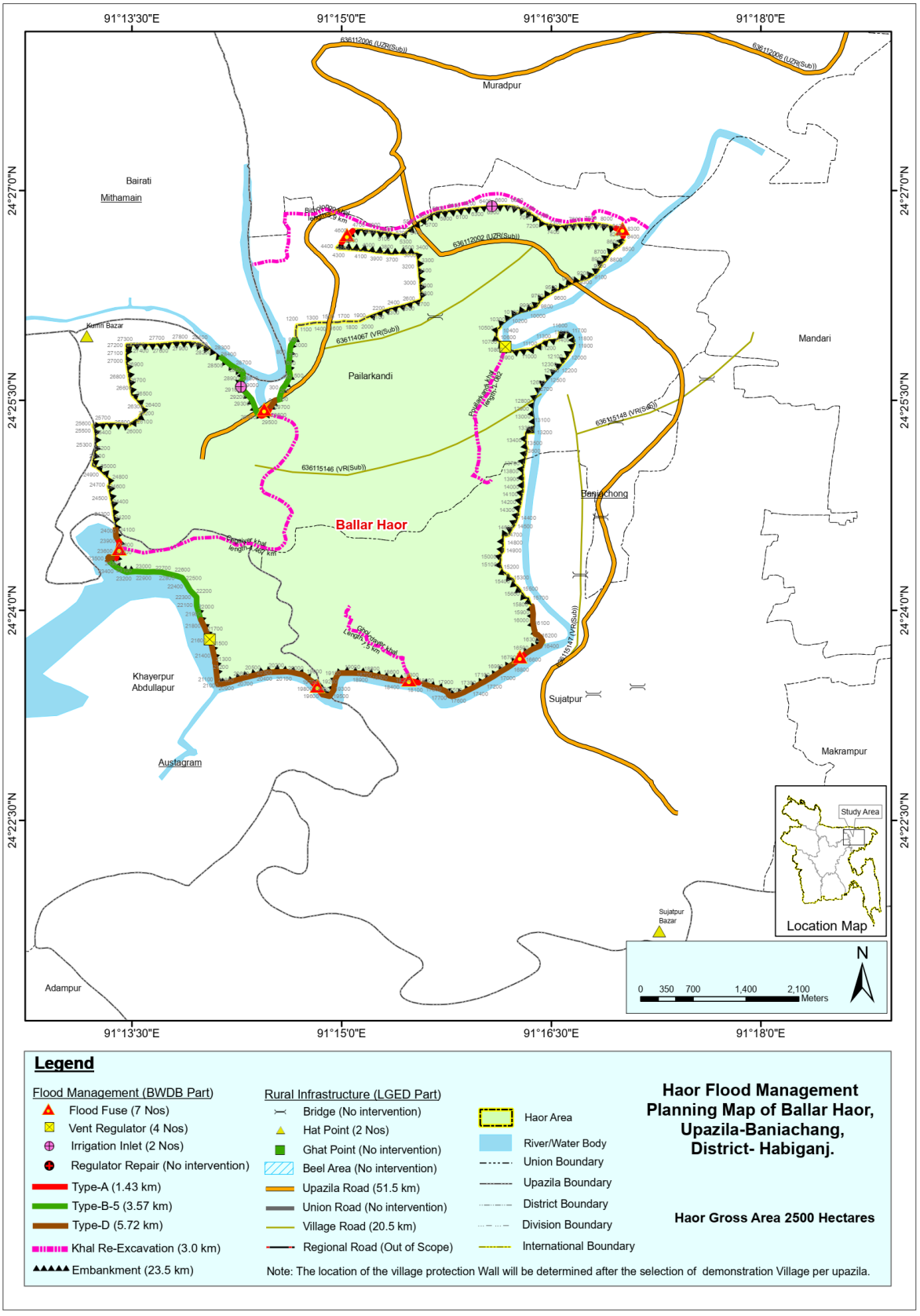
Rural Infrastructure (LGED Part)
- Bridge
- Hat Point (3 Nos)
- Ghat Point (3 Nos)
- Beel Area (10 Nos)
- Upazila Road
- Union Road (2.8 km)
- Village Road (57.8 km)
- Regional Road (Out of Scope)

- Haor Area
- River/Water Body
- Union Boundary
- Upazila Boundary
- District Boundary
- Division Boundary
- International Boundary

Haor Flood Management Planning Map of Updakhali Haor, Upazila- Kolmakanda & Moddhyanagarj, District- Netrokona & Sunamganj.

Haor Gross Area 2325 Hectares

Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.


91°13'30"E
91°15'0"E
91°16'30"E
91°18'0"E
24°27'0"N
24°25'30"N
24°24'0"N
24°22'30"N
Muradpur
Bairati
Mithamain
Kemiti Bazar
Pailarkandi
Mandari
Ballar Haor
Banjachong
Khayerpur
Abdullapur
Austagram
Sujatpur
Sujatpur Bazar
Makrampur
Adampur
Study Area
Location Map
N
0 350 700 1,400 2,100
Meters
Legend
Flood Management (BWDB Part)
Flood Fuse (7 Nos)
Vent Regulator (4 Nos)
Irrigation Inlet (2 Nos)
Regulator Repair (No intervention)
Type-A (1.43 km)
Type-B-5 (3.57 km)
Type-D (5.72 km)
Khal Re-Excavation (3.0 km)
Embankment (23.5 km)
Rural Infrastructure (LGED Part)
Bridge (No intervention)
Hat Point (2 Nos)
Ghat Point (No intervention)
Beel Area (No intervention)
Upazila Road (51.5 km)
Union Road (No intervention)
Village Road (20.5 km)
Regional Road (Out of Scope)
Haor Area
River/Water Body
Union Boundary
Upazila Boundary
District Boundary
Division Boundary
International Boundary
Haor Flood Management Planning Map of Ballar Haor, Upazila-Baniachang, District- Habiganj.
Haor Gross Area 2500 Hectares
Note: The location of the village protection Wall will be determined after the selection of demonstration Village per upazila.