Bangladesh Power Development Board (BPDB)

Environmental Impact Assessment Report
of
Saidpur 150 MW ±10% Simple Cycle HSD based Power Plant Project at Saidpur, Nilphamari, Bangladesh

December 2019

CEGIS
Center for Environmental and Geographic Information Services
(A Public Trust under the Ministry of Water Resources)
House 6, Road 23/C, Gulshan-1, Dhaka-1212. Bangladesh.
Tel: 88 02 58817649-52; 9842581, 9842551 Fax: 88 02 9843128 e-mail: cegis@cegisbd.com http://www.cegisbd.com

Environmental Impact Assessment Report

on

Saidpur 150 MW ±10% Simple Cycle HSD based Power Plant Project at Saidpur, Nilphamari, Bangladesh

Acknowledgements

The Center for Environmental and Geographic Information Services (CEGIS), a Public Trust under the Ministry of Water Resources, is grateful to Bangladesh Power Development Board (BPDB) for awarding the contract of consultancy on "Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) Study For (A) Saidpur 150 MW ± 10% Simple Cycle (HSD Based) Power Plant Project, Nilphamari, (B) Shahjibazar 100 MW Gas Turbine (Aero derivative) Power Plant Project, Habiganj and (C) Raozan 600 MW ± 10% Hi Efficient Combined Cycle Power Plant project, Chattogram, Bangladesh".

CEGIS greatly acknowledges the wide support of the Project Director, Mr. Md. Aslam Uddin, Superintending Engineer (S.E) BPDB for his valuable guidance in conducting the study. CEGIS is also thankful to Mr. Abu Sayeed Sarker, Manager (XEN) of Saidpur Power Plant, Saidpur, Nilphamari, Bangladesh for his kind support in conducting the study and extending help to the multidisciplinary team members during the site visit.

In the end CEGIS deeply appreciates and acknowledges the concerns and perceptions of the local people about the Project who actively participated and extended their cooperation during field survey.

EIA Study Team

Team composition for the EIA Study

Sl. No.	Name of Professional	Position Assigned
1.	Mr. Malik Fida Abdullah Khan	Team Leader, Civil Engineer
2.	Md. Maqbul-E-Elahi	Geotechnical Investigation
3.	Kazi Kamrull Hassan	Environmental Specialist
4.	Dr. Kazi Noor Newaz	Environmental Specialist
5.	Dr. Dilruba Ahmed	Socio-economist
6.	Mr. Subrata Kumar Mondal	Socio-Economist
7.	Dr. Choudhury Saleh Ahmed	Economist
8.	Mr. Abu Sayed Md. Faysal	Jr. Engineer (Environmental)
9.	Mr. Md. Jafrul Alom	Jr. Engineer (Soil)
10	Mr. M. Habibur Rahman	Jr. Engineer (Survey)
11	Mr. Rafiqul Islam	Field Supervisor
12	Mr. Md. Mutasim Billah	Field Supervisor
13	Mr. Dewan Mohammad Ariful Islam	Field Supervisor

Additional Team Members

Sl. No.	Name of Professional	Position Assigned
1	Deeba Farzana Moumita	Project Leader and Electrical Engineer
2	Jalal Ahmed Choudhury	Power Plant and Instrumentation Expert
3	Md. Azizul Haque	Water Resources Expert and advisor
4	Mohammed Mukteruzzaman	Biologist and specialist in Fisheries
5	Pronab Kumar Halder	Environmental Modeler
6	Mohammad Kamruzzaman	Ecologist
7	Hifzur Rahman	Sociologist
8	Most Tania Karim	Jr. Agriculture Specialist
9	Hasin Ahmed	Water Resources Expert
10	Riaz Hossain Khan	Geologist
11	Sharmin Akhter	Jr. Fisheries Expert

Table of Contents

Acknowledgements .... **i**
EIA Study Team .... **iii**
List of Tables .... **xi**
List of Figures .... **xiii**
Abbreviations and Acronyms .... **xvii**
Unit Conversion Table .... **xxi**
Glossary .... **xxiii**
Executive Summary .... **xxv**
1. Introduction **1**
1.1 Background 1
1.2 Objectives 1
1.2.1 Objective of the Project 1
1.2.2 Objective of the Study 2
1.3 Need of the Project 2
1.4 Rationale of the Project 2
1.5 Methodology of the EIA Study 4
1.5.1 Scoping 4
1.5.2 Bounding 4
1.5.3 Description of Baseline Condition 5
1.5.4 People's Participation 10
1.5.5 Finalizing of IECs 10
1.5.6 Determination of Potential Impacts Identification 10
1.5.7 Project Compliance with National and International Regulatory Requirements 12
1.5.8 Cumulative Impact Assessment 13
1.5.9 Development of an Environmental Management Plan 13
1.5.10 Risk and Hazard Assessment 14
1.5.11 Development of Emergency Response Plan 14
1.5.12 Public Consultation and Disclosure 15
1.5.13 EIA Documents 16
2. Analysis of Alternatives **17**
2.1 Introduction 17
2.2 Location Alternative 17
2.3 Fuel Alternatives 17
2.4 Technology Alternatives 18
3. Project Design and Description **19**
3.1 Project Concept 19
3.2 Project Location and Access Way 19

3.2.1 Project Location 19
3.2.2 Study Area 19
3.2.3 Access Way 19
3.3 Land Requirement and Acquisition 25
3.4 Project Site Development 25
3.5 Provisional Project Layout 25
3.6 Project Components and Description 25
3.6.1 Power Generation 25
3.6.2 Power Evacuation 28
3.7 Project Activities 28
3.7.1 Pre -Construction Phase 28
3.7.2 Construction Phase 29
3.7.3 Post Construction (Operation) Phase 29
3.8 Local Resources and Utility Demand 29
3.8.1 Resource and Utility Demand 29
3.9 Transportation of Equipment, Machineries and Fuel 29
3.10 Waste Management 30
3.10.1 Solid waste 30
3.10.2 Perishable waste 30
3.10.3 Non-perishable Waste 30
3.10.4 Sanitary Waste 31
3.10.5 Liquid Waste 31
3.10.6 Effluent Treatment and Maintaining Discharge Standard 31
3.10.7 Oil Sludge 32
3.11 Central Control, Monitoring and Protection 32
3.12 Civil Structure and Urban Facilities 33
3.13 Afforestation 33
3.14 Human Resources Required During Different Phases 33
4. Policy, Legal and Administrative Framework 35
4.1 Introduction 35
4.2 Applicable Policies and Legal provision 36
4.3 National environmental legal provisions in connection with setup, operation & maintenance 39
4.3.1 Procedure to obtain environmental clearance certificate 40
4.3.2 Provisions under the environmental legislations 40
4.3.3 Compliance with EIA guidelines of DoE 42
4.3.4 Compliance under the national laws 43
4.4 National Policy Guidance 45
4.5 International legal obligations 48
4.6 Development agency's health and safety guidelines 50

4.6.1 ADB's Social Safeguard Policy 50
4.6.2 World Bank Environmental Assessment (EA) Process 50
5. Environmental and Social Baseline Condition 51
5.1 Introduction 51
5.2 Physical Environment 51
5.2.1 Geology 51
5.2.2 Climate and Meteorology 58
5.2.3 Environmental Quality 61
5.2.4 Water Resources 66
5.2.5 Land Resources 71
5.3 Biological Environment 79
5.3.1 Agricultural Resources 79
5.3.2 Livestock Resources 84
5.3.3 Fisheries Resources 85
5.3.4 Ecological Resources 87
5.4 Social Environment 93
5.4.1 Area and Location 93
5.4.2 Communication System 95
5.4.3 Demographic Profile 95
5.4.4 Settlement and Housing 97
5.4.5 Economy and Employment 98
5.4.6 Literacy Status 101
5.4.7 Public Utilities 101
5.4.8 Community Access to Health 103
5.4.9 Safety nets 103
5.4.10 Sites of Important Properties 103
5.4.11 Social Relation 103
6. Stakeholder Consultation 105
6.1 Introduction 105
6.2 Regulatory Requirements 105
6.2.1 Bangladesh Guidelines 105
6.2.2 Objectives of Stakeholder Consultation 105
6.3 Approaches and Methodology of Consultation 106
6.3.1 Identification of Stakeholders 106
6.4 Details of Consultation Meetings 106
6.4.1 Informal Discussion 106
6.4.2 Locations of Stakeholder Consultations 107
6.5 Identified Issues discussed in Consultation 107
6.6 People's perceptions and suggested measures 108
6.7 Photographs and participant List 110

6.8 Public Disclosure Meeting 112
7. Environmental and Social Impacts and Mitigation Measures 119
7.1 General 119
7.2 Selection of IESCs 119
7.2.1 Physical Environment 119
7.2.2 Biological Environment 120
7.2.3 Socio-economic Environment 121
7.3 Environmental Impacts during Pre-Construction 121
7.3.1 Ambient Air Quality 121
7.3.2 Impact on Ambient Noise 122
7.3.3 Impact on Water Resources 122
7.3.4 Non-Hazardous Waste Generation 122
7.3.5 Impact on Ecological Resources 124
7.3.6 Impact on Social Environment 124
7.4 Environmental Impacts during Construction 124
7.4.1 Ambient Air Quality 124
7.4.2 Impact on Ambient Noise 124
7.4.3 Impact on Water Resources 125
7.4.4 Impact on Water Quality and Quantity 125
7.4.5 Non-Hazardous Waste Generation 125
7.4.6 Impact on Ecological Resources 126
7.4.7 Impact on Social Environment 127
7.5 Environmental Impacts during Operation 127
7.5.1 Impact on Ambient Air Quality 127
7.5.2 Impact on Ambient Noise 142
7.5.3 Impacts on Land Resources 144
7.5.4 Impact on Water Resources 144
7.5.5 Non-Hazardous Waste Generation 145
7.5.6 Hazardous Waste Generation 146
7.5.7 Impact on Ecological Resources 146
7.5.8 Impact on Social Environment 147
7.6 Summary of Assessed Impacts 147
8. Hazard and Risk Assessment 161
8.1 Introduction 161
8.2 Frequency Analysis 161
8.3 Consequence Analysis 161
8.3.1 Consequence Modeling Tools 161
8.3.2 Assumption and considering factors 162
8.3.3 Results of HSD Tank failure 163
8.4 Hazard, Magnitude and Frequency Analysis 165

8.4.1 Risk Matrix Development ... 166
8.4.2 OHS Training ... 173
8.5 Emergency Response Plan ... 174
8.5.1 Emergency Preparedness ... 175
8.5.2 Emergency Evacuation Plan ... 176
8.5.3 Emergency Response ... 176
8.5.4 The Incident Response Team (IRT) ... 179
8.5.5 The Emergency Response Group (ERG) ... 179
8.5.6 The Incident Management Team (IMT) ... 179
8.5.7 Emergency Recovery ... 179
8.5.8 Documenting and Reporting ... 179
8.5.9 Emergency Recovery ... 179
8.5.10 Emergency Evacuation Plan ... 180
9. Environmental Management Plan ... 181
9.1 Introduction ... 181
9.2 Objective of EMP ... 181
9.3 Project Components and Various Categories of Mitigation Measures ... 181
9.3.1 Project Components ... 181
9.3.2 Various Categories of Mitigation Measures ... 182
9.4 Inclusion of EMP in Contract Documents ... 182
9.5 Environmental Code of Practices ... 182
9.6 Environmental Management Plan during Pre-Construction Phase ... 182
9.6.1 Dismantling Components ... 182
9.6.2 Demolition Plan ... 191
9.6.3 Site Preparation ... 197
9.6.4 Kitchen Waste ... 197
9.6.5 Ecosystem Management Plan ... 197
9.6.6 Drinking Water Supply and Water Quality Management ... 198
9.6.7 Groundwater Level Management Plan ... 198
9.6.8 Management of surface water availability ... 198
9.6.9 Stakeholder engagement plan ... 198
9.7 EMP during Construction Phase ... 198
9.7.1 Acoustic Management Plan ... 198
9.7.2 Kitchen Waste ... 199
9.7.3 Construction waste management plan ... 199
9.7.4 Waste Disposal and Effluent Management Plan ... 199
9.7.5 Fuel and Hazardous substances Management Plan ... 199
9.7.6 Ecosystem Management Plan ... 199
9.7.7 Labor Recruitment Plan ... 200
9.7.8 Management of surface water availability ... 200

9.7.9 Drinking Water Supply and Sanitation Plan.. 200
9.7.10 Traffic Management Plan.. 200
9.8 EMP during Operation Phase.. 200
9.8.1 Air Pollution Management Plan... 200
9.8.2 Acoustic Management Plan... 201
9.8.3 Solid waste management... 201
9.8.4 Waste Water Management Plan 201
9.8.5 Sewerage Management Plan.. 201
9.8.6 Water resources management 201
9.8.7 Hazardous Material Management 201
9.8.8 Agricultural Land Management Plan... 202
9.8.9 Ecosystem Protection Plan 202
9.8.10 Greenbelt Development 202
9.8.11 Greenbelt Development Plan 203
9.8.12 Occupational Health Safety and Environment 207
9.8.13 Grievance Redress Mechanism.. 207
9.9 Mitigation Plan.. 208
9.10 Administrative Setup and Organogram 218
9.10.1 Bangladesh Power Development Board 218
9.10.2 Proposed Saidpur 150 MW ±10% HSD Based Simple Cycle Power Plant. 218
9.11 Environmental Monitoring Plan... 220
9.11.1 Compliance Monitoring 221
9.11.2 Impacts Monitoring during Construction.. 221
9.11.3 Independent/ External Monitoring 221
9.12 Budget for EMP.. 229
10. Conclusions and Recommendations..231
10.1 Conclusions... 231
10.2 Recommendations.. 231
References 233
Annexes 235
Annex 1: Site Clearance Certificate 237
Annex 2: Terms of Reference (ToR) 239
Annex 3: Layout and Design...249
Annex 4: ECR Standard 251
Annex 5: Checklist for Field Data Collection 263
Annex 6: Environmental Code of Practices 279

List of Tables

Table 1.1: Criteria for Determining Sensitivity of the Receptors 11
Table 1.2: Parameters for Determining Impact Scale 11
Table 1.3: Significance of Impact Criteria 12
Table 3.1: Distance of administrative Head Quarters and landmarks from the Project site 20
Table 3.2: ETP Design Treated Effluent Quality (ECR, 1997) 31
Table 4.1: National legal provisions and standards applicable to the proposed simple cycle Power Plant for ensuring environmental protection 36
Table 5.1: Stratigraphy of the Rangpur Platform based on Maddhyapara Granite Mine . 54
Table 5.2: List of Major Earthquakes in past 450 Years 54
Table 5.3: Location of Air Quality Sampling points 61
Table 5.4: Baseline Air Quality Monitoring Results at Saidpur 62
Table 5.5: Existing Noise Level at Nearby Sensitive Receptors 63
Table 5.6: Water Quality Assessment Details 65
Table 5.7: In-situ result of water quality in the study area 65
Table 5.8: Laboratory result of water quality in the study area 65
Table 5.9: Laboratory test result of groundwater quality in the study area 66
Table 5.10: Laboratory test result of water quality in the study area 66
Table 5.11: Land use of study area 74
Table 5.12: Land type of the study area 74
Table 5.13: Soil texture of study area 76
Table 5.14: Soil quality based on plant nutrient of the study area 76
Table 5.15: Soil sampling location of the study area 77
Table 5.16: Analytical result of soil samples 78
Table 5.17: Cropping pattern by land type of the study area 80
Table 5.18: Cropped area, yield and annual production and damage in the study area . 81
Table 5.19: Seed, labor, fertilizer and pesticides use in the crop fields 83
Table 5.20: Irrigation facilities in the study area 83
Table 5.21: Status of livestock and poultry in the study area 84
Table 5.22: Fish Habitat and Production Analysis in Study Area 86
Table 5.23: Tree species in the project area 87
Table 5.24: A list of social forests in the study area 91
Table 5.25: A list of common species in the study area 92
Table 5.26: Location and union coverage of the study area 95
Table 5.27: Demographic scenario of the study area 96
Table 5.28: Wage rate of labors in the study area 99

Table 5.29: Monthly income and expenditure level 100
Table 5.30: Land price two main units of the study area 100
Table 6.1: Detail of KIIs and IGDs 107
Table 6.2: Identified Problems and Suggested Solutions 109
Table 6.3: Participant List.. 111
Table 6.4: Issues raised in the meeting and response 113
Table 7.1: Estimation of Kitchen Waste during Pre-construction and Land Development Period 123
Table 7.2: Estimation of Kitchen Waste during Construction Period 126
Table 7.3: Project Area Coordinates (UTM Zone: 45 R) 128
Table 7.4: Air quality monitoring data in the study area 129
Table 7.5: Sensitivity Analysis for Stack Height 131
Table 7.6: Locations of Sensitive Receptors 132
Table 7.7: Major Point Source Emissions in the Project Area 133
Table 7.8: Air Quality Modeling – NO_x 134
Table 7.9: Air Quality Modeling – SO_2 134
Table 7.10: Air Quality Modeling – CO.. 135
Table 7.11: Air Quality Modelling – PM_{10}... 135
Table 7.12: Air Quality Modeling – $PM_{2.5}$... 136
Table 7.13: Maximum GLC of the criteria pollutants at each of the sensitive receptors 137
Table 7.14: Maximum Ground Level Concentration of Pollutants for Cumulative Case 141
Table 7.15: Annual GHG Emissions from Different Fuel Sources 142
Table 7.16: Predicted Noise Level at different sensitive noise receptors during the operation phase of the proposed Power Plant 144
Table 7.17: Estimation of Kitchen Waste during Operation Period 145
Table 7.18: Potential impacts, their significance and corresponding mitigation measures 149
Table 8.1: Damage due to incident radiation intensity 164
Table 8.2: Heat radiation and escape time.. 165
Table 8.3: Tolerable intensities for various objects 165
Table 8.4: Hazard Magnitude Scale.. 165
Table 8.5: Criteria for Determining Frequency of the Potential Hazard..................... 166
Table 8.6: Risk Matrix of Potential Hazards/Impacts 167
Table 8.7: Identification of Existing Safeguards.. 169
Table 8.8: Type of training and training actions 173
Table 8.9: Training schedule that may be adopted for safety 174
Table 8.10: List of preparedness measures... 175
Table 8.11: Emergency Response Escalation Protocol 177
Table 9.1: List of infrastructures and debris quantity from the demolitions site of SPS 183

Table 9.2: List of oil tanks and quantity of steel from the demolitions site of SPS 184
Table 9.3: Locations of Air Sensitive Receivers 187
Table 9.4: Type of Waste Materials from Demolition Activities 190
Table 9.5: Mitigation plan 209
Table 9.6: Environmental Monitoring Plan 223
Table 9.7: Tentative cost of EMP 229

List of Figures

Figure 1.1: Base Map of the Study Area 3
Figure 1.2: Steps of EIA Study 5
Figure 1.3: Methodology of land use mapping 7
Figure 1.4: Glimpse of Field Data Collection Process 7
Figure 3.1: Location Map of the Proposed Project Site 21
Figure 3.2: Distance Map of Saidpur Airport from the Power Plant 22
Figure 3.3: Aerial Distance of Important Landmarks from the Proposed Project Site 23
Figure 3.4: Aerial distance of important locations within 2 km radius area from the Project Site on Google Image 24
Figure 3.5: Typical process flow diagram of a Gas Turbine Simple Cycle Power Plant .. 26
Figure 3.6: Water Balance Diagram for the Proposed Power Plant 27
Figure 3.7: Flow diagram of Oily sludge 32
Figure 4.1: Process of obtaining site and environmental clearance certificate from DoE 43
Figure 5.1: Physiographic map of the proposed project site and surrounding areas 52
Figure 5.2: Tectonic map of Bangladesh 53
Figure 5.3: Seismic zoning map for Bangladesh 56
Figure 5.4: Major lineaments and the historical records of earthquakes in Bangladesh and adjoining areas 57
Figure 5.5: Monthly average Rainfall measured at Saidpur, Nilphamari Station 58
Figure 5.6: Monthly maximum and minimum Temperature measured at Saidpur station 59
Figure 5.7: Monthly average Humidity measured at Saidpur Station 59
Figure 5.8: Monthly average evaporation rate measured at Dinajpur Station 60
Figure 5.9: Monthly variation of average wind speed measured at Saidpur Station 60
Figure 5.10: Monthly average sunshine hours per day measured at Saidpur Station 61
Figure 5.11: Air Sampling Location Map 62
Figure 5.12: Noise Sampling Location Map 64
Figure 5.13: Water and Soil Sampling locations of the study area 67
Figure 5.14: Water Resources Map within the Study Area 68

Figure 5.15: Kharkharia River and Pond in the study area 69
Figure 5.16: Average daily Water Level at Kundal station, Saidpur, Nilphamari (1987-2017) 69
Figure 5.17: Average Monthly Groundwater Depth Inside the Study Area Land Resources 70
Figure 5.18: Agro-ecological Zone of the Project and Study Area 73
Figure 5.19: Land Use Map of the Study Area 75
Figure 5.20: Crop land in the study area 81
Figure 5.21: Crop calendar of the study area 82
Figure 5.22: Livestock and poultry in the study area 85
Figure 5.23: Different Types of Fish Habitat in the Study Area (Dry season) 86
Figure 5.24: Bio-Ecological Zone of the Study Area 88
Figure 5.25: Photographs of exisitng vegetation in the proposed Power Plant area 89
Figure 5.26: Partial view of the proposed diesel transmission pipeline alignment 89
Figure 5.27: Partial view of the proposed diesel transmission pipeline alignment (closer view) 89
Figure 5.28: Terrestrial vegetation of the study area 91
Figure 5.29: Aquatic ecosystem in the study area 93
Figure 5.30: Resource Map of the study area 94
Figure 5.31: Age structure of the studied population 96
Figure 5.32: Type of housing structures in study area 97
Figure 5.33: Concrete stuctures will be demolished opposite side of the plant boundary 97
Figure 5.34: Structure in the project area 97
Figure 5.35: Housing tenancy in the study area 98
Figure 5.36: Proportionate distribution of employment in the study area 98
Figure 5.37: Proportionate distribution of population by field of activity 99
Figure 5.38: Poverty status in terms of distribution of households in the study area .. 101
Figure 5.39: Distribution of Household by literacy rates 101
Figure 5.40: Sanitation facilities in the study area 102
Figure 5.41: Electricity coverage in the study area 102
Figure 6.1: Consultations with stakeholders at the study area 110
Figure 6.2: Invitation of local people through poster 112
Figure 6.3: Advertisement in Daily Newspaper 113
Figure 6.4: Some Pictures of Public Disclosure Meeting 118
Figure 7.1: Proposed Project Area 128
Figure 7.2: Wind speed and direction at the Project stack 130
Figure 7.3: 24 hr average Max. GLC of SO_2 131
Figure 7.4: Output of the Air Quality Modeling Results 140

Figure 7.5: Predicted operation phase noise propagation during daytime.................. 143
Figure 7.6: Predicted operation phase noise propagation during nighttime................ 143
Figure 8.1: Threat zone assessment 164
Figure 9.1: Some Pictures of the Structures to be Demolished 185
Figure 9.2: Distances of Air Sensitive Receivers from the Plant Site 187
Figure 9.3: Greenbelt Development Plan 205
Figure 9.4: Organogram of BPDB 218
Figure 9.5: Proposed Manpower Structure for Saidpur 150 MW ±10% HSD Based Simple Cycle Power Plant Project 219
Figure 9.6: Proposed Manpower Structure for Operation and Maintenance Set up...... 220
Figure 9.7: Monitoring Map for the proposed Power Plant Project 228

Abbreviations and Acronyms

AEZ	Agro-Ecological Zone
AEO	Agriculture Extension Officer
ANSI	American National Standards Institute
AOI	Area of Influence
BADC	Bangladesh Agricultural Development Corporation
BAPEX	Bangladesh Agency of Petroleum Exploration
BARC	Bangladesh Agriculture Research Council
BBS	Bangladesh Bureau of Statistics
BEZ	Bio-Ecological Zone
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BPCL	Bangladesh Petroleum Corporation limited
BPDB	Bangladesh Power Development Board
BRTA	Bangladesh Road Transport Authority
BTM	Bangladesh Transverse Mercator
BWDB	Bangladesh Water Development Board
CAMS	Continuous Air Monitoring Stations
CEGIS	Center for Environmental and Geographic Information Services
CPI	Consumer Price Index
DAE	Department of Agricultural Extension
DC	Deputy Commissioner
DCS	Distributed Control System
DLS	Department of Livestock
DoE	Department of Environment
DoF	Department of Fisheries
DPHE	Department of Public Health and Engineering
DTWs	Deep Tube Wells
ECA	Environmental Conservation Act
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rule
EIA	Environmental Impact Assessment
EIAG	EIA Guidelines for industries
EPA	Environmental Protection Agency
EPC	Engineering, Procurement, Construction

ESF	Environmental and Social Framework
ETP	Effluent Treatment Plant
EMP	Environmental Management Plan
FAO	Food and Agricultural Organization
FD	Forest Department
FGD	Focus Group Discussion
GAP	Good Agricultural Practices
GCPs	Ground Control Points
GDP	Gross Development Product
GIS	Geographic Information Systems
GOB	Government of Bangladesh
GTG	Gas Turbine Generator
HH	Household
HP	High Pressure
HSD	Heavy Speed Diesel
HYV	High Yielding Variety
ICM	Integrated Crop management
IEE	Initial Environmental Examination
IESC	Important Environmental and Social Components
IFC	International Finance Corporation
IGA	Informal Group Discussion
ICM	Integrated Crop Management
IPM	Integrated Pest Management
IUCN	International Union for Conservation of Nature
KII	Key Informant Interview
LGED	Local Government Engineering Department
LLP	Low Lift Pump
MEA	Multilateral Environmental Agreements
MoEP	Ministry of Energy and Power
MP	Muriate of Potash
NAAQS	National Ambient Air Quality Standard
NCA	Net Cultivable Area
NCS	National Conservation Strategy
NEMAP	National Environment Management Action Plan
NGO	Non-Government Office
NLDC	National Load Control Centre

NOA	Notification of Award
NOC	No Objection Certificate
NWRD	National Water Resource Database
OD	Operational Directive
PA	Project Authority
PAP	Project Affected Peoples
PCM	Public Consultation Meeting
PRA	Participatory Rural Appraisal
PM	Particulate Matter
PPE	Personal Protective Equipment
PSMP	Power System Master Plan
RRA	Rapid Rural Appraisal
RS	Remote Sensing
SCPP	Simple Cycle Power Plant
SDG	Sustainable Development Goal
SPS	Soidpur Power Station
SRDI	Soil Resource Development Institute
SSC	Secondary School Certificate
SPM	Suspended Particulate Matters
STWs	Shallow Tube Wells
ToR	Terms of Reference
TSP	Triple Super Phosphate
UAO	Upazila Agriculture Officer
UFO	Upazila Fisheries Office
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Program
WB	World Bank
WHO	World Health Organization

Unit Conversion Table

General Units

1 meter = 3.28 ft

1 kilometer = 0.621371192 mile

1 nautical mile = 1.852 kilometer

1 kilogram = 2.20 pound

1 metric ton = 1000 kg

1 barrel = 42 U.S. gallons = 159.0 liters

1 liter = 0.264172052 gallon (US)

1 square mile = 640 acres = 2.590 km^2

1 hectare = 10^{-2} km^2 = 2.471 acres

1 Pascal = 1 N/m^2= 0.01 millibar

1 liter = 0.001 cubic meter

1^0C = 274.15K=33.8^0F

1 mg/m^3 = 1 µg /L

1 mg/L ≈ 1 g/m^3 ≈ 1 ppm (w/w)

1 ≈ g/L ≈ 1 mg/ m^3 ≈ 1 ppb (w/w)

1 knot = 0.514444 m/s

1µg/m^3 = 1 ppb*(12.187)*(M) / (273.15 + °C)

Energy Units

1 Cal = 4.19 J

1 Btu = 1055.87J

1 Btu = 251.9958 cal

1 joule = 0.239 cal

1 kWh = 3412 Btu.

1MW=1000KW=10^6 W

1 kWh = 3.6 x 10^6 J

1 kWh = 859.85 kcal

1 horsepower = 746 W

1 GWyr = 8.76 x 10^9 kWh

Glossary

Aus	A photoperiod-insensitive, rain-fed, drought-prone, lowland or upland rice. Group of rice varieties sown in the pre-monsoon season and harvested in the monsoon season. These are broadcasted/transplanted during March-April and harvested during June-July. Irrigation needed for HYV T. Aus.
Aman	Group of rice varieties grown in the monsoon season and harvested in the post-monsoon season. This is generally transplanted/broadcasted at the beginning of monsoon from July-August and harvested in November-December. Mostly rain-fed, supplemental irrigation needed in places during dry spell.
Boro	A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.
Kharif	Pre-monsoon and monsoon growing season. Cropping season linked to monsoon between March-October, often divided into kharif-I (March-June) and kharif-II (July-October).
Rabi	Dry agricultural crop growing season; mainly used for the cool winter season between November and February.
High land	The land, which is not generally inundated under normal flood situation. This class has been subdivided into two classes: (i)Land, which is above normal flood-level. (ii) Normally flooded from 0- 30 cm deep where water normally can be stored by constructing ail and Aman can be transplanted.
Medium high land	Land, which normally is flooded between 30- 90 cm deep continuously more than two weeks to few months during the flood season. This can be divided into two classes: (i)Very shallow inundated land where HYV Aman can be practiced; (ii)Shallow inundated land, which is considered very deep flooding for HYV T. Aman.
Medium low land	Seasonally flooded 90-180 cm

Executive Summary

The Government of Bangladesh has committed to provide electricity to all by 2021 and accordingly, has prioritized power sector and has formulated Power System Master Plan (PSMP, 2010 and PSMP, 2016), wherein diversified fuel based power generation has been proposed to meet the national goal. In this regard Bangladesh Power Development Board (BPDB) has planned to enhance country's power generation by constructing a "150 MW ±10% (Net output 161.603 MW) Simple Cycle HSD-based (Gas Turbine) Power Plant Project at Saidpur, Nilphamari". The proposed Power Plant Project falls under "Red" category as per ECR (1997) and hence requires submission of Environmental Impact Assessment (EIA) report for obtaining Environmental Clearance Certificate (ECC) from DOE.

The proposed Power Plant Project will be implemented on 8 acres of land within the premises of Saidpur Power Station, which includes fallow land, some trees, herbs and some old buildings those are to be demolished. The site is well connected with Dhaka and rest of the country through Rail and Road network. Since natural gas is currently not available in this area, High Speed Diesel has been selected as fuel for this Plant that can be easily supplied by BPC from their Khulna Oil Depot by Railway Wagon (BTO) and can be unloaded at BPDB Saidpur unloading pump station and transferred to Saidpur Power Station Storage Tank through underground fuel pipeline. As surface water is not available in the vicinity, ground water will be used in this case. BPDB reasonably selected Gas Turbine at Simple Cycle with Closed cooling system, as it requires a minimum quantity of water which is about 250 m^3/day. Ground water availability calculation carried out under section 5.2.4 reveals that in total 250 m^3/day amount of groundwater may easily be withdrawn over the entire life span of the Plant Once completed 161.603 MW will be supplied to the National grid through the existing 132 kV AIS substation of the Power Plant. Before implementation of this proposed Power Plant, relevant legal provisions, policies, strategies and institutional issues need to be considered which are given in details in Chapter 4.

The Baseline Condition in terms of physical resources, water resources, land and agricultural resources, fisheries resources, ecological and socio-economic resources have been identified from an area encompassing 10 km radius from the stack of the proposed Power Plant to assess the environmental and social impacts, which might result from the pre-construction, construction and operation phases of the project. The Study area is comprised of medium highland and the elevation varies from 33- 56 m above the mean sea level which means the area is not very much vulnerable to flood. On the other hand, the study area falls under seismic Zone II with co-efficient of 0.20 is moderately vulnerable compared to the rests of the country. Similarly, climate meteorological data of nearest BMD station has been analyzed and found that the area is comparatively dry and cold in winter and humidity varies from 63% to 84% (ref. Chapter 5).

The base situation of the study area is such that most of the adverse environmental impacts of the Power Plant are localized and short term although some are permanent and irreversible such as loss of trees and wildlife habitats in the Plant site, health associated risks due to implementing construction works as well as air emissions, but these can be mitigated with appropriate mitigation measures. On the contrary, the magnitude of the impacts on the important environmental and social components shall range from moderate to minimum.

Ambient noise levels were measured within the 5 km radial area according to the Noise Pollution Control Rules, 2006 from the proposed Project site. At present the noise level of Project area is about 57.8 dBA during daytime and 58 dBA during nighttime which is less than the permissible limit of DoE. The Particulate Matter ($PM_{2.5}$ and PM_{10}) in the ambient air noticeably exceeds national and international standard values due to existing road and building constructions and other demolition activities. The test result of the ground water quality shows that the values of the tested parameters were within the standard limit of DoE. The Saidpur Airport is located around 5 Km away from the proposed Power Plant. As per the proposed preliminary layout plan the chimney of the Power Plant is in line with the runway of the Airport. The height of the Chimney has been calculated with due clearance of the Civil Aviation Authority of Bangladesh.

The Kharkharia and the Ichhamati River are seasonal and partially remain dry at the winter. People of the study area use submersible pump and deep tube wells (DTW) for their drinking and other household works as well as for irrigation purposes.

Most of the land of the study area is agricultural land with fertility level, in general, low to medium having good moisture holding capacity of soil. Most of the land are cultivated covering two crops in a year. Fish production within the study area is about 23 MT within the 454 habitat area for captured fish and about 2,573 MT within 735 habitat area for cultured fish. The study area falls under Teesta Floodplain Bio-ecological zone. There is no endangered species of Flora and Fauna within the study area.

According to the BBS 2012, most of the unions in the study area have over 70% of electricity coverage and some of those have already full coverage which is a remarkable progress over last few years. Most of the people of this area live on agriculture and females are occupied with household works. About 54 NGOs are working in the study area with the objective of eliminating poverty, achieving women empowerment, employment generation, health facilities, environmental management etc. The local community are found to be residing in friendly environment without having any major conflicts among them.

A number of KIIs, RRA and three FGDs were conducted with the stakeholders in the study area. Participatory approach was followed for identifying the participants as well as conducting some informal public consultation meetings with an aim of involving the stakeholders in the Project cycle and explore stakeholders' perception and attitude regarding the proposed Project. During the consultation, the Consultants have discussed with the participants about the proposed Project interventions and the process of peoples' participation in preparing the EIA. The local people showed positive attitude towards the Project. They identified some problems and urged to mitigate the problems. However, dissatisfaction among the communities in close vicinity of BPDB area was observed, due to installation of number of transmission towers rapidly decreasing their land value despite high demand of their land situated within the Paurashava area. The stakeholders identified the prospects as well as problems of the Project and recommended suitable solutions as per their perceptions. The recommendations were duly recorded during the meeting and documented in this Report.

Impacted components have been identified according to different stages of the project construction and operation stages during field visit. The impact extent, duration and frequency, have been identified and corresponding mitigation measures were suggested in this Report. Major impacts were identified on ecological resources in the pre-construction phase as a total of 94 trees will have to be cut for the installation of the proposed Power Plant. Impacts will be major for socio-economic environment both for pre-construction as well as construction phase as huge noise will be generated due to demolishing of the existing old buildings, land developing activities and construction activities. However, in operation phase, it is assumed that, agricultural land might be changed into industrial zone for further extension of industry, hence, loss of agricultural land will occur. In addition to that, wild life habitat within the study area might be decreased due to disturbance of their normal life. On the contrary, some positive impacts will be noticed as local people may have new job opportunities. The surrounding areas will be developed also. Necessary mitigation measures and suggestions are given according to the impacts as indicated in Chapter 7 of this Report.

An Environmental Management Plan (EMP) has also been designed to guide the implementing agency- especially the Project Authority (PA) to achieve sustainability of the Project ensuring environmental conservation as per national and international standards. EMP has been analyzed for three different phases i.e. pre-construction, construction and operation phases. EMP for ambient air, acoustic environment, waste generation, water resources, ecological resources and disturbance aspects are addressed in all the three phases. In addition, EMP for accidental occurrences, traffic congestion and economic status are addressed for pre-construction and construction phase while land and agricultural resources for pre-construction and post-construction phase. During demolition stage, approximately 37,065 tons of debris may be generated due to demolition of civil structures and 140 tons of steel from oil tanks. Management of such waste has been provided in the Demolition Plan in the section 9.6.1. A negligible impact on fishery resources may be noticed only if untreated effluent is discharged. Therefore, EMP has been suggested considering this issue. A mitigation Plan have been also mentioned in this Report with institutional responsibilities. Finally, a tentative budget has been estimated at around USD 2,074,500 (LS). The proposed Power Plant should be constructed strictly following the environmental management plan based on identified impacts of environmental and social components. The EIA Report prepared for “150 MW ±10% (Net output 161.603 MW) Simple Cycle HSD-based (Gas Turbine) Power Plant Project at Saidpur, Nilphamari” is recommended for approval from the DoE. It is expected that DoE while granting approval to this Project, will put conditions to strictly comply with the EMP requirements as stipulated in the EIA Report.

1. Introduction

1.1 Background

Electrical Power is the most useable form of energy and is one of the major inputs for development. Sustainable power supply is a pre-condition for the socio-economic development of a country and Bangladesh is no exception. The vision of the Government is to develop Bangladesh as a middle-income country by 2021 and as a developed country by 2041 through rapid industrialization, urbanization, mechanized cultivation etc. To that end, the Government committed to provide electricity to all by 2021 and predicts a power demand of 14,460 MW by 2021, 27,393 MW by 2030 and 50,979 MW by 2041. Accordingly, Government has prioritized power sector and has formulated Power System Master Plan (PSMP 2010) and has revised in 2016 (PSMP 2016). The PSMP 2010 emphasized on fuel diversification and the PSMP 2016 has emphasized on power transmission and distribution in addition to fuel diversification. Aligning with PSMPs the Bangladesh Power Development Board (BPDB) has planned to install a "150 MW ±10% (Net output 161.603 MW) Simple Cycle HSD-based (Gas Turbine) Power Plant Project at Saidpur, Nilphamari" (hereinafter called as 'the Project'). The base map of the aforementioned Project is given in the **Figure 1.1**.

This Project falls under the 'Red Category' as per the Environmental Conservation Rules, 1997 (amended in 2005) of Bangladesh and requires approval from the Department of Environment (DoE) before starting the construction works. The approval process requires carrying out Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA).

In this connection, the Center for Environmental and Geographic Information Services (CEGIS), a Public Trust under the Ministry of Water Resources of the Government of Bangladesh and a pioneer scientific organization with vast experience in carrying out EIA and studies of diversified fuel based Power Plants in Bangladesh, has been entrusted by BPDB and engaged on 10th January, 2019 for the aforesaid Power Plant Project.

An approved Terms of References (ToR) attached with the Initial Environmental Examination (IEE) from the Department of Environment (DoE). Accordingly, a comprehensive EIA Study Report has been prepared based on the approved ToR.

1.2 Objectives

1.2.1 Objective of the Project

The prime objective of the Project is to enhance country's power generation towards achieving the government's target for 2021 and to strengthen the national grid capacity, and ensure reliable and quality power supply to the consumers.

The specific objectives are:

- To ensure the reliable and quality power supply to all consumers;
- To get rid of frequent load shedding and under voltage hassles.
- To provide electricity to more new domestic and industrial consumers, in line with the Government's commitment for 2021;
- Balancing of Regional Power Generation;

- Diversification of primary fuel; and
- To create new employments and new business activities in and around the Project area for the local and other people of the country.

1.2.2 *Objective of the Study*

The objective of this study is to meet the environmental regulation of Bangladesh by carrying out Initial Environment Examination (IEE) for obtaining Site Clearance and Environmental Impact Assessment (EIA) for Environmental Clearance Certificate for the proposed Power Plant Project at Saidpur, Nilphamari at site conditions on turnkey basis under BPDB. The specific objectives are:

- To conduct Initial Environmental Examination (IEE) to identify preliminarily the possible environmental and socio-economic impacts with possible mitigation measures and a tentative environmental management plan;
- To conduct Environmental Impact Assessment (EIA) with detail environmental and socio-economic baseline survey, prediction and evaluation of potential environmental socio-economic impacts, analysis of risks and detail environmental management plan;
- To conduct topographical survey to determine land elevation; and
- To conduct geotechnical investigation for understanding the soil bearing capacity of the Project site.

1.3 Need of the Project

With the persistent increase in Gross Development Product (GDP), the demand for electricity is increasing rapidly due to rapid industrialization, urbanization etc. In line with the Government's prediction, BPDB and all its subsidiaries have taken massive drive to enhance power generation by building new Power Plants with diversified fuel, renovating old Power Plants and importing power from neighboring country. The proposed Project is one of such initiatives of the BPDB to make-up the demand partially. So, it can be concluded that construction of this Project is very much needed in country context for achieving the SDG's goal no. 7: Affordable and Clean Energy and Government's target of achieving 'Middle Income' status by 2021.

The Project once completed, will add another 161.603 MW of power to the national grid which will be used in further industrialization of the country. This will in turn create more job opportunities for the local people as well as for the people of other areas of the country.

1.4 Rationale of the Project

The proposed project is a 150 MW ±10% (Net output 161.603 MW) Simple Cycle HSD-based (Gas Turbine) Power Plant. The site is selected based on load center, availability of fuel and its transport facilities (i.e., Numaligarh-Parbatipur Oil line, railway, etc.) and reduced transmission loss potential. The site is also near to the Parbatipur Oil Depot and is well connected with rail and road networks. Therefore, it can be concluded that the site selected for the proposed Project is very much rationale.

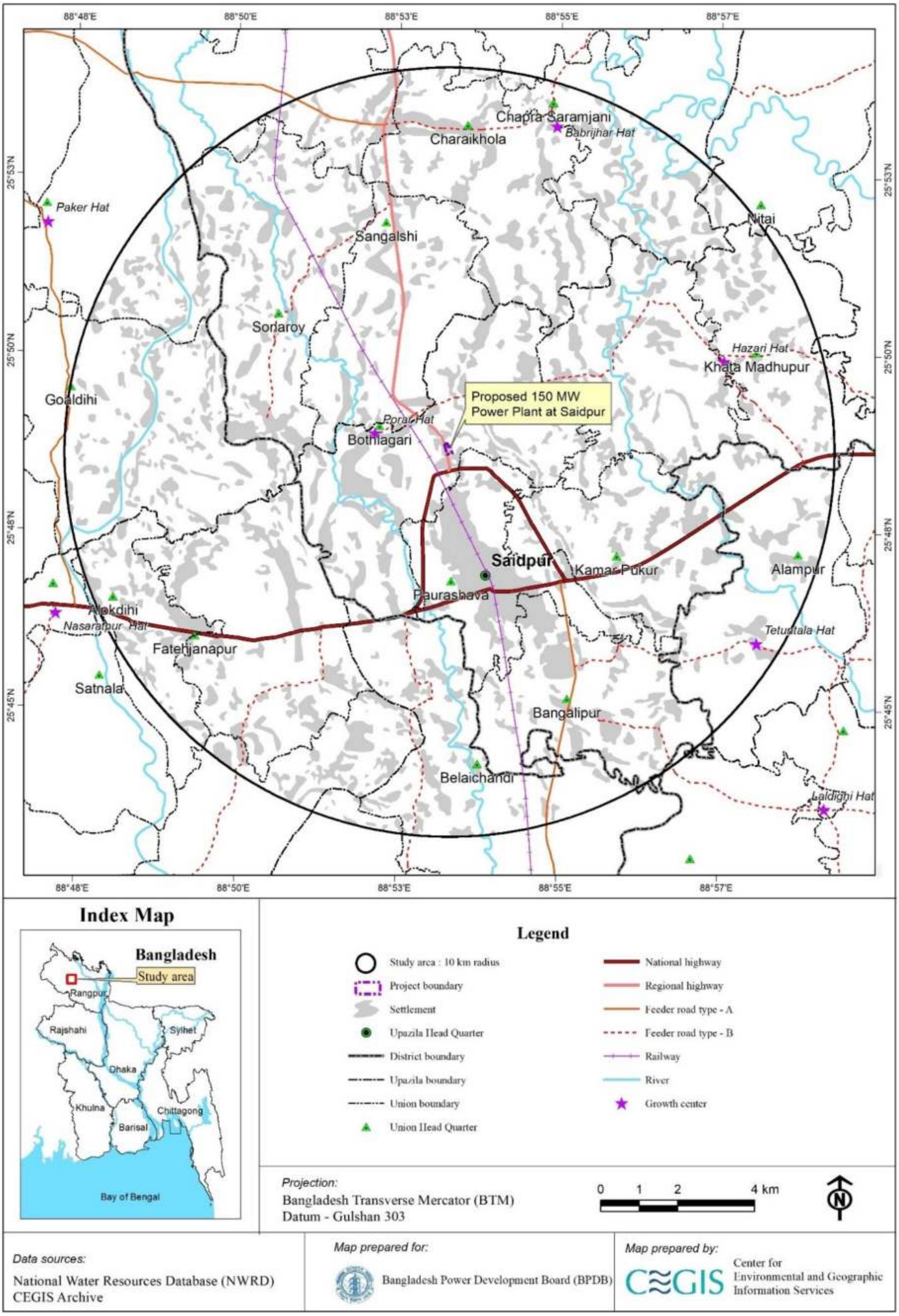


Figure 1.1: Base Map of the Study Area

1.5 Methodology of the EIA Study

The approved ToR defined the objective of this consultancy service to carry out the EIA study for the proposed 150 MW ±10% HSD based Simple Cycle Power Plant Project at Saidpur, Nilphamari. A methodological framework has been developed to visualize the major proposed activities to be carried out in this EIA study in line with the ToR received from DoE. Methodology for this study has been developed targeting each activity identified from the ToR following DoE's guidelines for conducting EIA of industries and some other international guidelines. The overall generic framework of the EIA process is depicted in **Figure 1.2**.

A composite interdisciplinary methodology is designed including world standardized ad-hoc methods, application of expert judgment, systematic and sequential approach of impact identification, simulation model for impact evaluation, spatial analysis through application of remote sensing and geographic information system (GIS), and intensive consultation with the local people to ensure their participation. After conducting field survey and understanding the baseline scenario having discussion with the Project proponents and consulting with/ interviewing other stakeholders and local people, the methodology for the EIA Study has been revised where required. According to guidelines of the Department of Environment (DoE), a team of multidisciplinary professionals from different sectors including water resources, ecology, fisheries, agriculture, environmental management, socio-economic and engineering, went for the field visit and the field investigation was executed following the structural checklist and questionnaires.

Primary data were collected through Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA). The issues of physical environment have been analyzed through professional observation and stockholder's consultation during field visit. The biological issues have been taken care of through secondary information and field observations. The environmental survey has been carried out to collect information on the status of flora and fauna – specially the threatened and endangered species and their habitats.

1.5.1 Scoping

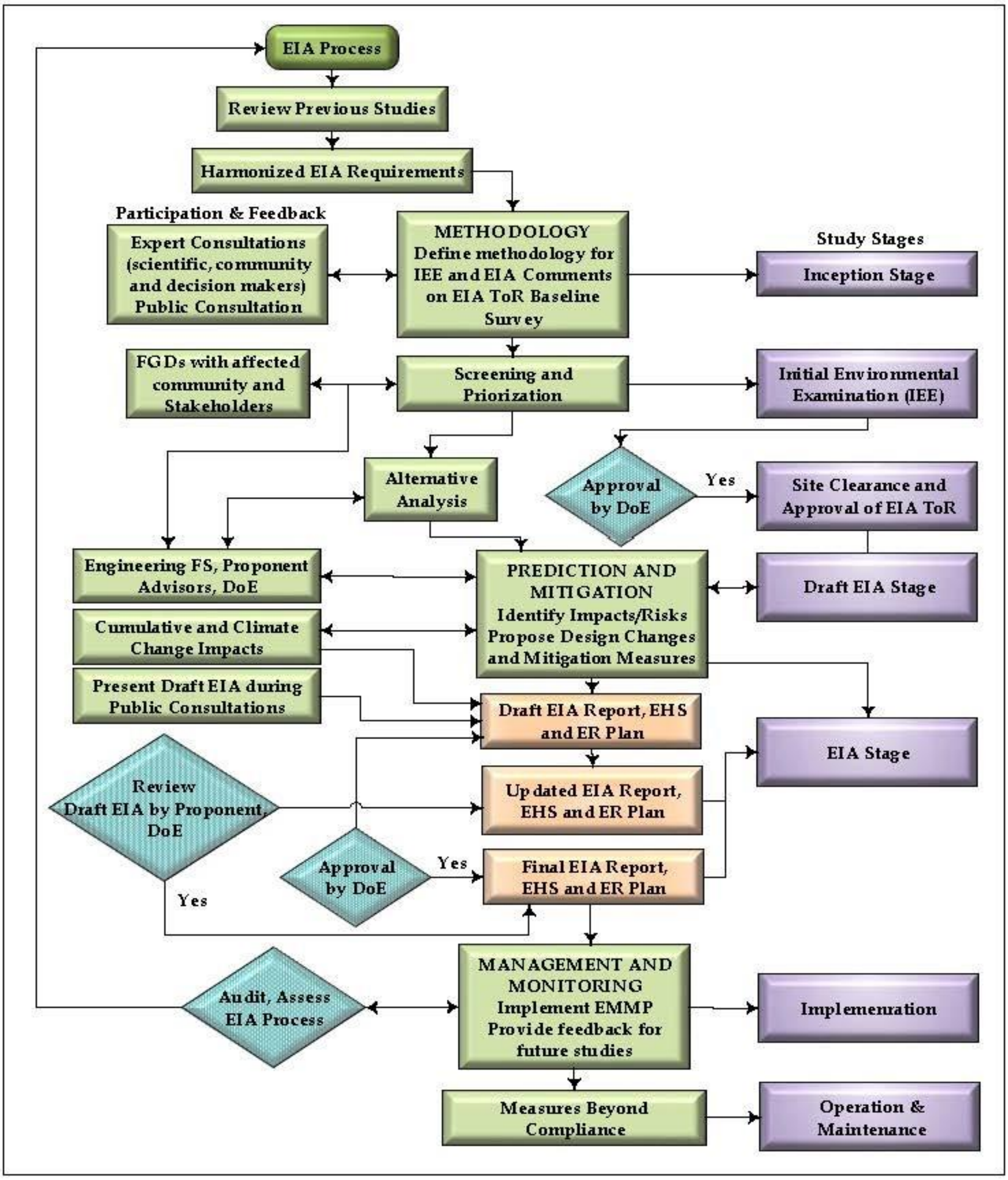
A scoping process has been followed for selecting Important Environmental and Social Components (IESCs) which are likely to be impacted by the proposed power plant.

Scoping has been done in two stages. In the first stage, Individual professionals of the EIA study team made a preliminary list of the components pertaining to their disciplines, which were likely to be impacted by the project activities.

The second stage includes study area scoping sessions where the stakeholders' perceptions/ views were collected regarding important environmental and social components. Professional judgment of the EIA team members from the first stage and the stakeholders' opinions obtained in the scoping sessions of the second stage has been considered in selecting the IESCs.

1.5.2 Bounding

The Project boundary, prepared on the basis of information available from the feasibility report, has been firmed up to finalize the study area boundary based on the nature of impacts that has been exerted by different activities of the Project i.e. including the pre-construction, construction and operation phases. The boundary of the study area includes the areas likely to be impacted around the proposed Project site.



Source: CEGIS

Figure 1.2: Steps of EIA Study

1.5.3 Description of Baseline Condition

The contemporary and world standardized tools have been used in investigating the physical, geo-physical and biological environment. Physical observation, Key Informants Interview (KII), stakeholder consultation, water and ambient air quality sampling and analyses, noise level measurement, transect walk, fish market survey, fish catch assessment, analysis of satellite image and geographic information system are the tools and techniques which have been used in the overall study.

Establishing environmental baseline situation

The environmental baseline situation is described in detail in this report. The baseline has given details of the prior project situation of the physical environment (geography, topography, meteorology, water quality, hydrology, and river morphology), geo-physical environment (geology, land type, soil type, seismicity etc.), biological environment (ecosystem, habitat and fisheries resources) and socio-economic environment (demography, education, economy, health and sanitation, and occupational health and safety). A number of physical, biological and socio-cultural parameters have been selected where the primary and secondary data has been collected from field investigation and multiple sources at the IEE stage. Baseline information of the proposed Project area and its surroundings have been described in details in this EIA Report.

Baseline data on the physical, biological, socioeconomic characteristics of the study area within 10 km radius from the power plant i.e. area of interest has been assembled and evaluated. The environmental parameters have been collected, measured and presented in such a way so that they are consistent with applicable environmental standards, norms and requirements of both national (i.e. ECR ’97 and subsequent amendments) and international (i.e. IFC guidelines). Secondary data have been used to comprehend the study area precisely.

Land Use and Land Cover Analyses

The land use data of the study area has been utilized for Environmental Impact Assessment of the proposed 150 MW ±10% (Net output 161.603 MW) Simple Cycle HSD-based (Gas Turbine) Power Plant Project at Saidpur, Nilphamari. The methodology of the land use information extraction from satellite images is shown in the **Figure 1.3**. The land use has been derived for about 315 sq.km (10 km buffer from the center of the Project Site) using medium resolution (5 m) multispectral RapidEye satellite images of 2019 and verified with the available current images in Google Earth.

All images were rectified (geo-referencing) to avoid geometric distortions, which was performed by transforming image coordinates into projected geographic coordinates, using a transformation matrix. The transformation matrix was developed from a set of input ground control points (GCPs) and corresponding reference ground control points. Using the transformation matrix, the images have been rectified (geo-referenced) into the Bangladesh Transverse Mercator (BTM) projection system.

The projection parameters of the BTM are as follows:

Projection Type:	Transverse Mercator
Datum:	Everest 1830
Spheroid:	Everest 1830
Latitude of Origin:	0.000000
Central Meridian:	90.00000
Scale Factor:	0.999600
False Easting:	5000000
False Northing:	-2000000
Linear Unit:	Meter

After geo-referencing, the land use and the other features have been extracted from the images using visual interpretation and on screen digitizing technique. Assessment of the accuracy for the land use data was made using referenced data collected from field survey.

(Source: CEGIS)

Figure 1.3: Methodology of land use mapping

Bio-physical Investigation

The baseline condition has been established with respect to ambient air quality, noise level, water resources including hydrology, river flow, land resources including land use and soil quality. Secondary seismic data has been collected from Geological Survey of Bangladesh (GSB) and Bangladesh Meteorological Department (BMD). Some baseline data collection pictures are shown in **Figure 1.4**.

Ambient Air Quality Monitoring

Ambient Noise Monitoring at Substation Point

In-situ Water Quality Monitoring

Figure 1.4: Glimpse of Field Data Collection Process

The major source of data collection was satellite images available in the archive of CEGIS which was followed by procuring up to date images in the database. The land use classification and zone was demarcated through the use of RS/GIS technique.

Meteorological Data Collection

Meteorological parameters, i.e. precipitation, temperature, humidity, wind speed, wind direction, sunshine hours of the study area have already been collected from the nearest BMD station during the IEE stage. Additionally, upper atmospheric data of the study area has been procured for pollution dispersion modeling from the concerned authentic source(s) in the EIA study.

Air Quality and Noise Level Assessment

Air Quality

With the aim of monitoring ambient air quality for baseline establishment, concentration of NO_x, SO_x, PM_{10}, $PM_{2.5}$, O_3, CO, etc. have been monitored in the ambient air at two locations in and around the project site depending on sensitivity and wind direction. One location was at the proposed plant site and the another one was from the surrounding areas.

Acoustic environment:

The baseline acoustic environment has been measured through ambient noise levels measurement in and around the project site considering existing sensitive receptors. The number as well as the locations for monitoring the acoustic environment have been selected based on the potential sensitive receptors. Noise levels have been measured twice in a day (during day-time and night-time) at each location. Each time, noise level has been recorded on an average of 15 minutes' time span by using portable ANSI Type II noise level meter. Depending on the site condition and acoustic environment, the noise meter has been set up and calibrated each time following the manufacturer's instruction manual.

Water Quality and Hydrological Assessment

Baseline water quality monitoring is important for comparing the present condition with no project and the condition with project in the future. Water quality parameters have been selected depending on the ambient water use and potential polluting agents from the project. The locations of the water samples were selected within the study area being impacted by the Project interventions. Standard practices have been maintained during sampling and analyses of the collected samples. The water quality parameters include relevant parameters. All samples have been tested following the standard procedure.

The necessary hydro-morphological data for modelling has been collected from the feasibility study team (if necessary). The morphological behavior of the study area has been studied based on image analysis and field investigation.

Transportation Study

Traffic volume in both railway and roads may increase during construction and operation of the project. Therefore, transportation survey has been conducted at the strategic points in the study area. The traffic survey has been conducted briefly to assess the types of the vehicles/ vessels, number of the vehicles/vessels etc.

Soil Quality and Land Resources Study

Soil samples have been collected from the SRDI, Bangladesh. Using the SOLARIS tools of SRDI the soil and land resources data have been extracted. This tool has been developed by CEGIS for SRDI. The SOLARIS stores all the data related to land and soil management for agricultural purposes which includes soil quality, texture, land type, deposition type, flooding depth, drainage, moisture content, etc.

Agriculture and Livestock Assessment

To prepare the baseline information on agriculture, various agricultural parameters such as farming practices, existing major cropping patterns, cropped area, yield rate, crop production, crop damage and various inputs viz. availability of irrigation water, fertilizers, pesticides, seeds, labor etc. have been collected from both the primary and the secondary sources. The methodologies for the assessment of the agricultural and livestock resources at the EIA stage are similar to the methodologies for the IEE stage. However, detailed information has been included in this report.

Ecological and forest resources study

Secondary data related to bio-ecological zones has been collected from IUCN. Ecological data and relevant information will be collected through field survey and review of different secondary sources. Overall perceptions of the local people about the biodiversity and ecosystem have been gathered from public consultation meetings (PCM), KII, FGD and RRA methods. Wildlife habitat types, roosting habitat, wetland and shoreline birds along with migratory species and other threatened species have been identified through field investigation and secondary information. Breeding habitats and migratory routes of the threatened wildlife species will be identified through public consultation, physical investigation and secondary information. The methodology for the assessment of the ecological resources are similar to the methodology for the IEE stage. The detail information has been included in this EIA Report.

Fisheries study

The methodology for the assessment of the fisheries resources is similar to the methodology for the IEE stage.

Socio-Economic Baseline

Starting with data collection from secondary sources, the primary data collection and investigation of the socio-economic components have been conducted following world standardized techniques and tools of socio-economic survey including participation of local people for primary data collection. Face-to-face interview technique, key informants interview (KII) and household survey have been conducted for gathering socio-economic information and data. Local people's participation has been ensured through RRA and PRA approach and FGD method.

Methodology for socio-economic baseline and find out probable impacts and corresponding mitigation measures has been developed through RRA those were conducted during reconnaissance field visit.

Following the PRA approach FGD with local people has been conducted in each village within direct impact buffer zone. Necessary tasks have been maintained to ensure participation of different social stratum and livelihood group in the FGD meeting. The place and time of FGD was also be fixed as per suggestion of the local people. The FGD meeting has been facilitated by a team of socio-economic specialist, people participation specialist and environmental specialist.

1.5.4 People's Participation

Public consultation meetings have been conducted in the study area during field investigation. One public consultation meeting has been conducted in the study area near the proposed Project site. Participation of local people (both male and female) consisting of elected people's representatives, different professional groups–government and non-government officials, teachers, fishers, labors, riverside people, power plant authority, etc. have been invited to public consultation meetings and their participation have been ensured to have their opinions and judgements on the various IESCs. A checklist has been used for conducting the consultation meetings to maintain uniformity on points of discussion and recording the opinions and views of the participants properly.

1.5.5 Finalizing of IECs

The IESCs have been identified and further refined and updated based on intensive field investigation, expert judgment and stakeholder consultation.

1.5.6 Determination of Potential Impacts Identification

Potential environmental and social impacts were identified on the basis of the review of feasibility reports, field visits, environmental quality baseline monitoring, ecological and fisheries surveys, and stakeholder consultations. The significance of potential impacts was assessed using the criteria and methodology given below.

Quantification of Impacts

Air Pollutant Dispersion Modelling

Air dispersion modelling is required for this project to estimate the contribution of criteria pollutants to the ambient atmosphere during operation of this project. Emission of flue gas contains certain quantities of criteria pollutants. The specific requirements for the emissions from the stacks has been identified based on national legal requirement. Dispersion modelling has considered the terrain effect, sensitivity of the receiver (e.g., city area, dense settlement, sensitive ecosystem etc.) emission rates, wind effect and baseline pollutant concentration.

USEPA approved Air Dispersion Model, AERMOD has been used for conducting the simulation of air pollutants dispersion. The modelling software is an advance meteorological, air quality (CO, SO_2, NO_x, PM_{10} and $PM_{2.5}$) modelling system which simulates the effects of time and space in varying meteorological condition on pollutant transport, transformation and removal. It includes algorithms for sub-grid scale effects such as terrain impingement as well as, longer range effects such as pollutant removal due to wet scavenging and dry deposition, chemical transformation, and visibility effects of particulate matter concentrations.

Noise Modelling

The sources of noise from different plants, equipment, machineries have been provided by the project proponents. A sophisticated noise model- 'Sound Plan Essential 3.0' has been used to simulate the noise propagation during plant operation period. The model has considered the physical obstruction, atmospheric absorption, land elevation etc. Finally, the propagation of the noise level to different sensitive receptor has been calculated twice in a day during day-time (6:00 am- 18:59 pm) and night-time (19:00 pm – 5:59 am) at each location. Each time, noise level has been recorded on an average of 20 minutes' time span for both day and night time. The result has been used to find out the necessary mitigation steps to protect the sensitive receptors from the adverse impacts of high noise.

Sensitivity of Receptor

The sensitivity of a receptor has been determined based on review of the population (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic. Criteria for determining receptor sensitivity of the Project's potential impacts are outlined in **Table 1.1**.

Table 1.1: Criteria for Determining Sensitivity of the Receptors

Sensitivity Determination	Definition
Very High (4)	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
High (3)	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Medium (2)	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low (1)	Vulnerable receptor with good capacity to absorb proposed changes and/or good opportunities for mitigation

Impact Magnitude

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

The magnitude of potential impacts of the Project has generally been identified according to the categories outlined in **Table 1.2.**

Table 1.2: Parameters for Determining Impact Scale

Parameter	Major (4)	Moderate (3)	Minor (2)	Minimal (1)
Duration of potential impact	Long term (more than 15 years)	Medium Term (5 to 15 years)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact

Parameter	Major (4)	Moderate (3)	Minor (2)	Minimal (1)
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Potential impact requires a year or so for recovering with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains almost constant
Compliance to Legal Standards before Mitigation Measures	Breaches national standards and or international guidelines/ obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Assigning Significance

Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor has been determined and the significance of each potential impact established using the impact significance matrix shown in **Table 1.3**.

Table 1.3: Significance of Impact Criteria

Magnitude of Impact	Sensitivity of Receptors			
	Very High (4)	High (3)	Medium (2)	Low (1)
Major (4)	Critical (16)	Major (12)	Moderate (8)	Minor (4)
Moderate (3)	Major (12)	Major (9)	Moderate (6)	Minimal (3)
Minor (2)	Moderate (8)	Moderate (6)	Minor (4)	Minimal (2)
Minimal (1)	Minor (4)	Minimal (3)	Minimal (2)	Minimal (1)

Color Legend

Red (13-16)	≡ Catastrophic/Critical	: Action with follow-up Verification & Validation by Authority needed before allowing work
Orange (9-12)	≡ Major	: Action needed under follow-up supervision before allowing work
Yellow (6-8)	≡ Moderate	: Need maintaining with routine monitoring and reporting
Blue (4-5)	≡ Minor	: Only for awareness
Green (1-3)	≡ Minimal	: No action needed to start work

1.5.7 Project Compliance with National and International Regulatory Requirements

All activities of the proposed Project during pre-construction, construction and post-construction period have been evaluated to find out the compliance with legal requirements.

1.5.8 *Cumulative Impact Assessment*

The cumulative impacts have been assessed for air quality parameters, considering the impacts for activities related to sensitive receptors. This assessment has been used for future projection of the traffic volume including air emission in the surrounding environment.

USEPA approved air quality modelling system 'AERMOD' has been used for this purpose. AERMOD is an advance non steady state meteorological, air quality modelling system. It simulates the effects of time and space varying meteorological condition on pollutant.

Emission of SO_x, NO_x and $PM_{2.5}$, PM_{10}, and other sources have been addressed during modelling process. A number of scenarios have been developed in these regards. The model result has generated the cumulative concentration for those pollutants at the selective receptors. The level of pollution from the simulation has then been compared for scenarios with mitigation measures and without mitigation measures. The appropriate mitigation and management plan have been suggested on the basis of the modelling result. Eventually, the future monitoring location has also been finalized through this study.

Cumulative impacts for noise has also been developed by using sophisticated noise modelling software, Sound PLAN. Noise level from the study area and the future increase of industries and vehicles and their noise level will be considered in this the baseline noise level.

The stakeholders including the local people have been engaged in the process of socio-economic assessment through different participatory approach of stakeholder engagement like PRA, RRA and FGD in the study area. Data has been analyzed regarding their correspondence to best practices or literature on cumulative impact assessment.

1.5.9 *Development of an Environmental Management Plan*

The Project impacts have been evaluated on the basis of local bio-physical and social settings. In this stage a number of measures have been suggested to avoid or minimize the negative impacts of the Project, if observed. All of the environmental impacts mitigation measures have been assessed basing on the financial viability, technically feasibility and low risk potential. Furthermore, mitigation measures (including technological choices and management options) have been suggested to minimize the negative impacts as low as reasonably practicable (ALARP) level. The cumulative impact of NH_3, NO_x, PM_{10}, $PM_{2.5}$, noise, water effluent has been quantified at the sensitive receptors. Finally, the air pollutants and noise level have been quantified after taking the mitigation measures which complies with the national and international standards. Ecological and social issues have also been taken care of in the EIA study. A number of techniques and tools have also been suggested to reduce the impacts with respect to minimum cost involvement.

The detail of the management plan covering water quality, air quality, noise level, firefighting, and community management, emergency response to accidental events as well as occupational health and safety plan have been elaborated in the study.

A detail emergency response plan has been developed taking into account various stages of decommissioning, construction and operation of the Power Plant. The risk assessment and emergency response plan includes institutional arrangement for securing occupational health safety, on-site or off-site disaster management plan depending on EMS 14001 and OHSAH 18001. A number of contingency plans have been recommended for safe operation of the Project. The EMP has been formulated in a manner so that the implementing agency can easily develop their environmental action plan for the Project.

A feasible environmental monitoring plan has been suggested at the end of the study for future environmental compliance monitoring. The monitoring parameters have been carefully selected depending on the Project activities coherent with the monitoring procedure of the International Finance Corporation (IFC) 2008 guideline for thermal power plant. The monitoring plan has also suggested location of monitoring station and frequency of data collection. The institutional arrangement delineating roles and responsibilities of various agencies and officials involved have also been outlined in this EIA report.

1.5.10 Risk and Hazard Assessment

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

- Identification of all hazardous scenarios associated with transport, storage and processing of dangerous goods taking the equipment failures and human errors into account;
- Execution of risks assessment tools and technique in both individual and societal terms;
- Comparison of individual and societal risks with Government Risk Guidelines and comment on the acceptability of the assessed risk;
- Identification of the risk management strategies required to render the risks acceptable; and
- Identification and assessment of practicable and cost effective risk mitigation measures.

The risk and hazard analysis will have two major components:

Occupational Hazard and Safety Assessment

In the EIA, hazard assessment has been carried out to identify the potential hazards associated with or inherent in the design process and to identify possible measures to avoid the hazards along with the safety plan for minimizing the risk. Incorporating these measures and safety plan in design, planning and operational procedure of the proposed plant, the potential hazard points can be eliminated. Steps to be followed include identification of potential hazard points, hazard cause identification, consequences of exposure, risk management and safety plan.

Environmental Risk Assessment

Hazards and associated risks with construction and implementation of the proposed project have been identified using risk matrix that results the consequence. The risk of the proposed project has been accounted through qualitative risk assessment technologies.

1.5.11 Development of Emergency Response Plan

Emergency response plan have been developed in six phases- identification and assessment of potential hazards, prevention of hazards through alternative options, mitigation of hazards, hazard preparedness, and emergency response taken during hazard scenario and recovery after hazard scenario. At present, no guidelines for emergency response scenario in Bangladesh are available to prevent and mitigate hazard in power plant. However, other national and international guidelines have been followed and incorporated in this Project. These include; The Awareness and Preparedness for Emergencies at Local Level (APELL) process as promoted by the United Nations Environment Programme (UNEP), Environmental health and safety (EHS) guidelines of the IFC, and Emergency Response Plan and EIA Guidelines for Projects in the Natural Gas Sectors of the DoE (2009). Noise level standard are compiled under the Noise Control rules of Bangladesh (2006), which sets the daytime noise level at 75 dB and night time noise levels at 70 dBA. Some of the potential hazards that may affect workers and employees' health may include:

- Fire/explosion;
- Injuries from burns, cuts, bruises, slips and falls;
- Inhalation of small particulates ($PM_{2.5}$, PM_{10}), noxious fumes (NH_3, NO_x, SO_2, CO) and other toxic substances;
- Loud noise levels (75 dBA during daytime and 70 dBA during night time);
- Previous illness; and
- Tiredness/fatigue.

1.5.12 Public Consultation and Disclosure

Public Consultation

Stakeholder consultation is a regulatory process by which the opinions of the local people are sought on the matters relating to implementation of any project that could affect them. It is mandatory to conduct stakeholder consultations within the framework of Environmental Impact Assessment (EIA) study of any development project as per the approved Environmental Impact Assessment (EIA) Guidelines of the Government of Bangladesh. Stakeholder consultation is a part of the Environmental Impact Assessment (EIA) process aims to involve the stakeholders and the local people in every step of the project development and implementation process. In order to ensure peoples' participation in any development project, necessary formal/informal meetings/discussions arranged during different steps of planning and implementation. In line with this, a number of formal/informal meetings/ discussions have been conducted under this study. In the meetings/discussions, the participants have expressed their opinions spontaneously using a neutral platform to share their experiences and opinions with a view of whether the proposed interventions will be socially acceptable and environmentally sustainable

Stakeholder's/public consultation meetings have been organized for assessing the possible social impacts. This addresses the key issues on:

- Communication with local people and stakeholders about the proposed project;
- Provide information on the project activities and involvement of the stakeholders,
- Collection of opinions of the local people and stakeholders, in particular, the attitudes to the proposed industrial activities, interest in employment opportunities and local economic development and importance of energy independence etc.;
- Involvement of the stakeholders during installation and operation stages of the project;

- The aspects of the project design that would be influenced by the stakeholders; and representation of different stakeholders' interests.

Finally, consultation meetings have been organized and the feedback on the EIA findings have been incorporated in this EIA Report.

Public Disclosure

Dissemination of the final Project information and results of EIA to the local people as well as local stakeholders have been made to meet the requirement of GoB policy on Public disclosure. A document has been prepared in local language i.e. in Bengali, specifying the timing of the proposed Project, main components, the potential impacts and environmental management plan of the proposed Project which have been disclosed to the PAPs and key stakeholders.

Process

A Bengali document has been prepared on the basis of the baseline report, impact assessment report, environmental and social management plan report including the action plan and timeline of the Project and would be disclosed publicly through a meeting.

Issues

In the public disclosure sessions, the following data/information have been disclosed to the local people as well as to the local stakeholders:

- The views and perceptions of the PAPs about the proposed Project and resettlement affects;
- The environmental and social baseline of the area
- The potential impacts of the proposed Project;
- The environmental management plan and social management plan;

1.5.13 EIA Documents

Finally, after exercising all the above activities and assessment, this EIA report has been prepared. A draft version of the report has been submitted to the client (project authority) within the given time frame for having their feedbacks and comments. The report has been finalized by incorporating these comments and feedbacks. A presentation on this Final EIA report will be delivered to EIA review committee of DoE in the meeting to be arranged for the approval of the EIA Report.

2. Analysis of Alternatives

2.1 Introduction

The alternative analysis study of the Project covers an analytical comparison of sites, technologies, fuels, cooling systems etc. The purpose of alternative analysis is to select one of the best possible options considering the Project's sustainability, financial viability, social acceptability, environment friendliness, etc. Right selection of the project components shall make the investment viable with sustainable return.

2.2 Location Alternative

Bangladesh is one of the most densely populated countries of the world along with scarcity of a huge land required for industrial development. Moreover, land acquisition is a very cumbersome and time consuming process. Considering all these factors, BPDB has decided to construct the proposed Power Plant in the premise of the existing Saidpur Power Station. The site is accessible through road, rail and airways. The proposed site for the Project is ear marked and comprises of old civil structures and trees of different size-group. No Land Acquisition Plan (LAP) and Resettlement Action Plan (RAP) is required for the proposed site. Moreover, the site does not have any settlement. Furthermore, carrying of heavy equipment to the site can be done easily through the well-built road and/or through rail wagon. In addition to that, Project cost can be minimized by using the existing facilities like power evacuation facility, fuel tanks, store building, mosque etc. Thus, selection of the proposed site for implementation of the Project is justified under aforementioned considerations.

2.3 Fuel Alternatives

Energy subsidy is one of the toughest challenges as drastic increase of fuel price resulting in increase in electricity price, which may trigger another negative effect on the national economy. There is no natural gas supply in the Project site, gas as an alternative fuel is thus not been considered.

Coal is the cheapest fossil fuel in the present market but possess serious environmental concern. Moreover, coal availability in Bangladesh is very inadequate and it needs to import coal for the operation of coal-based Power Plants. There is no water way connected with the site. Since, the site is connected through road and railways, coal Transportation cost from the sea ports to the site will be very high. The closer sea port from the site is Mongla Port, but till now there is no railway facilities connected with this Port.

Moreover, renewable energy like solar power Plants require a huge amount of land at the rate of 3-4 acres of land for generation of one MW of power. For this Project with the net capacity of 161 MW will require at least about 483 acres of land. Arrangement of such a huge amount of land in this area is deemed very difficult. On the contrary, HSD-based present Project will require only about eight (08) acres of land.

On the other hand, High Speed Diesel will be supplied through India-Bangladesh Friendship pipeline, which is already under construction between Numaligarh Refinery Limited, Siliguri, India and BPC Oil Depot, Parbatipur, Dinajpur, Bangladesh executing, by Bangladesh Petroleum Corporation (BPC). However, an alternative option for fuel (HSD) supply has been planned to be supplied from BPC Khulna depot by Rail Wagon, which will be unloaded through

BPDB unloading pump station and transferred to Saidpur Power Station Storage Tank through underground fuel pipeline. Considering these factors BPDB has selected HSD as the main fuel for the proposed Project.

2.4 Technology Alternatives

Considering the non-availability of surface water and restriction in ground water extraction, steam turbine technology is not selected as it requires a huge amount of water for cooling purpose. Therefore, the proponent has reasonably selected Gas Turbine Simple Cycle (GTSC) closed cooling system with cooling tower technology. In this case, the Plant will require a minimum quantity of water.

Moreover, BPDB has further plan to extend the Project into a highly efficient Power Plant and establish into a Combined Cycle Power Plant in near future. This can only be done if the Project has Gas Turbine Simple Cycle technology.

3. Project Design and Description

3.1 Project Concept

The relentless effort of the Government of Bangladesh has brought a significant change in the economy of the country and the life style of its people as well. The Government with a target of developing the country's economy in steps to that of a middle-income country by 2021 has planned a number of efforts in almost all the sectors including industrialization and urbanization. In achieving the target, electrical power deemed the most useable form of energy. In line with the recommendations of PSMP 2010 and 2016 the BPDB has planned to install proposed Power Plant Project at Saidpur, Nilphamari. The project once completed will add another 150 MW ±10% (Net output 161.603 MW) to the north-west power grid of Bangladesh. The proposed Power Plant will be built on modern and advanced technology, having low noise and pollutants emitting equipment and facilities. Moreover, closed cooling system with cooling tower technology of this Plant will require a minimum quantity of water that will be used only for lube oil cooling. Therefore, it is assumed that the Plant will not keep any significant adverse impact to the local people and environment.

3.2 Project Location and Access Way

3.2.1 Project Location

The project site is located in the premise of existing Saidpur 20 MW HSD Power Station. Administratively the site is situated at Bothlagari union, Saidpur Upazila under Nilphamari District and geographically the site is under 25°48'45.52" N latitude and 88°53'3.36" E longitude, 25°48'46.34" N latitude and 88°53'6.20" E longitude, 25°48'38.12" N latitude and 88°53'10.96" E longitude and 25°48'36.79" N latitude and 88°53'6.10" E longitude (**Figure 3.1)**. The Dinajpur-Rangpur National Highway (N4) and Saidpur bypass road are on the south side of the project. Saidpur Railway Station and Saidpur Airport are also located on the South side of the Project. Saidpur Station Road (N5) passes beside the Project site and directly connected with the Saidpur Town through which is on the West side of the Project. Sermasta Kismat Kadikul Road on the North, Bagdokra Nala and Chikli River are on the East side.

3.2.2 Study Area

Based on the nature of the Project, study area of a Power Plant Project is customarily considered as 10 km radius area centering the stack of the Plant. The study area of this Project comprises of agricultural land, fishponds and river, residential areas, etc. The study area is considered for establishing environmental baseline conditions and for the assessment of impacts associated with the interventions. The Saidpur Airport is located 5 km away from the proposed Power Plant Project (**Figure 3.2**) which is an important issue for the stack height of the Plant. Hence, the issue is also considered in this case.

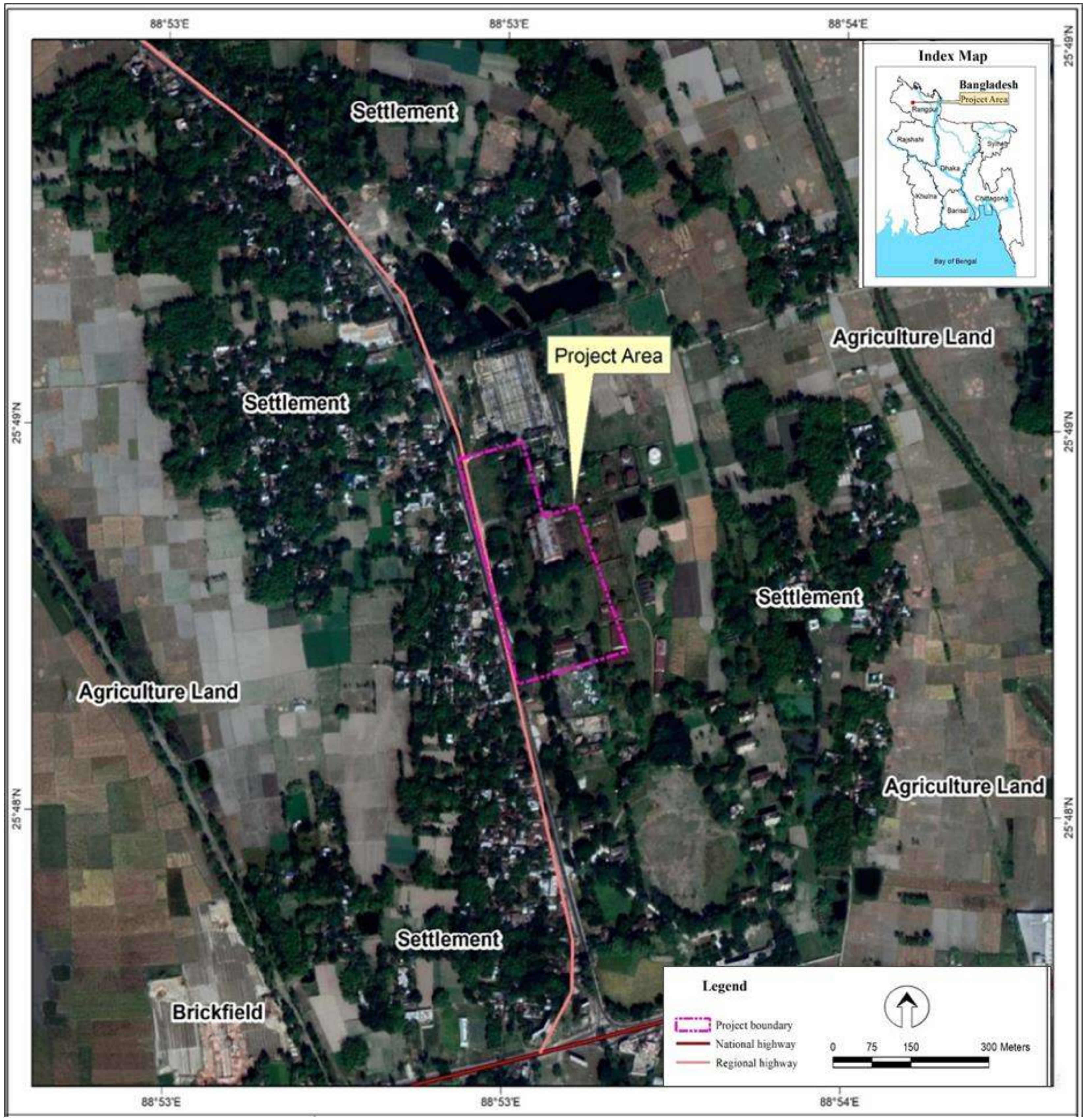
3.2.3 Access Way

The proposed Project site is well connected with different parts of the country including Dhaka through road and railways. Saidpur Station Road (N5) passes beside the Project site and directly connected with the Saidpur Town. Railway facility for fuel supply was already established for the previous Project. Internal road network is sufficient for proper transportation of goods to the project site.

Table 3.1, **Figure 3.3** and **Figure 3.4** show the distance from different landmarks to the proposed Project Site.

Table 3.1: Distance of administrative Head Quarters and landmarks from the Project site

Sl.	Land-marks	Distance (km)
1.	Saidpur Upazila HQ	3.5
2.	Kamarpukur Union HQ	5
3.	Panchagarh- Banglabandha Highway	4
4.	Saidpur Theme Park	2
5.	Eque Paper Mill	4
6.	Eque Jute Mill	2
7.	Panch Matha More	3.5
8.	Saidpur Railway Workshop	1.5
9.	Wood Craft	0.5
10.	Bothlagari Union HQ	2.0
11.	Sonaroy Union HQ	5.8
12.	Kushiram Belpukur Union HQ	7.5
13.	Sangalshi Union HQ	6.2
13.	Charaikhola Union HQ	8.5
14.	Chapra Saramjani Union HQ	9.4
15.	Alokdihi Union HQ	9.6
16.	Fatehjanapur Union HQ	8.2
17.	Belaichandi Union HQ	8.1
18.	Bangalipur Union HQ	7.1
19.	Alampur Union HQ	9.4
20.	Porar Hat	2
21.	Tetuntala Hat	9
22.	Hazari Hat	7.5
23.	Kachhari More	2
24	Saidpur Airport	5
25	Saidpur Cantonment	4.9



Data Source: National Water Resources Database (NWRD), CEGIS Archive
Image Info: Google Earth Image; Date: February 2, 2017;
Projection: Bangladesh Transverse Mercator (BTM), Datum: Gulshan 303

Figure 3.1: Location Map of the Proposed Project Site

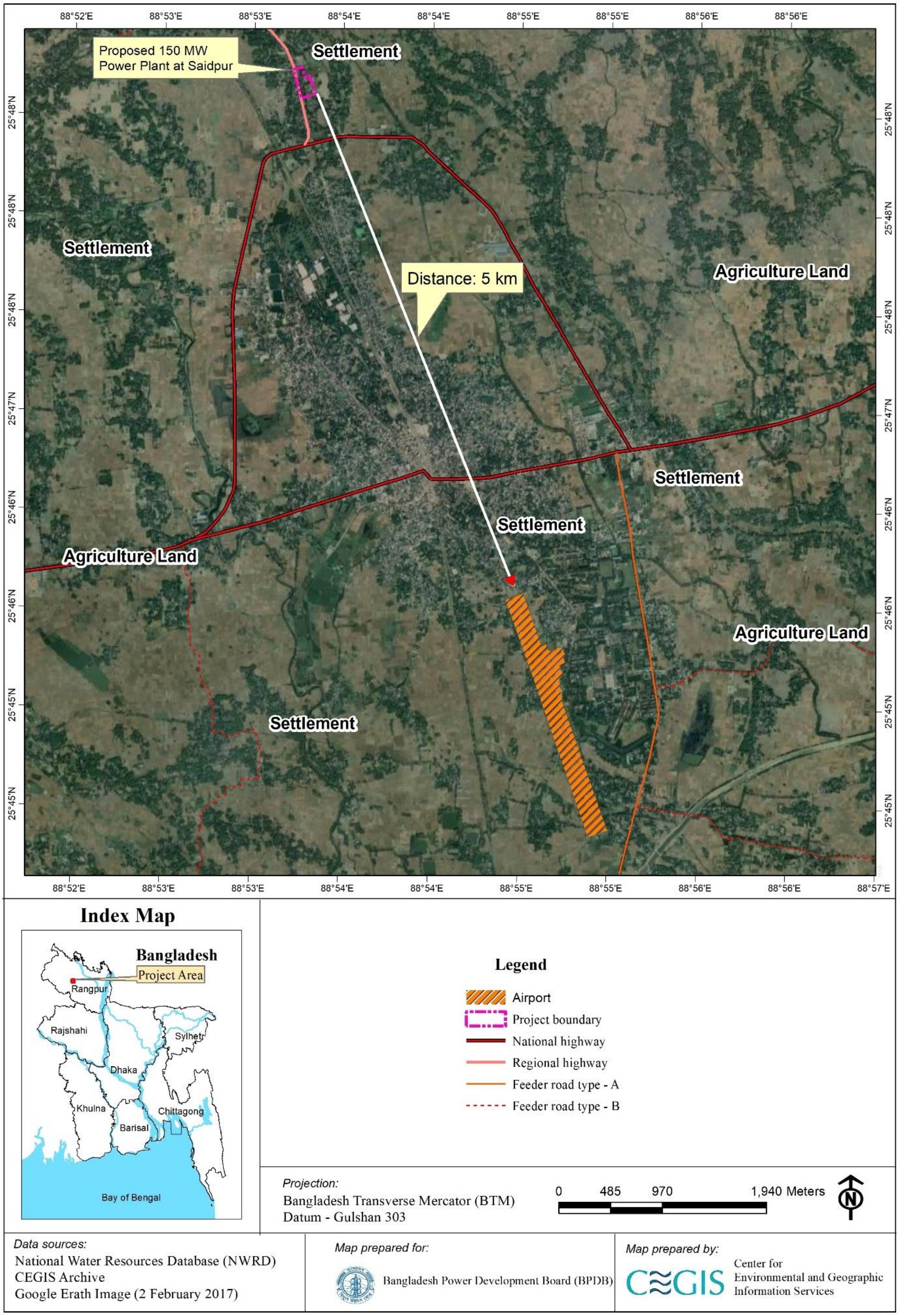


Figure 3.2: Distance Map of Saidpur Airport from the Power Plant

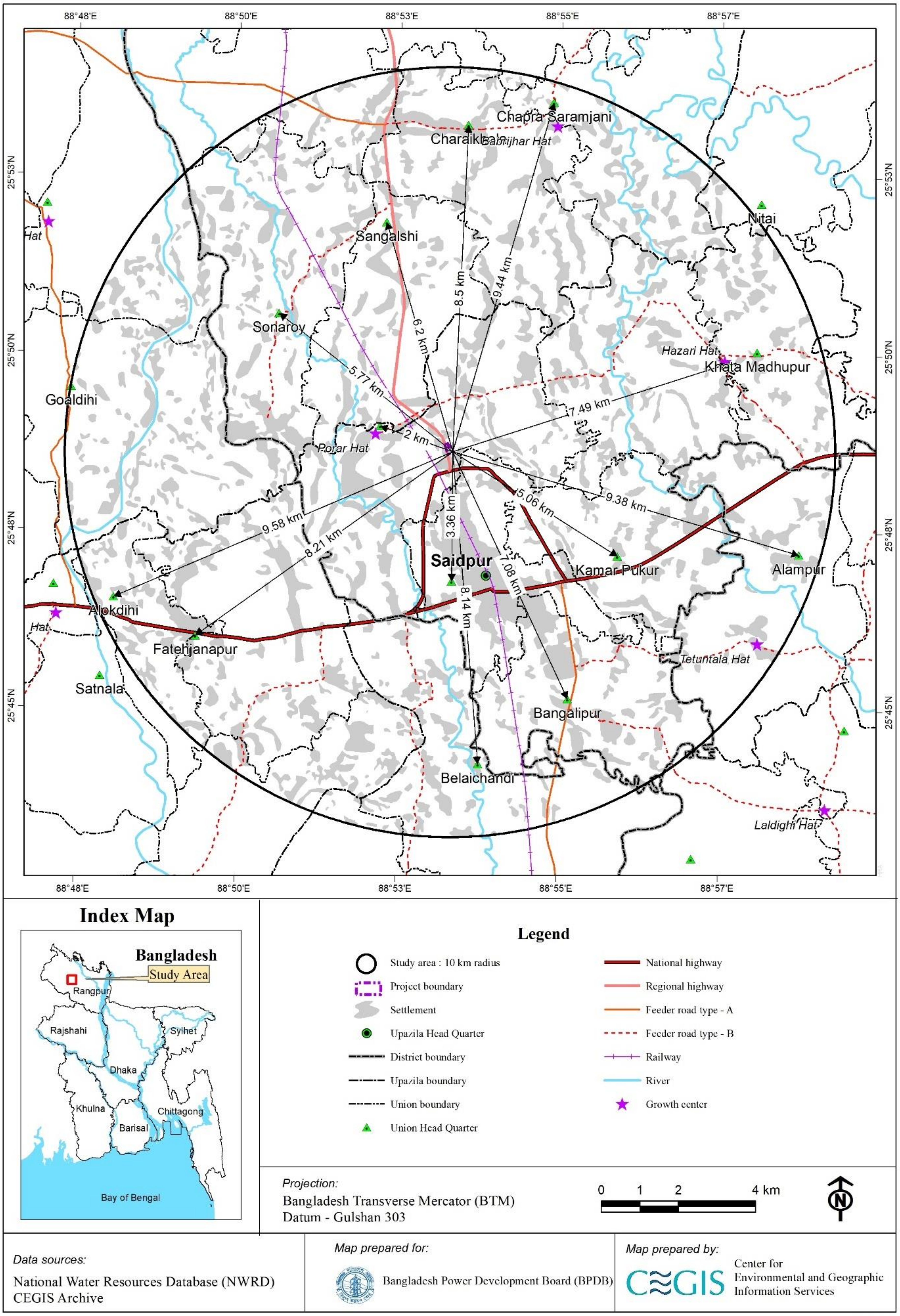


Figure 3.3: Aerial Distance of Important Landmarks from the Proposed Project Site

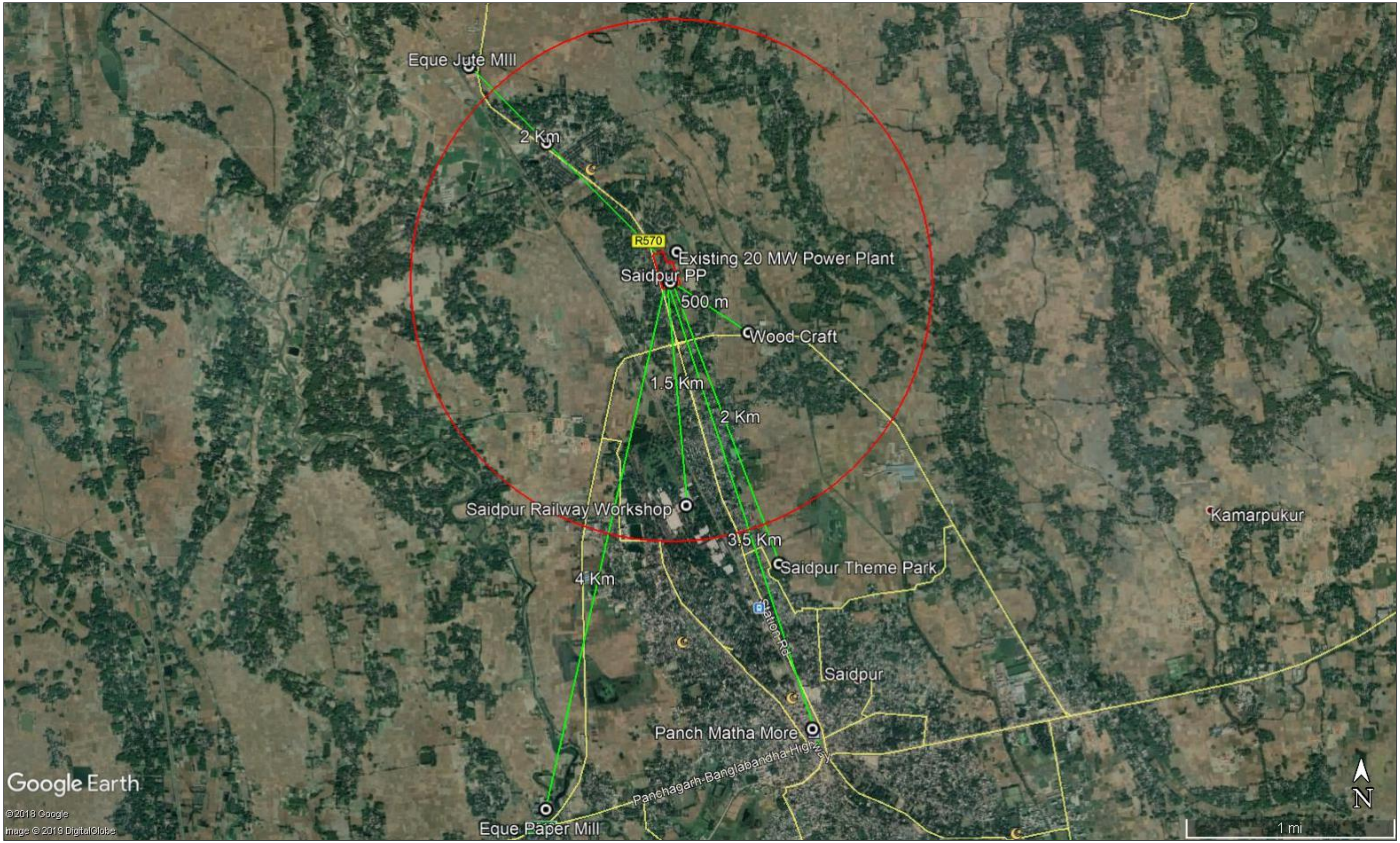


Figure 3.4: Aerial distance of important locations within 2 km radius area from the Project Site on Google Image

3.3 Land Requirement and Acquisition

The Project site is a developed land owned by BPDB. Around 18 acres (Including playground) of land is available in the existing power station premise under the BPDB's occupancy. Out of which about 8 (Eight) acres of land will be used for implementation of this Project and the remaining space will be kept for future conversion of this simple cycle plant to combined cycle power plant. Reasonably, the issue of land acquisition, payment of compensation, rehabilitation etc. will not arise.

3.4 Project Site Development

The project site is already a developed land and needs only some site preparation works like demolishing of some existing structures, clearing bushes, felling of trees, removal of debris, cutting and filling and levelling of some pools, puddles and rat holes etc. regret

3.5 Provisional Project Layout

The layout of the proposed Project provided by EPC showing the locations of the Gas Turbine, cooling tower, Stake and other major components of the project with their legends is provided in **Annex 3**.

3.6 Project Components and Description

The major components of the project include are: Gas Turbine coupled with Generator, Generator Switch Gear, Unit Transformer, 132 kV equipment, Lightning Arrester, 6.6 kV Switchgear, DC System, civil structures like control room building, administrative building, store workshop, internal roads, boundary wall, water treatment plant, control and protection panels, Cooling System, deep tube well etc.

3.6.1 Power Generation

Large scale electrical power is generated using a mechanical device called Turbo-generator that converts the kinetic energy of a flowing fluid (flue gas in this case) into electrical power. High speed diesel (HSD) as fuel will be pumped from the plant's oil Tank which will mixes with compressed ambient air in the combustor and will then ignite. The hot flue gas thus produced from the combustor is then directed to the GTG, where it expands, loses pressure and temperature and causes the GTG to spin and finally escapes to atmosphere through stack. The spinning of the generator will cause the generation of electrical power at 15.75 KV which will be stepped up to grid voltage level of 132KV by three single phase step up transformers with one spare and feed to the national grid (Saidpur 132 kV Grid Sub-station) through underground cable via plant switch yard. A typical process flow diagram is presented in **Figure 3.5**.

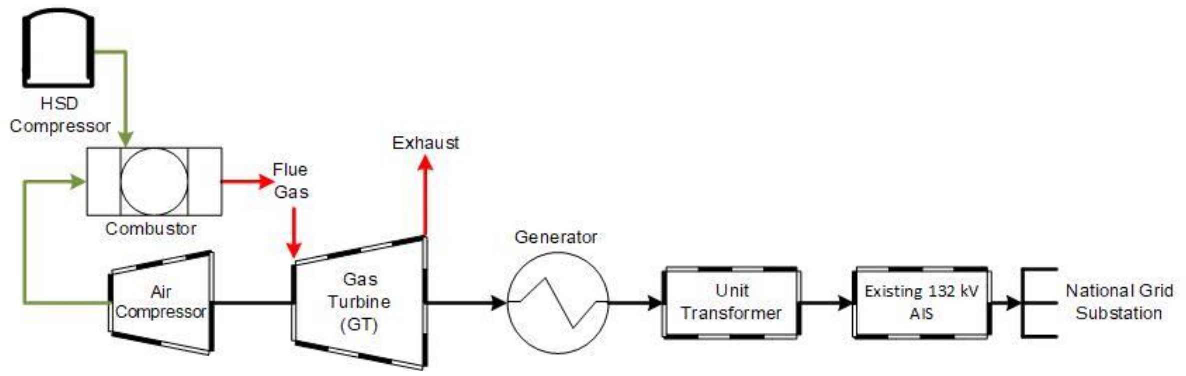


Figure 3.5: Typical process flow diagram of a Gas Turbine Simple Cycle Power Plant

Turbine and its Auxiliaries

Turbines are of three types Gas Turbine, Steam Turbine and hydraulic Turbine. A gas turbine is a type of internal combustion engine. It has an upstream rotating compressor coupled with a downstream Generator and a combustion chamber in between called combustor.

A combustor is a component of a gas turbine where combustion takes place. High pressure air from the air compressor is fed in to the combustion chamber that contains a ring of fuel injectors through which a steady supply of fuel is maintained. The fuel mixes with air and gets ignited. This combustion produces high temperature and high pressure flue gas stream that enters and expands in the HP section of GT and causes the Turbo Generator to spin and thus generates electrical power.

Water Source, Requirement and Management

Since there is no surface water source near the vicinity of the project site, ground water using deep tube well is the only possible water source for the Project. Ground water-based closed cooling system with cooling tower technology has been planned for the Project and other auxiliary equipment cooling. Since the project is a HSD based Simple Cycle Gas Turbine peaking Power Plant the water requirement is very limited compared to a Combined Cycle Power Plant. Average water requirement as one time circulating cooling water for cooling tower has been estimated as 15 m^3. The daily makeup water in the proposed Power Plant for cooling tower, RO system and services will be 250 m^3. The total makeup water includes the Cooling tower total loss 65 m^3/day in which for cooling tower blow down 10 $m^{3,}$ / day, RO system 15 m^3/day and for evaporation and drift loss 40 m^3 /day. From RO system 185 m^3/day water will be injected for NO_x control and another 10 m^3/day will be used for other services like sanitary purposes, bathing and drinking purposes for 92 people, plant services and other miscellaneous use. The cooling tower blowdown water which is about 10m^3/day, waste water from service and other use 4 m^3/day and treated wastewater from ETP which is 5 m^3/day will be collected in the monitoring basin which will mostly be used for gardening and in other miscellaneous purposes. Rest of the water, if available, will be drained to the local drainage system.

The water balance diagram for the proposed Project is shown in the **Figure 3.6**. It can be mentioned here that the water quantities shown in the diagram are the maximum requirement at Plant's full load operation. However, at other loads, water quantities will be lower which is proportionate to Plant's load.

According to the Department of Energy and Mineral Resources, Government of Bangladesh, a Bogura-Rangpur Gas Pipeline will be constructed by Bangladesh Oil, Gas and Mineral

Resources Corporation (PetroBangla) by June 30, 2021. Therefore, once the construction of the proposed gas pipeline is completed and Gas connection to this power Plant is established then this HSD based Gas Turbine Power Plant can easily be converted to Gas based Gas turbine power plant with a minimum cost. Consequently, the present wet (By injecting water) NO_x control technology will be replaced by dry (using dry low NO_x burner) NO_x control technology. This will greatly reduce the Plant's water requirement, as no more water will be required for NO_x control.

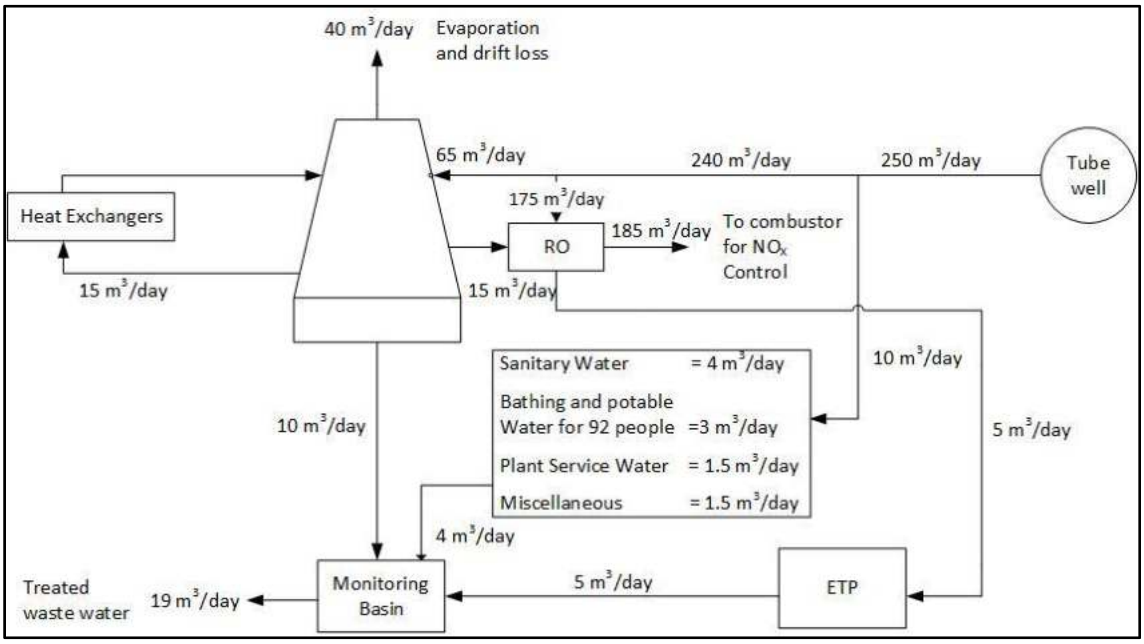


Figure 3.6: Water Balance Diagram for the Proposed Power Plant

Considering the number of local and expatriate labors, officials (around 92 in numbers) and others in different phases, maximum of around 3 m^3/day of water has been considered as their bathing and potable water. Ground water availability calculation carried out under **section 5.2.4** reveals that in total, around 250 m^3/day of groundwater may easily be withdrawn over the entire life span of the Plant. This will negligibly deplete the water table and there will not be any ground water mining as the required pumped water is only 20.13% of available recharged amount, which is comparatively higher. Therefore, groundwater may safely be withdrawn for the proposed Power Plant without affecting the existing domestic use within the influenced area.

To ensure the availability of ground water over the lifetime of the Plant, it is suggested to assess ground water potentiality to ascertain underground water availability and its quality. Based on the water quality, proponent may have to carry out water treatment like sedimentation, before using the water in the process.

Fuel Type, Source and Requirement

HSD has been selected as fuel for the proposed Project. Main option for fuel (HSD) supply will be through India-Bangladesh Friendship Pipeline which is under construction between Numaligarh Refinery Limited, Siliguri, India and BPC Oil Depot, Parbatipur, Dinajpur, Bangladesh executing by BPC. Alternative option for fuel (HSD) supply is from BPC Oil Depot, Khulna by Rail Wagon (BTO), which is unloaded through BPDB unloading pump station and transferred to Saidpur Power Station Storage Tank through underground fuel pipeline. Present oil unloading system with 6-inch diameter pipeline needs upgradation. It is about 3 km away from the existing GT Plant. For the proposed GT Plant the unloading system requires upgradation and relocation close to the Plant site. At present, there exist 5 (Five) oil tanks for the existing 20 MW GT Plant of which three tanks can be renovated and used. For the proposed GT Plant, two oil tanks of each 10,00,000 (Ten lac) liter capacity and two oil tanks of each 50,00,000 (Fifty lac) liter capacity will be constructed at the project site.

Exhaust System and Stack

The flue gas generated in the combustor enters the GT through its high pressure side and flows over the bladed rotor and finally escapes into the atmosphere through the exhaust system and the stack or chimney. The exhaust system mainly consists of an exhaust diffuser, Silencers, Exhaust Stacks or chimney etc. A chimney is a vertical pipe like structure that provides ventilation for hot flue gases to the outside atmosphere. Chimneys may be Double-walled like a pipe inside a larger pipe with the space between the two packed with insulation. Now-a-day, chimneys of a Plant are usually manufactured in a factory and assembled at the site. The space inside the chimney is called a flue. The height of a chimney is determined through modelling. So that the contaminated flue gas does not come in contact to men or other living organisms until the contamination dilutes to permitted level. Saidpur power plant is about 5 Km away from the Saidpur airport. Moreover, the chimney of power plant as proposed in the preliminary layout is in the same alignment with the airport runway. BPDB has been communicated with Bangladesh civil aviation authority to know the permissible height of the chimney that can be constructed in this project. CEGIS has been received through BPDB, the clearance of Chimney height of 260 feet including plume and according to the air quality report chimney height would be about 160 feet (50 m) which is within the permissible limit.

3.6.2 Power Evacuation

Power from the existing 20 MW Gas Turbine Power Plant is currently being evacuated through the existing 132 kV AIS sub-station of the Power Plant. Generated power of the proposed Project can be evacuated through the empty bay of this sub-station which was earlier allotted for the old Diesel Power Plant through step-up transformers to the national grid.

3.7 Project Activities

The major activities of the Project during pre-construction, construction and post construction phases are as below:

3.7.1 Pre -Construction Phase

- Selection of site (Project site is already selected by the proponent BPDB. Ref. In-house Feasibility Report)
- Land ownership and site establishment: The Project site is about 8 acres of land which is a part of existing 18 acres of BPDB’s land adjacent to the existing 20 MW HSD Power Station premises.
- Site establishment will be made after the start of site activities like site preparation, labor shed and sanitation development, temporary road for vehicle movement etc. after getting site clearance from DoE.
- Environmental and Feasibility Study (BPDB has prepared the in-house feasibility Report. Environmental Report is under preparation by CEGIS).

3.7.2 Construction Phase

- Civil, mechanical, electrical and other constructions.
- Post erection check and pre-commissioning test.
- Monitoring of environmental impacts and mitigations.
- Overall Project management.

3.7.3 Post Construction (Operation) Phase

- Commercial operation of the Plant
- Commissioning test
- Reliability test run
- Implementation and monitoring of EMP
- Monitoring of EMP
- Proper O & M of the Plant for efficient running.

3.8 Local Resources and Utility Demand

3.8.1 Resource and Utility Demand

Resources and utilities required to develop the Project include soil, construction materials, manpower, electricity, fuel, water, etc. The proposed Project site is a vacant space adjacent to the existing 20 MW HSD Power Station. It is a developed land of about 18 acres of which 8 acres will be used for the proposed project. The site needs no major earth filling except filling of some rat holes, cutting of some bushes etc. and some minor dressing. However, based on the design requirement the area, partly or fully, may have to be raised to a higher level for which topographic survey shall have to be carried out. The filling earth can be imported soil from other areas.

Most of the Project components like Turbine, Generator, air compressor, Pumps, Transformers etc. will be imported from abroad. Only materials like cement, MS rod, brick etc. and some small and minor tools and machineries will be used in the construction work from local sources. These items would be available in the local market or in the regional markets of Rangpur. During pre-construction and construction periods, labors of different capacities from unskilled to skilled level will be needed and they can be hired from the nearby locality. During installation and commissioning period, mostly skilled manpower will be required. Local skilled manpower can be hired locally or through advertisement in the national daily newspapers. As there is no suitable surface water source in the near vicinity, ground water is to be used for construction and other purposes.

The site is a part of the existing power station area where there is an electricity distribution system. The same can be used to provide electricity during pre-construction and construction period.

3.9 Transportation of Equipment, Machineries and Fuel

Heavy machineries and equipment like gas turbine, gas turbine generator, transformer, switchyard equipment etc. will be imported from abroad. Using Mongla Port facility these machineries and equipment can be transported to Balashi Ghat at Gaibandha and then to the project site by trailer. Other lighter machineries and equipment like pump, fans, firing equipment etc. can be transported through road or rail network. In this connection, it is suggested that the load bearing capacity of the existing road network including bridges and culverts need to be checked through relevant departments and necessary actions should be taken accordingly.

HSD has been selected as fuel for the proposed Saidpur Power Plant Project. Main option for fuel (HSD) supply will be through India-Bangladesh Friendship Pipeline which is under construction between Siliguri, India and BPC Oil Depot, Parbatipur, Dinajpur, Bangladesh and under execution by BPC. Alternative option for fuel (HSD) supply is the use of existing fuel supply system for the 20MW GT Power Plant where fuel from BPC Oil Depot, Khulna is transported by Rail Wagon (BTO) and is unloaded through BPDB unloading pump station and transferred to Saidpur Power Station Storage Tank through underground fuel pipeline. Present oil unloading system with 6-inch diameter pipeline needs upgradation. It is about 3 km away from the existing GT Plant. For the proposed GT Plant the unloading system requires upgradation and relocation close to the Plant site. At present, there exist 5 (Five) oil tanks for the existing 20 MW GT Plant of which three tanks can be renovated and used for the proposed power plat as well. For the proposed GT Plant, two oil tanks of each 10,00,000 (Ten lac) liter capacity and two oil tanks of each 50,00,000 (Fifty lac) liter capacity will be constructed at the project site.

3.10 Waste Management

Wastes to be generated in the pre-construction, construction and operation phases of the Project would be of two types. These are solid waste and liquid waste.

3.10.1 Solid waste

The major solid wastes generated during site preparation is the debris from some demolished structures which are mainly Brick and brick pieces, Plaster materials, MS bars/rods etc. These wastes are saleable and can be sold through open auction.

Wastes during construction phase are mainly construction materials like concrete pieces, small cut pieces of MS bars/rods, plastic pieces, empty cement bags, empty cartons, waste papers, waste from worker’s colony, kitchen wastes, human wastes, etc.

3.10.2 Perishable waste

Perishable kitchen wastes will be disposed of in covered plastic containers kept at designated places, which will be periodically collected by local authority for final disposal to be used for land filling. In short, all kinds of generated solid wastes will be disposed of onsite maintaining DoE’s standard.

3.10.3 Non-perishable Waste

Non-perishable solid wastes like metal pieces, empty cartons, plastic materials, paper bags etc. will be disposed of in covered Plastic containers of different colours specified for different type of wastes kept at a designated place. Recyclable and plastic wastes will be sold to the re-cycling companies and other interested buyers. Other combustible solid wastes like waste paper, wood etc. will be burnt in local incinerator and the resultant ash will be buried in nearby open space.

3.10.4 Sanitary Waste

In the pre-construction and construction phases, human wastes will be managed by constructing temporary sanitary latrines, which will be finally filled, demolished and dressed with adjacent land.

3.10.5 Liquid Waste

The liquid waste generated in the same period is mainly water from bore holes, non-consumptive construction water and waste water from workers' colony, office etc. Construction site waste water will be collected in a pool and will be reused in construction activities. Liquid waste from workers' colony and office will be drained to a soak pond/ soak pits for ultimate evaporation and soaking by the soil.

All liquid wastes generated from cooling tower blow down, water from leaks and vents, waste water from turbine floor and workers' colony and offices etc. will be drained to central effluent sump and then to effluent treatment plant (ETP) for treatment as per DoE and IFC standards including other international standards. After treatment, the liquid will be mostly used as gardening water for green belt, car wash and other internal purposes. In exceptional cases, the treated waste water will be drained into the nearby river following GoB and IFC standards as applicable. Oil from the oily water from turbine floor and transformer area will be separated using centrifugal machine and will be sold to the oil trading companies and the water will be drained to ETP for further treatment.

During operation, some HSD wastes will be collected in trays from different leaks of pipe joints and burner area, which will finally be transferred to plastic drums and will be sold to the oil trading companies.

3.10.6 Effluent Treatment and Maintaining Discharge Standard

A comprehensive wastewater management system shall be provided in the Power Plant complex to treat the liquid effluent to meet the DoE standard as per Schedule- 12 (Standards for Sector-wise Industrial Effluent or Emission) of ECR, 1997. The wastewater treatment plant at Saidpur Power Station shall be designed based on combining physical, fuel and biological treatment systems to effectively control the quality of effluent. The following parameters and limit in **Table 3.2** shall be applied based on ''The Environment Conservation Rules, 1997, Schedule 12''. The capacity of Effluent Treatment Plant (ETP) provisioned for the proposed Power Plant in normal condition will be about 5 m^3/day whereas the design capacity should be 15 m^3/day. The effluents will come from different sections of the wastewater treatment system described in the section **3.6.1**.

Table 3.2: ETP Design Treated Effluent Quality (ECR, 1997)

Sl. No.	Parameters	Unit	Concentration
1.	pH	--	6.5 to 8.0
2.	Suspended Solids	mg/l	100
3.	Oil & Grease	mg/l	10

Notes:

1) *'DO (dissolved oxygen)' is excluded in regulatory parameters as DO contained in the effluent is uncontrollable.*

3.10.7 Oil Sludge

The proposed Power Plant is a HSD based Power Plant. Water, heavy metals and solid particles etc. present in this type of fuel deposit in the oil tank which is commercially known as sludge. Sludge contaminate water is separated using centrifuging machine and treated in the Effluent Treatment Plant (ETP). Over the years, a variety of methods have been developed for the treatment of oily sludge as discussed below in **Figure 3.7**.

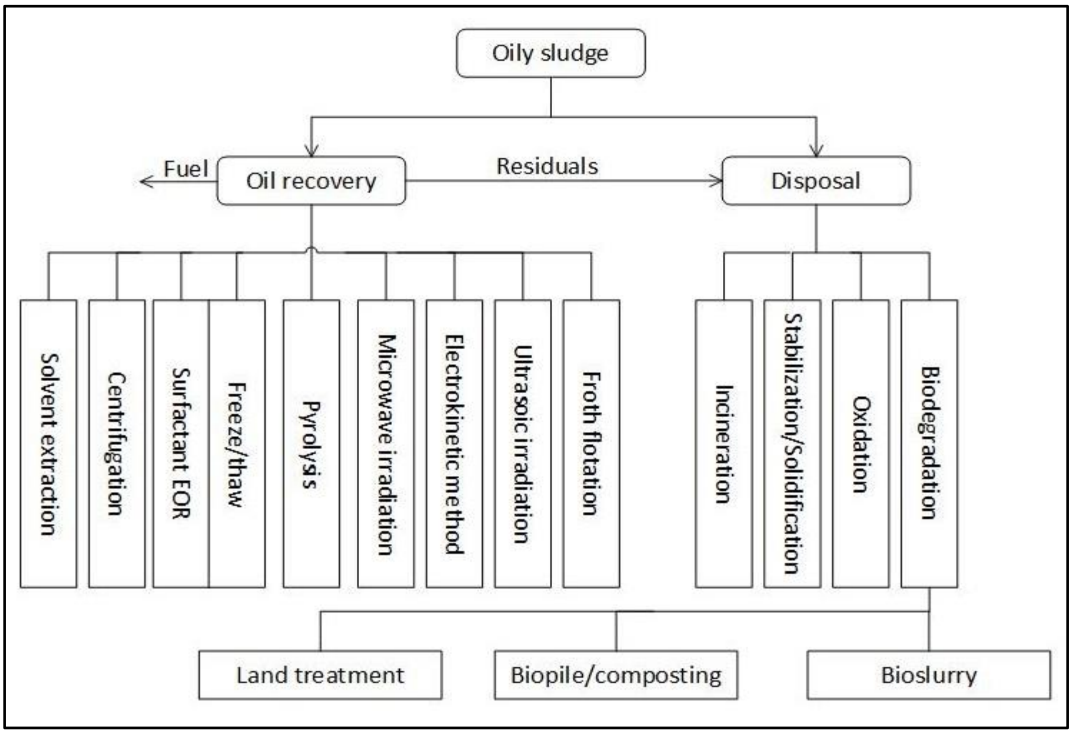


Figure 3.7: Flow diagram of Oily sludge

3.11 Central Control, Monitoring and Protection

All control, monitoring, protection and measuring instruments like relay, control switch, automatic controllers, annunciators, analogue to digital signal converter etc. required for proper operation, control, protection and monitoring of the Simple Cycle Power Plant (SCPP), switchyard and their associated facilities should be from internationally reputed firms like Siemens, ABB, Foxboro and the like. A fully integrated microprocessor based Distributed Control System (DCS) control, monitoring and protection system would be provided for the proposed SCPP, switchyard and their associated facilities. The system will be integrated with the control, instrumentation, alarm and protection of the Plant, data acquisition, signal conditioning, closed loop control, open loop control, alarm processing and annunciation, event recording and real-time trend recording and communication with other devices/systems. For the purpose of communication between the components, a reliable and unique Digital Control and Information System (DCIS) redundant communication system will be installed. The DCIS will provide safe, efficient and reliable operation of the plant. It will be integrated with sub-system control of generator, gas turbine and with their packaged auxiliaries’ systems control and supervision will be performed by this integrated plant control system. The DCIS will provide modulating and digital control monitoring, alarming, indication and data acquisition for overall SCPP and its auxiliaries.

Provision will be maintained to incorporate automatic load control from the National Load Despatch centre (NLDC), after setting the load demand into the DCS through the operator console.

3.12 Civil Structure and Urban Facilities

The possible civil and urban facilities to be constructed are listed below:

- Infrastructures and civil structures includes but not limited to-
    - Central control and electrical building
    - Water treatment building
    - Fire water pump house
    - Air compressor building
    - Cooling tower
    - Workshop, store building and store yard
    - Administration building
    - Rest House
    - Site Office
    - Officer's dormitory
    - Staff dormitory
    - Guard house
    - Security guard shade
    - Chemical dosing shelter for cooling tower
    - Renovation and construction of internal road
    - Renovation and construction of internal drain
    - Extension of security wall
    - Electrical system
    - Fuel Tank Foundation.

3.13 Afforestation

A large-scale afforestation and green belt development activities shall be undertaken in all available spaces except the switchyard site within the proposed Project area.

3.14 Human Resources Required During Different Phases

The estimated number of workers required during (i) Pre-construction (ii) Construction and (iii) Operation phases are as follows. It may be noted that in all phases local people with prerequisite qualification and experience should be given preference over others.

a. Pre-Construction Phase:

- **Demolition Phase:** During demolition phase, EPC contractor is expected to have unskilled, semi-skilled and skilled workers of around 125 at peak time and about 100 in regular basis. Moreover, around 10 supervisors including engineers, management staff, etc. will require also in this phase.
- **Site Preparation Phase:** During site preparation, EPC contractor is expected to have workers of around 100 at peak and about 75 in regular basis including unskilled, skilled, engineers and about 10 supervisors and management staff, etc.

b. Construction Phase:

During construction, EPC contractor is expected to have around 300- 500 number of unskilled, semi-skilled and skilled labors temporarily for the construction activities that include civil works and plumbing and around 10 supervisors will be engaged to monitor and supervise them. Among the manpower, expatriate employees will be around 30-40.

c. Commissioning Phase:

During commissioning, EPC Contractor will employ around 50- 75 persons. Among the labor, expatriate employees will be around 50 and rest will be local.

d. Operation Phase:

During this phase, BPDB will employ around 92 persons in which 39 persons for Managerial post and rest 53 persons will be staff and other posts.

4. Policy, Legal and Administrative Framework

4.1 Introduction

The Government of Bangladesh has planned to install a 150 MW ±10% Simple Cycle HSD-based Power Plant Project at Saidpur, Nilphamari. According to the Environment Conservation Act, 1995, no industrial unit or development project will be established or undertaken without obtaining an Environmental Clearance Certificate from the Department of Environment (DoE). To do so the respective authority is required to conduct Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) as it is obligatory under the law of Bangladesh.

Along with the environmental assessment, relevant legal provisions, policies, strategies and institutional issues of planned projects/industries are very important for any project proponent or developer before they actually execute a program or plan. The proponent has to be well aware of these requirements and comply with the provisions as applicable and necessary. The activities of the proposed 150 MW ±10% Simple Cycle HSD-based Power Plant Project at Saidpur, Nilphamari of Bangladesh Government falls under the 'Red' category according to the Bangladesh Environment Conservation Rules, 1997 and therefore, need to conduct IEE and EIA studies respectively for obtaining site/location and environmental clearance from the DoE.

In respect of legal obligations and policy guidelines under the IEE study of the new construction of 150 MW Power Plant the following activities have been carried out:

- Identification of national legal obligations in relation to the interventions which will be require to review under the EIA study of the proposed 150 MW ±10% Simple Cycle HSD-based Power Plant Project at Saidpur, Nilphamari;
- Review of the national legislative provisions and policy guidelines on environmental sectors;
- Identification of international legal obligations and relevant provisions of multilateral environmental agreements in relation to the proposed project interventions;
- Investigation of national and international legal provisions on Gas and Power Plant development sector; and
- Identification of the standard guidelines at regional and international level in connection with the thermal Power Plant setup.

National laws, by-laws and official resolutions relevant to HSD based simple cycle PP installation, operation and maintenance and associated activities have been identified under this study. Under the national legal framework, the proposed intervention needs to comply with the environmental legislations of the country and needs to fulfill the requirements to obtain required permissions to implement these activities.

As per the requirement, the EIA report has been prepared and will be submitted to the DoE for the purpose of obtaining EIA approval Certificate. It may be noted here that the proposed Power Plant is a new one and this will be built beside the existing Power Plant on the acquired land of BPDB by utilizing the existing facilities. Followed by IEE study, EIA study has been conducted based on a Terms of Reference (ToR) approved by the DoE.

4.2 Applicable Policies and Legal provision

All legal provisions relevant to environmental protection applicable to the planning, construction, operation and maintenance were identified under the scope of the EIA. **Table 4.1** below summarizes all relevant legal provisions:

Table 4.1: National legal provisions and standards applicable to the proposed simple cycle Power Plant for ensuring environmental protection

Act/Rule/Law/ Ordinance	Responsible Agency-Ministry/Authority	Key Features-Potential Applicability
Bangladesh Energy Regulatory Commission Act, 2003	Ministry of Power, Energy and Mineral Resorces	Governance of power generation and management system
• Power System Master Plan, 2010 • Power System Master Plan, 2016	Bangladesh Power Development Board (BPDB) and Ministry of Power, Energy and Mineral Resorces (MPE&MR)	
National Energy Policy		
• Petroleum Act, 1934	Bangladesh Agency of Petroleum Exploration (BAPEX)/ Petrobangla	Gas mining, gas exploration and quality management
• The Civil Aviation Act. 2017 and Manual of Aerodrome Standards-CAAB	Ministry of Civil Aviation and Tourism	The main features of the civil aviation Act is to maintain equivalent level of safety of the Airports as well as safety of the Aircrafts.
• Fatal Accidents Act, 1855 • Imports and Exports (Control) Act, 1950 • Public Safety Ordinance, 1953 • Fire Prevention and Extinguish Act, 2003	Health Department/Ministry of Labour and Manpower/Ministry of Home Affairs	Health and Safety
The Public Procurement Act. 2006 and Public Procurement Regulations, 2008 and Revisions Thereafter.	Ministry of Law, Justice and Parliamentary Affairs.	Procurement process followed in Bangladesh
The Environment Conservation Act, 1995 and subsequent amendments in 2000 and 2002	Department of Environment, Ministry of Environment and Forest and Climate Change	• Declaration of Ecologically Critical Areas; • Obtaining Environmental Clearance Certificate; • Regulation with respect to vehicles emitting smoke harmful for the environment; • Regulation of development activities from environmental perspective; • Promulgation of standards for quality of air, water, noise, and soils for different areas and for different purposes;

Act/Rule/Law/ Ordinance	Responsible Agency-Ministry/Authority	Key Features-Potential Applicability
		• Promulgation of acceptable limits for discharging and emitting waste; • Formulation of environmental guidelines relating to control and mitigation of environmental pollution, conservation and improvement of environment.
Environment Conservation Rules, 1997 and subsequent amendments in 2002 and 2003	Department of Environment, Ministry of Environment and Forest	• Declaration of Ecologically Critical Area; • Requirement of Environmental Clearance Certificate for various categories of projects; • Requirement for IEE/EIA according to the appropriate category of the project; • Renewal of the environmental clearance certificate within 30 days after the expiry; • Provides standards for quality of air, water & sound and acceptable limits for emission/discharges from vehicles and other sources.
Environment Court Act, 2000 and subsequent amendments 2002	Judiciary and Ministry of Environment & Forest	GoB has given highest priority to environment pollution and passed Environment Court Act, 2000 for completing environment related legal proceedings effectively
The Vehicle Act, 1927; The Motor Vehicles Ordinance, 1983;The Bengal Motor Vehicle Rules, 1940	Bangladesh Road Transport Authority (BRTA)	Exhaust emission; vehicular air and noise; road safety
Bangladesh Explosive Act, 1884	Ministry of Homes	This rule emphasizes on the manufacturing, possession, use, sale, transport and importation of explosives.
The Fire Services Ordinance 1959	Ministry of Homes	Protection of lives and properties from Fire hazards.
Water Supply and Sanitation Act, 1996	Ministry of Local Government, Rural Development and Cooperatives	Management and Control of water supply and sanitation in urban areas
The Ground Water Management Ordinance 1985 and Use of ground water resources for the agricultural purposes.	The Ground Water Management Ordinance, 1985 has been repealed by the new rule “Use of ground water resources for the agricultural purposes.”	Management of ground water resources based on the National Water Policy.

Act/Rule/Law/ Ordinance	Responsible Agency-Ministry/Authority	Key Features-Potential Applicability
The Forest Act, 1927 and subsequent amendments in 1982 and 1989	Ministry of Environment and Forest	Reserve Forests; Protective Forests; Village Forests
The Private Forests Ordinance Act, 1959	Regional Forest Officer, Forest Department	Conservation of private forests and for the afforestation on wastelands
Bangladesh Wild Life (Preservation) Act, 1974	Ministry of Environment and Forest Bangladesh Wild Life Advisory Board	Preservation of Wildlife Sanctuaries, parks, reserves
The Protection and Conservation of Fish Act 1950 and subsequent amendments in 1982	Ministry of Fishery	Protection and Conservation of fish in Government owned water bodies
Bangladesh Water Act. 2013	Ministry of Water Resources	The Bangladesh Water Act. 2013 was passed to ensure “integrated development, management, abstraction, distribution, use, protection and conservation of water resources. This Project will use water as natural resources and accordingly this Act. will be followed during implementation of this Project.
Natural Water Bodies Protection Act 2000	Rajdhani Unnayan Kartipakkha/Town Development Authority/Municipalities	According to this Act, the character of water bodies i.e. rivers, canals, tanks, or floodplains identified as water bodies in the master plans or in the master plans formulated under the laws establishing municipalities in division and district towns shall not be changed without approval of concerned ministry.
The Embankment and Drainage Act 1952	Ministry of Water Resources (erstwhile Ministry of Irrigation, Water Development and Flood Control)	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.
Antiquities Act 1968	Ministry of Cultural Affairs	Governs preservation of the national cultural heritage, protects and controls ancient monuments, regulates antiquities as well as the maintenance, conservation and restoration of protected sites and monuments, controls planning,

Act/Rule/Law/ Ordinance	Responsible Agency-Ministry/Authority	Key Features-Potential Applicability
		exploration and excavation of archaeological sites.
The Building Construction Act 1952 and subsequent amendments	Ministry of Works	An Act to provide for the prevention of haphazard construction of building and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh
The Bangladesh National Building Code (BNBC)	Ministry of Public Works	The Bangladesh National Building Code (BNBC) provides necessary provision for constructing safe and healthy habitat and regulates properly all activities related to building construction such as planning, design and construction. Besides these, all building structures related issues highlighted in the code shall be considered as appropriate for implementation of this Project.
• The Land Acquisition Act, 1894 • The Acquisition and Requisition of Immovable Property Ordinance 1982 and subsequent amendments in 1994, 1995 and 2004	Revenue Department	Current GoB Act. & guidelines, relating to Acquisition of land
• The Factories Act, 1965 • Bangladesh Labor Law 2006	Ministry of Labor	This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions.
Bangladesh Constitution Article 11: Democracy and Human Rights	Ministry of Law, Justice and Parliamentary Affairs	Protection of human rights

4.3 National environmental legal provisions in connection with setup, operation & maintenance

The Environment Conservation Act of 1995 is the key legislation in relation to environment protection in Bangladesh. This Act has been promulgated for environment conservation, standards, development, pollution control, and abatement. It has repealed the Environment Pollution Control Ordinance of 1977. The Act has been subsequently amended in 2000, 2002, 2007 and latest amendments done up to year 2010. The main objectives of the Act are:

- Conservation and improvement of the environment; and
- Control and mitigation of pollution of the environment.

The main strategies of the Act can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried/initiated in the ecologically critical areas;

- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the industries and other development activities' discharge permits;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

According to the law before setting up any new project/interventions by the Government/ non-government agencies/public, the proponents are required to obtain respective clearance from the Department of Environment. Under the Environment Conservation Rules 1997, the project promoter must obtain site clearance from the Director General of Department of Environment. An appeal procedure does exist for those promoters who fail to obtain clearance. The Department of Environment executes the Act under the leadership of the Director General.

Under the Environment Conservation Act, 1995 the first set of rules promulgated is the Environment Conservation Rules, 1997. The Rules have provided categorization of industries/ projects, hence identified types of environmental assessments needed against respective categories of industries/projects. The Environment Conservation Act (Amendment), 2000 provides responsibility for compensation in cases of damage to ecosystems: (1) The polluter pay principle is included herein, (2) increased provision of punitive measures both for fines and imprisonment and (3) fixing authority on cognizance of offences.

The Bangladesh Environment Conservation Act (Amendment), 2002 elaborates on: (1) restriction on polluting automobiles, (2) restriction on the sale and production of environmentally harmful items like polythene bags, (3) assistance from law enforcement agencies for environmental actions, (4) break up of punitive measures and (5) authority to try environmental cases.

The Environmental Rules are not explicit for various oil and gas exploration interventions. Rather, this is covered under the broader heading of "exploration, extraction and distribution of mineral resources" under the 'Red' category projects.

So far the Rule has been updated three times- February and August 2002 and April 2003.

4.3.1 *Procedure to obtain environmental clearance certificate*

According to the Section 12 of the Environment Conservation Act 1995 no industrial unit or project will be established or undertaken without obtaining, in the manner prescribed by the Environment Conservation Rules 1997, an Environmental Clearance Certificate from the Director General. Therefore, every development projects/industries which are specified under the Schedule- 1 of the Environment Conservation Rules 1997 require obtaining site and environmental clearance from the Department of Environment.

4.3.2 *Provisions under the environmental legislations*

National laws, by-laws and official resolutions relevant to HSD based thermal Power Plant installation, operation and maintenance and associated activities have been identified under this study. Under the national legal framework the proposed intervention needs to comply with the environmental legislations of the country and need to fulfill the requirements of DoE to obtain permission for implementing the activities.

The ***Bangladesh Environment Conservation Act of 1995*** (ECA 95) is the key legislation in relation to environment protection in Bangladesh. This Act is promulgated for environment conservation, standards, development, pollution control, and abatement. It has repealed the Environment Pollution Control Ordinance of 1977. The Act has been amended in 2000, 2002, 2007 and was proposed for amendment in the year 2010.

The main objectives of the Act are:

- Conservation and improvement of the environment; and
- Control and mitigation of pollution of the environment.

The main strategies of the Act can be summarized as:

- Declaration of Ecologically Critical Areas (ECAs) and restriction on the operations and processes, which can or cannot be carried/initiated in the ecologically critical areas;
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the industries and other development activities' discharge permits;
- Promulgation of standards for quality of air, water, soil and level of noise for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

Before any new project/development interventions by the government or by non-government agencies can go ahead, as stipulated under the Environment Conservation Rules 1997, the project promoter must obtain SCC and successive ECA from the Department of Environment (DoE). An appeal procedure does exist for those promoters who fail to obtain clearance. Failure to comply with any part of this Act may result in punishment of imprisonment or fine or both. The DoE executes the Act under the leadership of the Director General.

The Bangladesh Environment Conservation Act (Amendment), 2000 focuses on: (1) ascertaining responsibility for compensation in cases of damage to ecosystems, (2) increased provision of punitive measures both for fines and imprisonment and (3) fixing authority on cognizance of offences.

The Bangladesh Environment Conservation Act (Amendment), 2002 elaborates on: (1) restriction on polluting automobiles, (2) restriction on the sale and production of environmentally harmful items like polythene bags, (3) assistance from law enforcement agencies for environmental actions, (4) break up of punitive measures and (5) authority to try environmental cases.

The Bangladesh Environment Conservation Rules, 1997 is the first set of rules, promulgated under the ECA 95 (so far there have been three amendments to this set of rules - February and August 2002 and April 2003). The Environment Conservation Rules of 1997 has provided categorization of industries and projects and identified types of environmental assessments needed against respective categories of industries or projects.

Among other things, these rules set (i) the National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc., (ii) the requirement for and procedures to obtain environmental clearance, and (iii) the requirement for IEE and EIA according to categories of industrial and other development interventions.

The Rules are not explicit for various oil and gas exploration interventions. Rather, this is covered under the broader heading of “exploration, extraction and distribution of mineral resources” under the ‘Red’ category projects.

The proposed project, according to the DoE, is considered under the Red category of the Environment Conservation Rules, 1997 (Item 65: Exploration, extraction and distribution of mineral resources)

4.3.3 Compliance with EIA guidelines of DoE

The proposed 150 MW ±10% Simple Cycle HSD-based Power Plant Project activities fall under the ‘Red’ category according to the Environment Conservation Rules 1997. For projects under this category, it is mandatory to carry out EIA including Environmental Management Plan (EMP) and where necessary develop a Resettlement Plan for getting environmental clearance from the DoE. The DoE has issued *EIA Guidelines for Industries* (this document was released in December 1997) and addresses the IEE and EIA for several industrial sectors and activities. Each project proponent shall conduct IEE and EIA and is expected to consult and follow the DoE guidelines. Under this study the provisions of the environment legislations and the EIA guidelines of the DoE has been carefully reviewed.

The DoE has issued application procedure for obtaining site/environmental clearance. The following **Figure 4.1** shows the application procedure of all four categories:

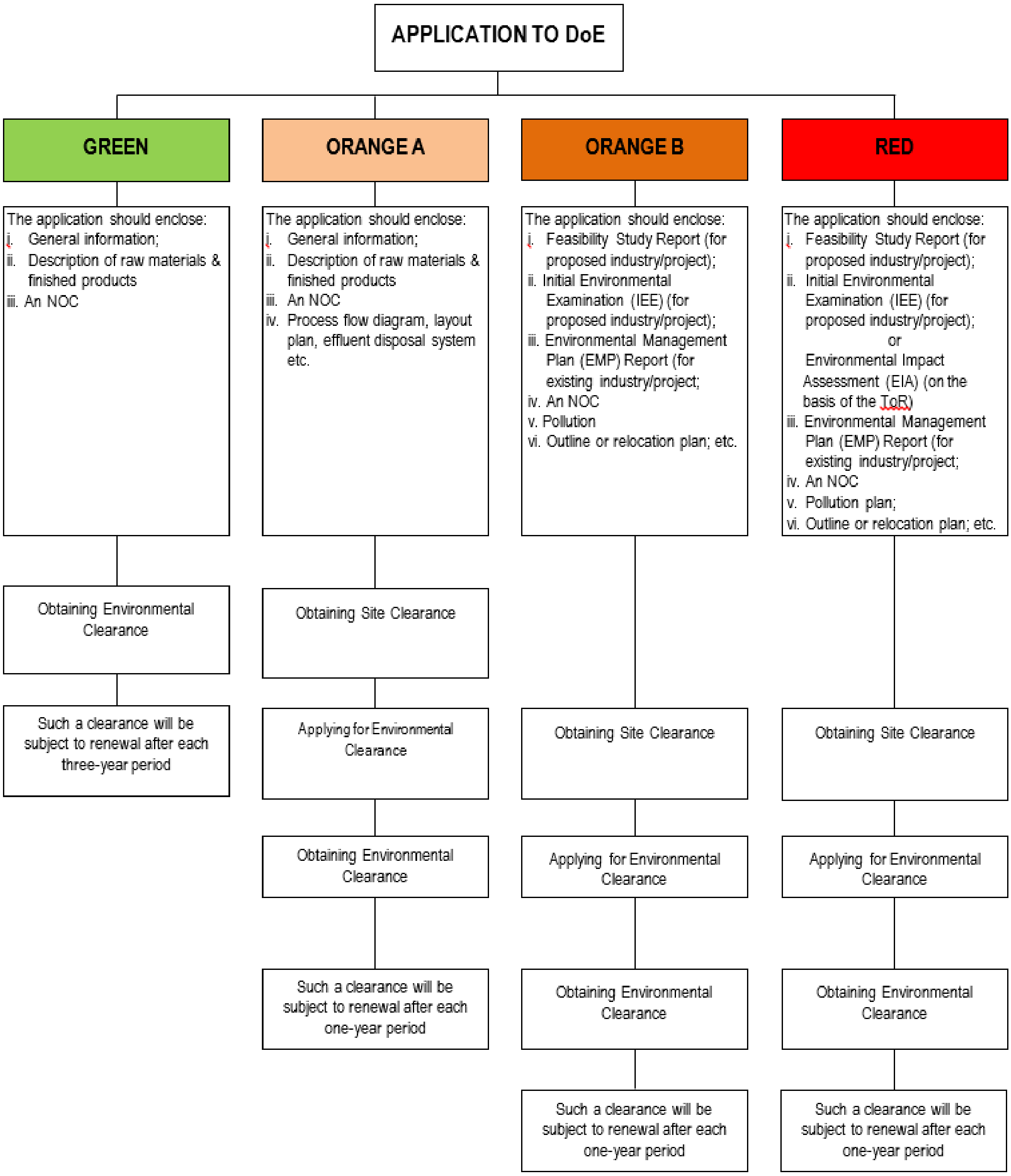


Figure 4.1: Process of obtaining site and environmental clearance certificate from DoE

4.3.4 Compliance under the national laws

The Forest Act, 1927 & Amendment Act 2000

The Forest Act of 1927 provides for preserving forests over which the government has an acquired property right. This act has made many types of unauthorized uses or destruction of forest produce punishable. The Government may assign any village community its right to or over any land, which has constituted a reserve forest.

According to the Act the government may prohibit certain activities in the declared reserve forest area such as any intervention kindles, keeps or carries any fire; trespasses or pastures cattle, or permits cattle to trespass; causes any damage by negligence in felling any tree or cutting or dragging any timber; etc. There is no declared reserve forest area near the proposed site of the 150 MW ±10% Simple Cycle HSD-based Power Plant Project at Saidpur, Nilphamari. Therefore, the proposed project complies with these requirements of legislation. During the EIA study this law, and rules and regulations under it has been reviewed to explore whether the proposed activities of the project violate any provisions of the Forest Act.

The Supplementary Rules of 1959 empowered the concerned governmental bodies to restrict totally and for a specified period, the shooting, hunting or catching of various birds, animals and reptiles in the controlled and vested forests. The Private Forest Ordinance of 1959 provides for the conservation of private forests and for the forestation, in certain cases, of wastelands in Bangladesh.

The Penal Code, 1860

The Penal Code of 1860 has some valid provisions related to pollution management, environment protection and protection of health and safety. Some of these are: 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; and Section 286: Negligent Conduct with Respect to Explosive Substance. (Chapter XIV of offences affective Public health, safety, convenience, decency and morals).

The Acquisition and Requisition of Immovable Property Ordinance (1982)

This Ordinance has replaced the Land Acquisition Act of 1894 and the East Bengal (Emergency) Requisition of Property Act of 1948. The Ordinance governs acquisition and requisition by the government of immovable property for any public purpose or in the public interest. It may be noted that contrary to the previous Acts (i.e. Act XIII of 1948), this Ordinance deals only with immovable property.

The Ordinance has well-defined procedures regarding payment of compensation for an acquired piece of land. If, for example, the land is used for rice growing, then an amount equivalent to approximately 1.5 times the market value of a given variety of rice (e.g., paddy) that is currently being (or could be) produced annually is fixed as a yearly lease value. In case of outright purchase (carried out on a 99-year lease), the compensation-value of acquired land varies widely according to the locality, soil fertility, and access to transportation and related infrastructure factors. The current compensation and resettlement provisions are however inadequate both in terms of timing of payments and quantum. The procedures involved are cumbersome and time consuming and often cause hindrance to the smooth execution of the project. Legal provisions covering adequate compensation to the project affected persons, particularly disadvantaged groups such as women and squatters and such other vulnerable groups are yet to be framed.

The Protection and Conservation of Fish Rules, 1985

These are a set of rules in line with the overall objectives of the Fish Act. Section 5 of the Rules requires that “No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters”. Section 6 of the Rules states -“No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters". Therefore, the proposed intervention of BPDB will need to be carried in such a manner that the activities do not cause damage to the inland water fisheries.

The Fatal Accidents Act, 1855

An Act to 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 felony or other crime.

The Explosives Act, 1884

The Government may for any part of Bangladesh, make rules consistent with this Act to regulate or prohibit, except under and in accordance with the conditions of a license granted as provided by those rules, the manufacture, possession, use, sale, transport and importation of explosives or any specified class of explosives.

Any person manufacturing, possessing, using, selling, transporting or importing an explosive in contravention of a notification issued shall be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine which may extend to fifty thousand Taka, in default of which with a further imprisonment for a term which may extend to one year, and in the case of importation by water or land, the owner and master of the vessel or carriage in which the explosive is imported shall, in the absence of reasonable excuse, each be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine with a further imprisonment for a term which may extend to one year.

4.4 National Policy Guidance

Under the study a number of sectoral national policies will be reviewed to identify, the guiding principles which are relevant to the HSD based thermal Power Plant installation, operation and maintenance activities. The sector policies will include energy, environment, water, forest, transport, import, fisheries, etc.

National Environment Policy

The National Environment Policy of 1992 sets out the basic framework for environmental action, together with a set of broad sectoral action guidelines. The Policy provides the broader framework of sustainable development in the country. It is also stated all major undertakings, which will have a bearing on the environment, (including setting up of an industrial establishment) must undertake an IEE and EIA before they initiate the project.

The Policy delineates DoE, as the approving agency for all such IEE and EIA to be undertaken in the country. The policy guidelines of fifteen sectors are stated in the Policy. Under the 'energy and fuel sector' (section 3.4), the use of environmentally sound and less harmful fuel has been encouraged in Section 3.4.1. Section 3.4.5 provides, 'Conservation of country's fossil fuel reserve and renewable sources of energy'. And section 3.4.6 provides that EIA should be conducted before implementation of projects for extraction of fuel and mineral resources. Under the Environmental Action Plan Section of the Policy and sub-section 'Fuel and Energy', it says that:

- Section 4.2 "In the rural areas the use of gas, coal, kerosene and petrol as fuel will be expanded in the rural areas, so that fuel wood, agricultural residues and cow dung are conserved. This will help the use of agricultural residues, and cow dung etc. as manure";
- Section 4.7 "Appropriate measures will be taken to ensure that extraction, distribution and use of natural resources such as oil, gas, coal, peat etc. do not adversely affect air, water, land, the hydrological balance and the ecosystem"; and
- Section 3: 'Forest, wildlife and biodiversity' directs the followings:
    - Conserve wildlife and biodiversity, strengthen related research and help dissemination and exchange of knowledge in these areas; and
    - Conserve and develop wetlands and protect migratory birds.

National Environment Management Action Plan 1995

The National Environment Management Action Plan (NEMAP) is a wide ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environment Policy (NEP). NEMAP was developed to address issues and management requirements for a period between 1995 to 2005 and set out the framework within which the recommendations of the National Conservation Strategy (NCS) are to be implemented.

NEMAP has the following broad objectives:

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

One of the key issues in NEMAP regarding the energy sector is that "energy conservation awareness is generally low throughout the country". NEMAP did not recognize mineral resources as an important sector and there is no separate discussion on this.

The National Forest Policy (1994)

The National Forestry Policy of 1994 is the revised version of the National Forest Policy of 1977 in the light of the National Forestry Master Plan. The major targets of the Policy are to conserve the existing forest areas; bring about 20% of the country's land area under the afforestation program, and increase the reserve forest land by 10% by the year 2015 through coordinated efforts of GO-NGOs and active participation of the people.

The need of amendments of the existing forestry sector related laws and adopt new laws for sectoral activities have been recognized as important conditions for achieving the policy goals and objectives. The Forest Policy also recognizes the importance of fulfilling the responsibilities and commitments under international multilateral environmental agreements

The National Energy Policy (1995)

The National Energy Policy provides for utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy sources and environmentally sustainable energy development programs. The Policy highlights the importance of protecting the environment by requiring an EIA for any new energy development project, introduction of economically viable and environment friendly technology.

One (Section 1.2) of the seven objectives addresses the environment and states, "(vi) to ensure environmentally sound sustainable energy development programs causing minimum damage to the environment".

The seven specific policy recommendations are listed under Chapter 1.9. Of those, the following three are relevant to the present project:

- EIA should be made mandatory and should constitute an integral part of any new energy development project;
- Use of economically viable environment friendly technology is to be promoted; and
- Public awareness is to be promoted regarding environmental conservation.

The National Water Policy (1999)

The National Water Policy of 1999 was adopted to ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and institutional capacity building for water resource management. It has also addressed issues like river basin management, water rights and allocation, public and private investment, water supply and sanitation and water needs for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc. The water policy, however, fails to address watershed management.

The Bangladesh Water Act 2013

The Bangladesh Water Act. 2013 was passed by the Government on 6 November 2013 to ensure “integrated development, management, abstraction, distribution, use, protection and conservation of water resources”. By virtue of this Act all rights over surface water, ground water, sea water rain water and water in the atmosphere is vested on the State. Notwithstanding the above, “rights over the surface water on any private land shall remain with the owners of such land”, and such right to use the water shall be subject to the provision of the Act. Furthermore, under the provisions of this Act, “right to potable water, and to water for hygiene and sanitation shall be treated as the highest priority right”.

The Act makes a provision for constituting a National Water Resources Council headed by the Prime Minister.

The Act also makes a provision for approving national water resources plan prepared in accordance with the water resources planning Act, 1992.

Finally, if anybody deliberately violates or ignores the responsibility or protection mentioned under this Act, in that case, under the provisions of sub-section (2), he will get maximum of 5 years’ imprisonment or maximum Tk. 10,000 as financial punishment or both the punishments.

Bangladesh National Building Code 2015

The draft national building code of Bangladesh (2015) indicates that all buildings and structures shall be designed and constructed in conformance with the provisions as described in this code. Analysis of the structural systems shall be made for determining the load effects on the resisting elements and connections, based on well-established principles of mechanics taking equilibrium, geometric compatibility and both short and long term properties of the construction materials into account and incorporating the mathematical modeling, loads and forces, soil structure interactions etc. Besides these, all building structures related issues are highlighted in the code which shall be considered as appropriate for implementation of this Project.

The Civil Aviation Act. 2017

The provisions of the Civil Aviation Act, 2017 apply to, whole of Bangladesh, Civil Aerodromes/Heliports and to persons on, aircraft registered in Bangladesh wherever they may be and also to, and to persons on, all aircraft for the time being in or over Bangladesh except otherwise specified. In consonance with the above, all persons/ aircraft are expected to comply with the all provisions of the Civil Aviation Act, 2017, rules, ANOs made thereunder. The main ideology of the civil aviation Act is to maintain equivalent level of safety of the Airport as well as safety of the Aircraft using the Airport.

4.5 International legal obligations

Bangladesh is signatory to a number of Multilateral Environmental Agreements (MEAs) and also some bilateral instruments. Some of them are very important in 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 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 implementation of the project. The pertinent ones of these are highlighted below:

Rio Declaration

The 1992 United Nations Conference on Environment and Development (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 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".

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 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; and
- 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.

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 (art. 4).

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 has ratified the Convention 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 co-operation 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.

World Heritage Convention

Convention concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972: This convection 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.

Bangladesh is one the country who ratified the convention on Protection of the World Cultural and Natural Heritage, Paris, 1972: The proposed Power Plant will be constructed at a place, which is far away from the World Heritage site. So, this law not have any implication on construction of the proposed Power Plant.

The following MEAs include provisions relevant to different aspects of oil and gas operations for environmental management, nature protection, and biodiversity conservation:

- Convention relative to the Preservation of Fauna and Flora in their Natural State 1933;
- International Convention for the Protection of Birds, Paris, 1950;
- International Plant Protection Convention, Rome, 1951;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973 (Popularly known as CITES): This provides a framework

for addressing over harvesting and exploitation patterns which threaten plant and animal species. Under CITES, governments agree to prohibit or regulate trade in species which are threatened by unsustainable use patterns; and

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

4.6 Development agency's health and safety guidelines

Under the study health and safety guidelines of few development agencies will be reviewed. This will include ADB's Social Safeguard Policy and the World Bank's Environmental Process.

4.6.1 ADB's Social Safeguard Policy

ADB has had environmental assessment requirements for more than 20 years and own safeguard policy framework which is currently taken to consist of three operational policies, namely the Environment Policy (2002), the Policy on Indigenous Peoples (1998), and the Policy on Involuntary Resettlement (1995), together with their respective operation manual sections and guidelines.

4.6.2 World Bank Environmental Assessment (EA) Process

In 1989, the World Bank adopted Operational Directive (OD) 4.00, "Annex A: Environmental Assessment". EA became standard procedure for Bank financed investment project. In 1991 the directive was as OD 4.01, which has subsequently been changed to operational policy OP 4.01 in January 1999 and the operational policy statement has been updated in March, 2007. EA is designed as a flexible process allows environmental issues to be addressed in a timely and cost-effective way during project preparation and implementation.

5. Environmental and Social Baseline Condition

5.1 Introduction

Baseline Condition study refers to the proper documentation of the environmental and social status in and around the Project area before implementation of any Project. This chapter presents the existing situation of environmental and social context before implementing the proposed Project at Saidpur, Nilphamari. The baseline situation has been drawn based on the following broad outlines, i.e., the physical environment (includes landscape and topography, meteorological, hydrological, geological components and processes, air quality, acoustic environment, land resources, land use and communication), the biological environment (includes agricultural resources, fisheries resources, flora, fauna and ecosystems) and the socio-economic situations (includes cultural activities, economic status, livelihoods and hazards of the study area). Primary and secondary data were used to delineate the baseline condition of the above sub-items of the study area.

5.2 Physical Environment

5.2.1 Geology

The proposed Project area is located in the North Bengal at Saidpur in Nilphamari District of Bangladesh.

Physiography

The project area lies mostly within the Teesta Meander Floodplain. A small portion also falls in the Level Barind Tract and North-Eastern Barind Tract. The topography of the project area and the study area are comprised of medium highland, and elevation varies between 33 – 56 m above the mean sea level.

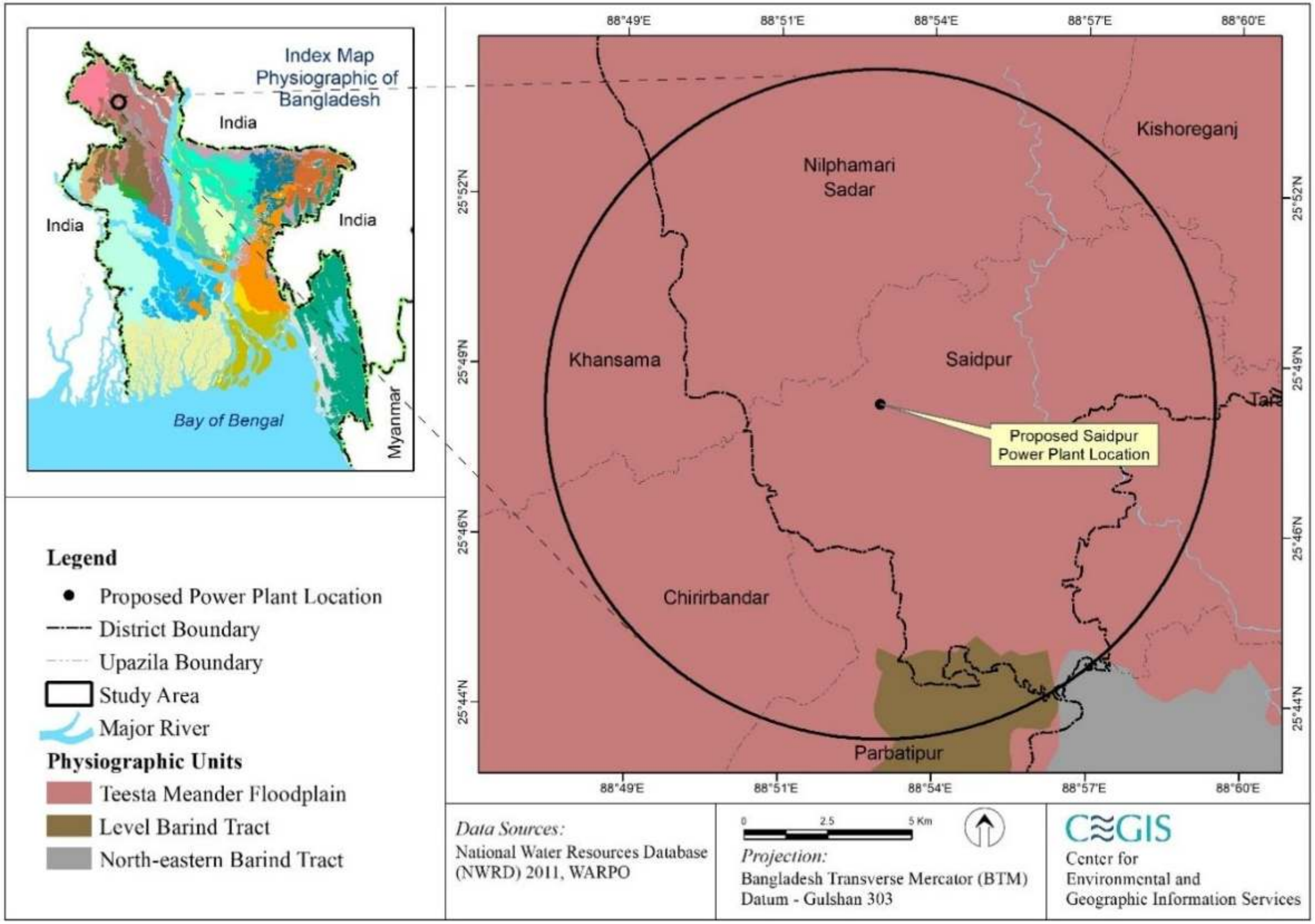


Figure 5.1: Physiographic map of the proposed project site and surrounding areas

Tectonics

Tectonically, the proposed project site is situated in Rangpur platform, which is located close to the Teesta lineament (**Figure 5.2 & 5.4**).

Figure 5.2: Tectonic map of Bangladesh

General Stratigraphy and Hydro-stratigraphy

The general stratigraphy of the Rangpur platform (based on Maddhyapara Granite mine) is provided in **Table 5.1**.

Table 5.1: Stratigraphy of the Rangpur Platform based on Maddhyapara Granite Mine

Rock Unit		Lithology	Thickness (m)	Geological Age
Alluvium		Clay and silty clay	0 – 0.5	Recent
Madhupur Clay		Red clay	0.5 – 7	Pleistocene
Dupi Tila		Yellowish brown, fine to medium grained sand Greyish black, medium to coarse grained sand	7- 141	Pliocene/Miocene (?)
Kaolinized Rock		Greyish white clay	136 -141	Archean (??)
Weathered Rock		Granite, granodiorite	141 -160	Archean (?)
Fresh Rock		Granite, granodiorite	More than 160	Archean (?)
	Unconformity			

Seismicity

Bangladesh had been divided into four seismic zones (BNBC 2015). Among those, the proposed Saidpur power plant area is located in Zone II (**Figure 5.3**). The seismic co-efficient for Zone II is 0.20 which indicates that the proposed project site is seismically moderately vulnerable compared to the rest of the country.

Earthquake history of Bangladesh and surrounding areas

Details of seismic intensity and the historical records of earthquakes in and around Bangladesh are presented in **Figure 5.3** and **Table 5.2**. Historically, several minor earthquakes (4≤M<6) and one major earthquake (6≤M<7) were reported at the nearby locations of the study area. However, the possible effects of a high magnitude earthquake in adjacent locations should not be overlooked, and soil engineering properties at the project site needs to be examined in detail.

Table 5.2: List of Major Earthquakes in past 450 Years

SL	Year	Source Area	Magnitude (Richter Scale)	Depth (Km)
1	1548	Sylhet	-	-
2	1664	Shillong-Plateau	-	-
3	1762	Chattogram-Arakan	-	-
4	1858	Sandway, Myanmar	6.5	-
5	1869	Cachar, India	7.5	48
6	1885	Sirajganj, Bangladesh	7	72
7	1897	Assam, India	8.1	60
8	1906	Calcutta, India	5.5	-
9	1912	Mandalay, Myanmar	7.9	25
10	1918	Srimangal, Bangladesh	7.6	14
11	1930	Dhubri, India	7.1	60
12	1934	Bihar, India-Nepal	8.3	33

SL	Year	Source Area	Magnitude (Richter Scale)	Depth (Km)
13	1938	Mawlaik, Myanmar	7.2	60
14	1950	Assam, Himalaya	8.6	25
15	1954	Manipur, India	7.4	180
16	1975	Assam, India	6.7	112
17	1984	Cachar, India	5.7	4
18	1988	Bihar, India-Nepal	6.6	65
19	1997	Sylhet, Bangladesh	5.6	35
20	1997	Bangladesh-Myanmar	5.3	56
21	1999	Maheskhali, Bangladesh	4.2	10
22	2003	Rangamati, Bangladesh	5.6	-
23	2011	Sikim, India	6.9	-

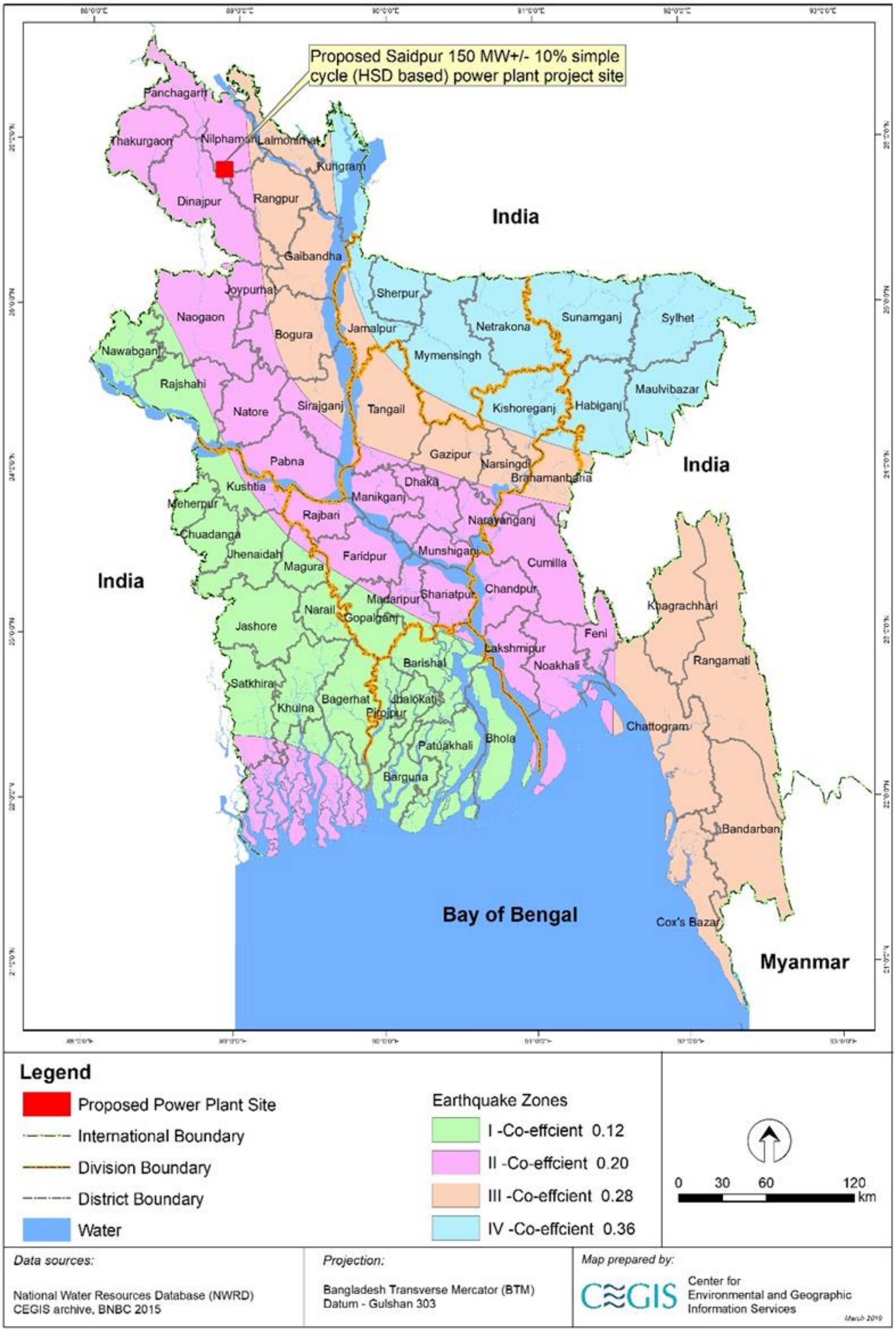
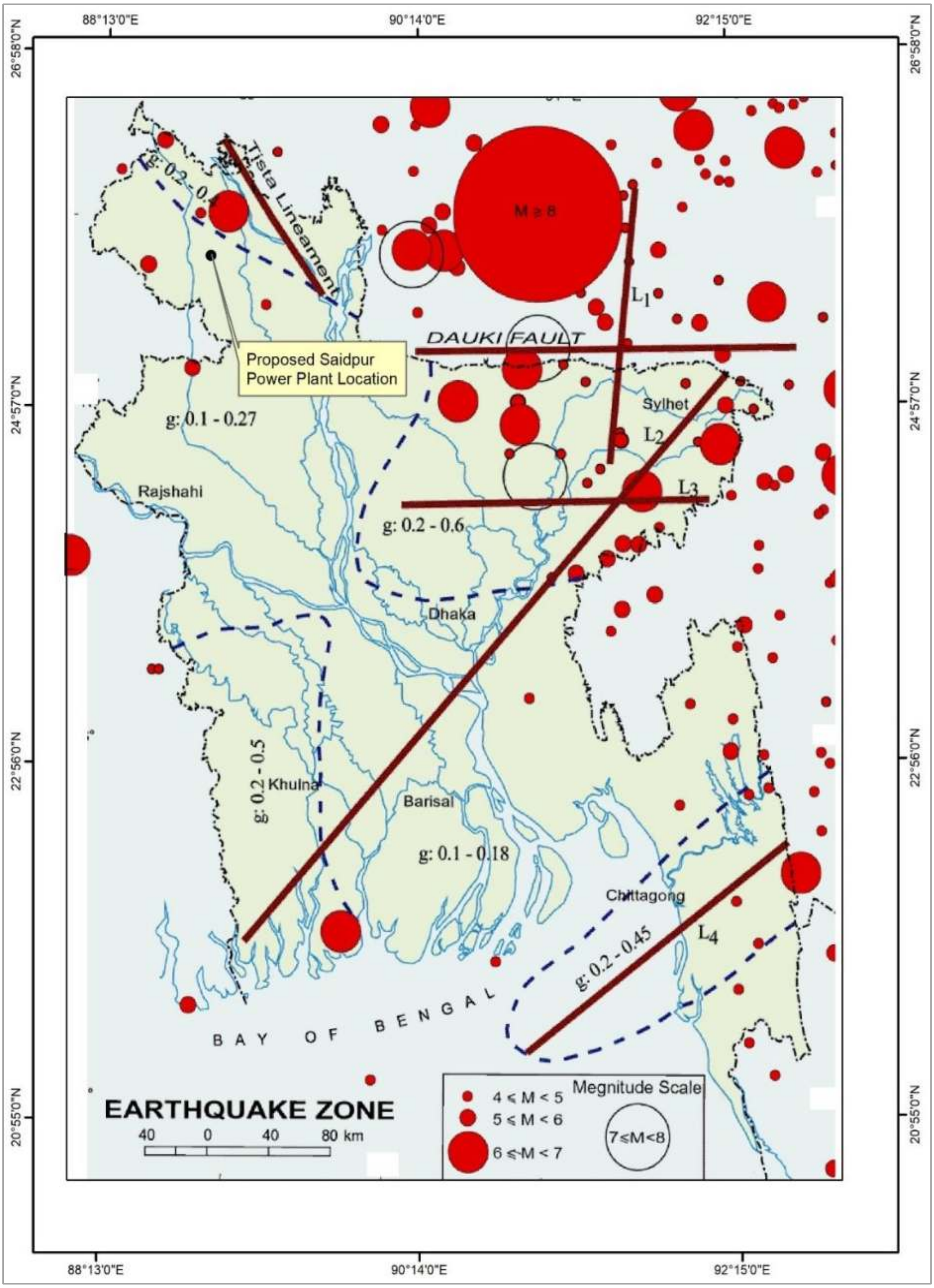


Figure 5.3: Seismic zoning map for Bangladesh



Source: Banglapedia 2014

Figure 5.4: Major lineaments and the historical records of earthquakes in Bangladesh and adjoining areas

5.2.2 Climate and Meteorology

The proposed Saidpur 150 MW ±10% (Net output 161.603 MW) simple cycle (HSD based) power plant project area lies in the North Western part of Bangladesh.

Available meteorological data such as rainfall, temperature, humidity, evaporation, wind speed and sunshine hours were collected from the Bangladesh Meteorological Data (BMD) and Bangladesh Water Development Board (BWDB) websites. As all of the necessary meteorological data were not available for the Saidpur, Nilphamari area, data from the nearest Dinajpur and Rangpur stations were considered for this Study.

Rainfall

The results of average monthly rainfall analyses for Saidpur Upazilla of Nilphamari, is given in **Figure 5.5**. Bi-modal peaks of rainfall were observed at Nilphamari Station (1991-2017) with a maximum rainfall in June and July (400 – 500mm). The peak rainfall was noticed in July at both locations. The monsoon period undergoes significant rainfall whereas the dry period (esp. November to March) experiences little or no rainfall.

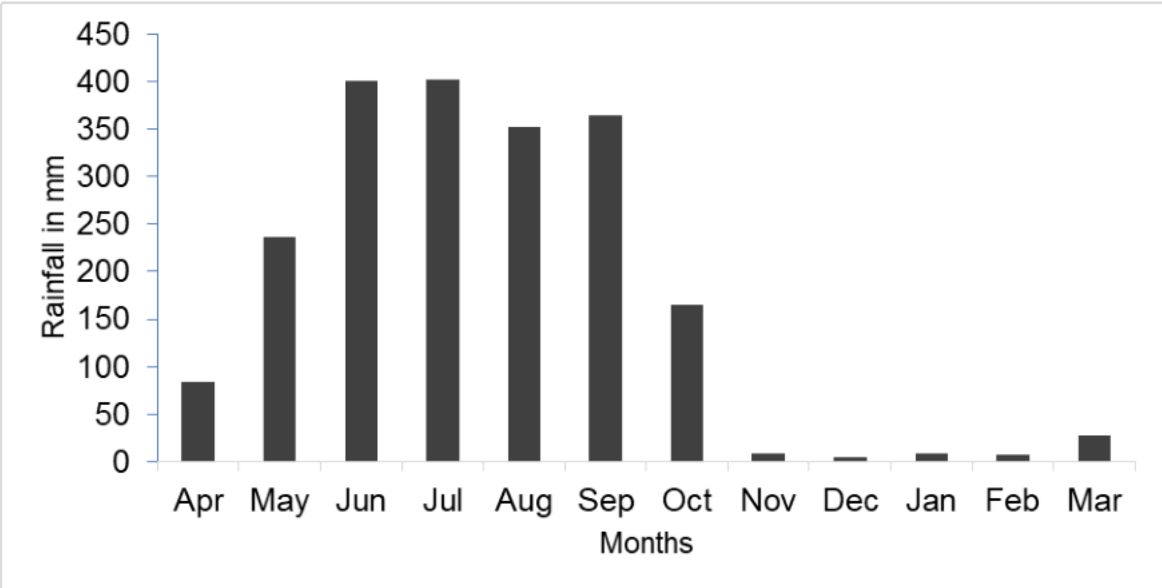


Figure 5.5: Monthly average Rainfall measured at Saidpur, Nilphamari Station

Temperature

The warmest month was found in April for all of the stations (4/1991- 3/2017) with the temperature ranges between 7°C and 38°C. January was noticed as the coldest month at all of those locations (**Figure 5.6**). During monsoon, the average monthly minimum temperature remains above 22°C. Significant variability of maximum temperature were noticed during April and May in different years.

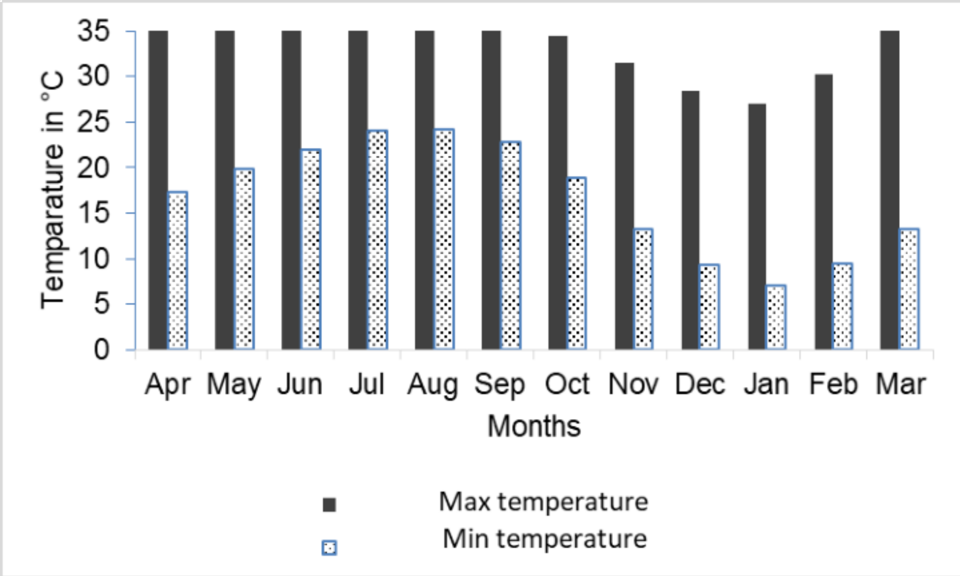


Figure 5.6: Monthly maximum and minimum Temperature measured at Saidpur station

Humidity

The range of monthly average humidity varies between 63% and 84% at Saidpur, Nilphamari (**Figure 5.7**). Bi-modal peaks of humidity were observed in this stations (1991-2017). The predominant peak is present in monsoon (June to September), and the other peak is at the beginning of dry months (December and January).

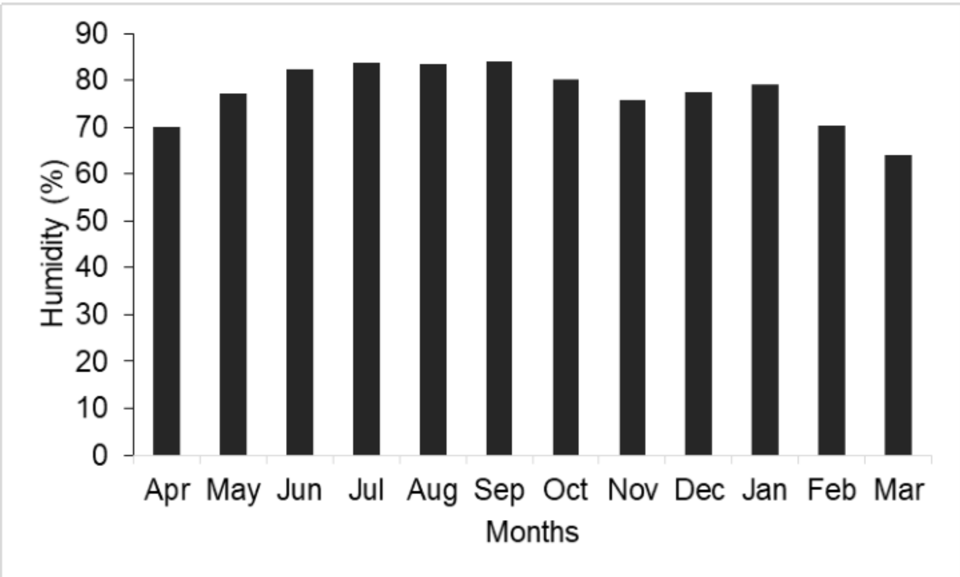


Figure 5.7: Monthly average Humidity measured at Saidpur Station

Evaporation

The result of mean monthly evaporation analysis at Dinajpur Station (1987-2017) is given in **Figure 5.8**. Result shows that monthly mean minimum and maximum evaporation rate are 0.8 and 2.8 mm/day in December and July respectively. A higher summer temperature in April generally allows a higher evaporation of water. In addition, a higher wind speed at those months transfer water vapor along the wind flow direction and hence allows a higher evaporation rate.

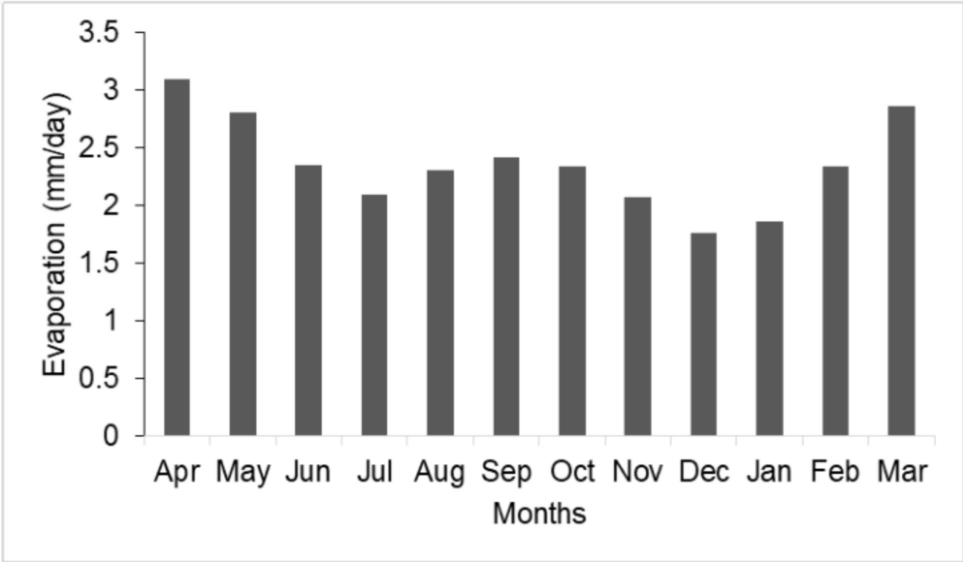


Figure 5.8: Monthly average evaporation rate measured at Dinajpur Station

Wind Speed

The variation of monthly average wind speed at Saidpur Station (4/1991- 3/2017) is shown in **Figures 5.9**. At Saidpur, the average highest wind speed (200 Km/day) was found in April and lowest in November (70 Km/day). The lowest wind speed is present during the post-monsoon period. A sharp rise of the wind speed was found during the dry months and reaches to its maximum level during the pre-monsoon months.

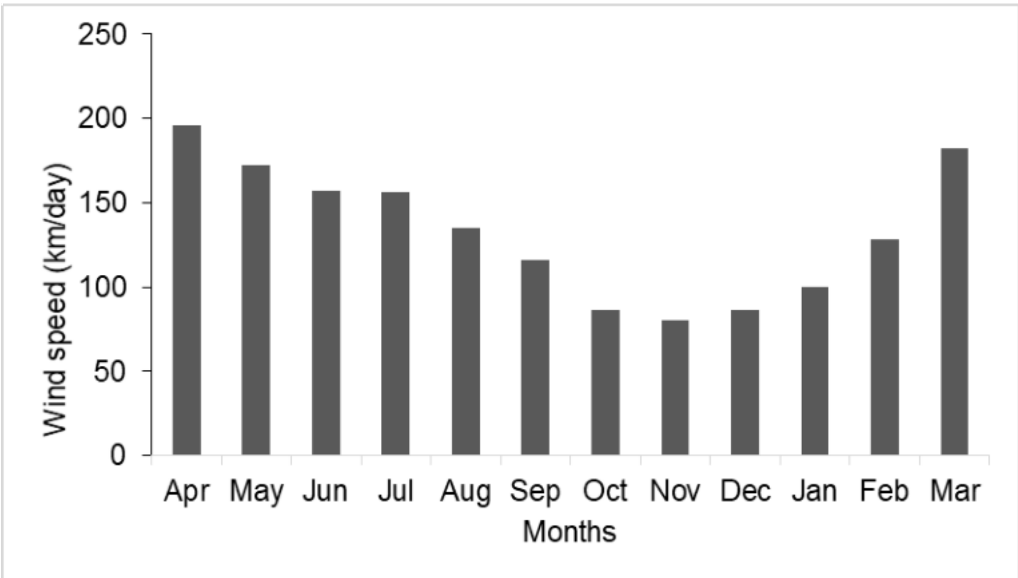


Figure 5.9: Monthly variation of average wind speed measured at Saidpur Station

Sunshine Hour

The available data for sunshine hours has been collected for stations at Saidpur (1985-2017). A bi-modal peak (March and November) of daily sunshine hours were noticed at all of the stations and reach up to 8 hours/ day (**Figure 5.10**). Daily sunshine hours significantly drops due to cloud coverage, and reaches close to 4 hours/ day during monsoon period (June to

September). A significant drop of daily sunshine hours may hamper daily activities and progress of work during the monsoon.

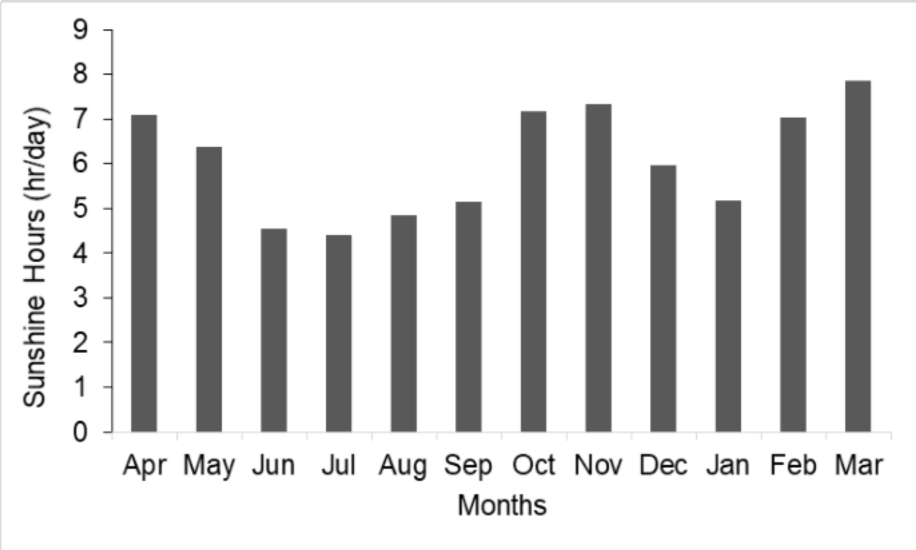


Figure 5.10: Monthly average sunshine hours per day measured at Saidpur Station

5.2.3 Environmental Quality

Air Quality

Air quality is one of the very important factors for a power plant project since generation of SOx, NOx, suspended particulate matters (SPM), greenhouse gases, and other fumes may cause air pollution which might be detrimental to the ecological as well as human health.

The Proposed 150 MW Power Plant project site is located in the premise of existing Saidpur HSD based Power Station at Bothlagari union, Saidpur Upazila under Nilphamari district of Rangpur Division.

Important air quality parameters such as NOx, SOx, CO, Ammonia (as NH_3), Hydrogen Sulfide (as H_2S), Total VOC, Ozone (as O_3), Suspended particulate matters including PM_{10}, $PM_{2.5}$, were measured in March 2019.

Field measured air quality data are provided in **Table 5.3** and **Table 5.4**.

Table 5.3: Location of Air Quality Sampling points

Station Number	Location	Distance (Km) & Direction	Coordinates		Sampling dates
			Latitude	Longitude	
1	Saidpur, Nilphamari	0.91 Km, SE	25°48´40.2´´ N	88°53´5.4´´ E	19/3/2019 – 20/3/2019
2	Saidpur, Nilphamari	0.59 Km, ESE	25°48´ 48.3´´ N	88°53´0.1´´ E	20/3/2019 – 21/3/2019

In order to assess present air quality status of the proposed project airshed, field level air quality monitoring of major air quality parameters were carried out from two points at distances of few hundred meters away from the proposed project site (**Figure 5.11**). However, background ambient air quality monitoring was conducted during winter month when worse case situation was prevail (especially for SPM).

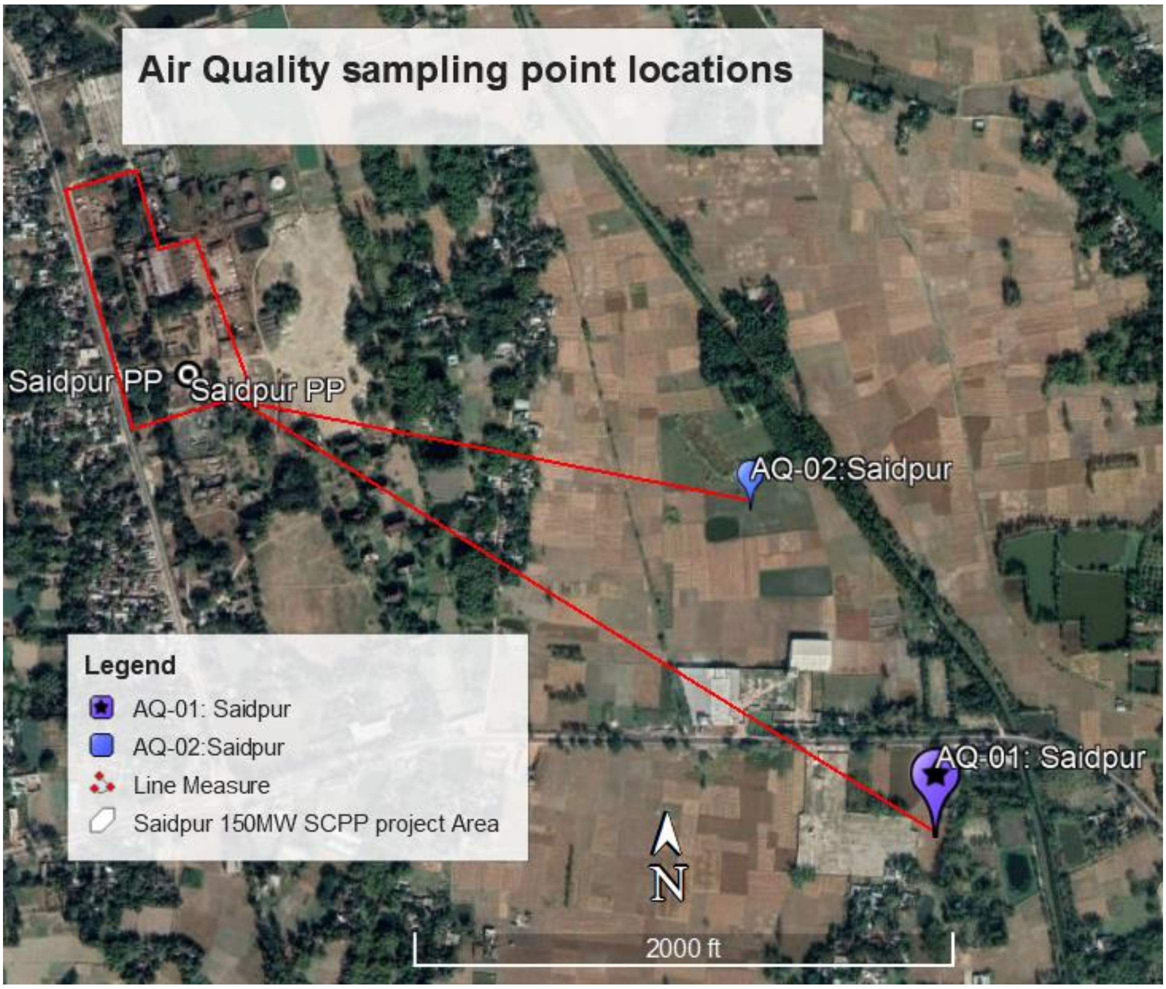


Figure 5.11: Air Sampling Location Map

Air quality sampling has been conducted during dry period for 24 hours continually at two locations based on the wind direction and potentiality to deposition high pollutants during operation period. **Table 5.4** shows the baseline air quality monitoring results.

Table 5.4: Baseline Air Quality Monitoring Results at Saidpur

Monitoring Air Quality Parameters	Air quality Monitoring Results for 24 Hr (µg/m^3)		National and International Standard (µg/m^3)	
	Station ID-01	Station ID-02	ECR, 2005	IFC*, 2007
Suspended Particulate Matter (SPM)	296.7	347.2	200 (8 Hr)	-
Sulfur Dioxide (as SO_2)	6.8	7.6	365 (24 Hr)	125 (24 Hr)
Nitrogen Dioxide (as NO_2)	26.5	32.8	100 (Annual)	200 (1 Hr)
Carbon Monoxide (as CO)	0.67	0.78	10000 (8Hr)	-
Ozone (as O_3)	30.6	38.7	157 (8Hr)	160 (8 Hour)
Ammonia (as NH_3)	18.5	21.7	-	-
Hydrogen Sulfide (as H_2S)	<10	<10	-	-
PM_{10}	126.4	165.8	150 (24 Hr)	150 (24 Hr)
$PM_{2.5}$	58.2	111.3	65 (24 Hr)	75 (24 Hr)
Total VOC	<4.2	<4.2	-	-

*Note: *Interim Target (IT) -1 has been used for IFC standard*

Results show that all of the air quality parameters are within permissible limit fixed by national (ECR, 2005) and international (IFC 2007) air quality standards, except $PM_{2.5}$, PM_{10} and other suspended particulate matters. Existing road and building constructions and demolition activities, pollen along with agricultural operations are the possible sources of high ambient air particulate concentrations in the study area. No noticeable number of industries are present to make any significant impact on air quality under existing condition. Agricultural fertilizer usage, emissions from motor vehicles and burning of fossil fuels generate little amount of SOx and NOx but concentration remain far below the national air quality standard limit. The monitoring of air quality has been conducted 24 Hr continuously at the single sampling location. Based on the dataset, the air quality index in the study area may be considered moderately healthy during this time of the year.

Acoustic Environment

Ambient noise levels were measured at the nearby sensitive receptors around the proposed Project site. Overall ambient noise levels in and around the Project area were found within the Bangladesh standard. However, ambient noise level at PDB school and PDB mosque are slightly higher than that of the Bangladesh standard as those institutions are located within the BPDB Power Station premises which are influenced by the industrial activities. The Project site is considered as industrial zone that is surrounded by some residential dwellings and agricultural field. **Table 5.5** represents the collected ambient noise data with their sampling locations and **Figure 5.12** shows the noise sampling locations from the study area.

Table 5.5: Existing Noise Level at Nearby Sensitive Receptors

SL	Sample Code	Location Name	GPS Point	Noise Level			
				Day-time dB(A)	Standard* dB(A) (day-time)	Night-time dB(A)	Standard* dB(A) (night-time)
1	NL1	Proposed Project site	25°48'40.10"N 88°53'9.38" E	57.8	75 (Industrial Area)	58	70 (Industrial Area)
2	NL2	PDB School	25°48'27.50"N 88°53'14.40"E	53.2	50 (Silent area)	45.4	40 (Silent area)
3	NL3	PDB Mosque	25°48'34.10"N 88°53'13.10"E	50.4	50 (Silent area)	41.2	40 (Silent area)
4	NL4	Residential zone, PDB Colony	25°48'29.70"N 88°53'16.80"E	45.5	55 (Residential area)	45.2	45 (Residential area)
5	NL5	Saidpur Bazar	25°47'39.20"N 88°53'25.30"E	61	70 (Commercial Area)	49.8	60 (Commercial Area)
6	NL6	Saidpur Terminal	25°46'53.20"N 88°54'56.00"E	60.3	70 (Commercial Area)	60	60 (Commercial Area)

*Note: *Bangladesh Noise Pollution Control Rules, 2006*

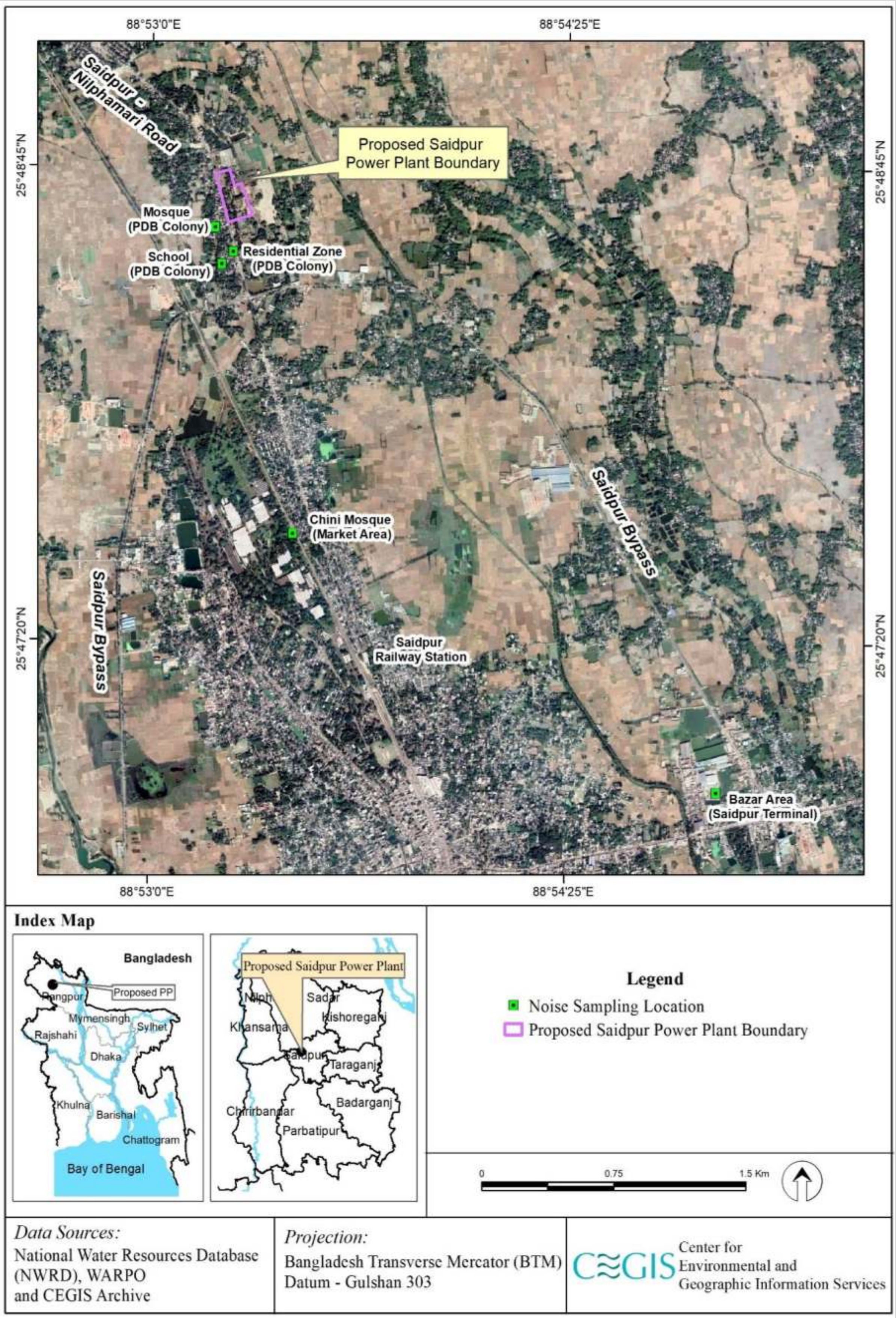


Figure 5.12: Noise Sampling Location Map

Water Quality

The quality of groundwater and water of Kharkharia River near the project site were assessed. Some parameters of water of Kharkharia River as well as groundwater were tested in-situ. Besides, samples of both river water and groundwater were collected for laboratory tests. Water sample (**Figure 5.13**) collection and quality assessment details are presented in **Table 5.6**.

Table 5.6: Water Quality Assessment Details

SL	Water Source Type	Location	GPS	Date & Time	Parameters	
					Lab	In-Situ
1	Ground (Tube well) Sample: GW01	Sample location: Proposed site Upazila: Saidpur Dist: Nilphamari	N 25^0 48' 30.5" E 88^0 53' 10.6"	18/02/19 12:00 pm	Arsenic, Hardness, Lead, Phosphate, Total Suspended Solid, COD	Temp, EC,TDS, Salinity
2	Surface (Kharkharia river) Sample: SW01	Sample location: River side Upazila: Saidpur Dist: Nilphamari	N 25^0 49' 6.2" E 88^0 51' 37"	19/02/19 12:30 pm	Arsenic, Hardness, Lead, Phosphate, Total Suspended Solid, COD	Temp, EC,TDS, Salinity

Table 5.7 presents the values of the water quality parameters as well as the DoE standard. It shows that the values of in-situ tested parameters are within the DoE standard.

Table 5.7: In-situ result of water quality in the study area

Sample Source	Location of Sampling	Temperature (°C)	EC (mS/ cm)	TDS (g/l)	Salinity (ppt)	Time
GW-1	Proposed Site, PDB	21.8	208.4	104.1	0.4	12:00
SW-1	Kharkharia river	25.6	145.5	72.5	0.2	12:30
Standards for drinking MoEF, ECR (Schedule-3), 1997		20-30	-	1000	-	

(Source: CEGIS field study, 2019)

Table 5.8 presents the values of the water quality parameters as well as the DoE standard. It shows that the values of CEGIS Laboratory tested parameters are within the DoE standard.

Table 5.8: Laboratory result of water quality in the study area

Sample Source	Location of Sampling	TDS (g/l)	pH	DO (mg/l)	EC (mS/ cm)	Turbidity (NTU)	Nitrate (NO_3^-)	Sulphate (SO_4^{2-})	Iron (Fe)
GW-1	Proposed Site, PDB	101.2	7.75	8.08	202.2	5.7	8.0	5.68	0.23
SW-1	Kharkharia river	67.7	7.77	8.03	135.4	8.67	7.5	4.36	0.11
Standards for drinking MoEF, ECR (Schedule-3), 1997		1000			-		10	400	0.3-1

(Source: CEGIS Laboratory, 2019)

Table 5.9 presents the values of the water quality parameters as well as the DoE standard. It shows that the values of DPHE Laboratory tested parameters are within the DoE standard.

Table 5.9: Laboratory test result of groundwater quality in the study area

Sl	Water Quality Parameters	Unit	Ground Water	Surface Water	Analysis Method	LOQ	Bangladesh Standard MoEF, ECR (Schedule-3), 1997
1	Arsenic	mg/l	0.001	0.001	AAS	0.001	0.05
2	Chemical Oxygen Demand	mg/l	4	4	CRM	-	4.0
3	Hardness	mg/l	155	145	Titrimetic	-	200-500
4	Phosphate	mg/l	0.46	0.39	UVS	0.10	6.0
5	Total Suspended Solid	mg/l	2	5	Gravimetric Method	-	10

Table 5.10 presents the values of the water quality parameters as well as the DoE standard. It shows that the values of BCSIR Laboratory tested parameters are within the DoE standard.

Table 5.10: Laboratory test result of water quality in the study area

Lab ID	Particulars of supplied sample	Parameter	Concentration	Test Method (APHA)
A-385	Khora River Water, Saidpur, Nilphamari	Oil and Grease	Less than 2.0 mg/L	5520.B
A-386	PDB colony Ground Water, Saidpur, Nilphamari	Oil and Grease	Less than 2.0 mg/L	5520.B

5.2.4 *Water Resources*

Water is a vital natural resource for sustenance of human life and other biota of a region. This indispensable natural resource occurs both on the earth surface and under the ground. The study area comprises a number of rivers. Besides, groundwater is also available in the study area. The details of the surface water and groundwater are provided in the subsequent sections.

Surface Water

Hydrological Network

The main rivers around the Project site are the Kharkharia and the Ichhamati flowing on the West, the Chikli and Bagdorka Nala on the East and the Karatoya on the South-east (**Figure 5.13**). These rivers suffer from unavailability of water at some segments during the period of November to June. This means sufficient water is not available throughout the year. Moreover, the nearest distances of the Kharkharia and the Chikli River from the proposed Power Plant are about 3 km and 5 km respectively. Besides, a number of water bodies such as Kuni Pukur, Debi Duba pond, Doula Beel, Kamar Pukur, Dakdokra khal, kadikhol khal was observed in the study area. The nearest river from the project area is Kharkharia River which is approximately 2.90 km away from the project site. Usual depth of this river in dry season is about 1.5 ft and in monsoon, it is nearly 6 ft deep. Doula beel is located in a low land and has usual water depth of 7-8 ft in dry season and 14-16 ft in monsoon. The other beels and ponds are mostly dry throughout the year.

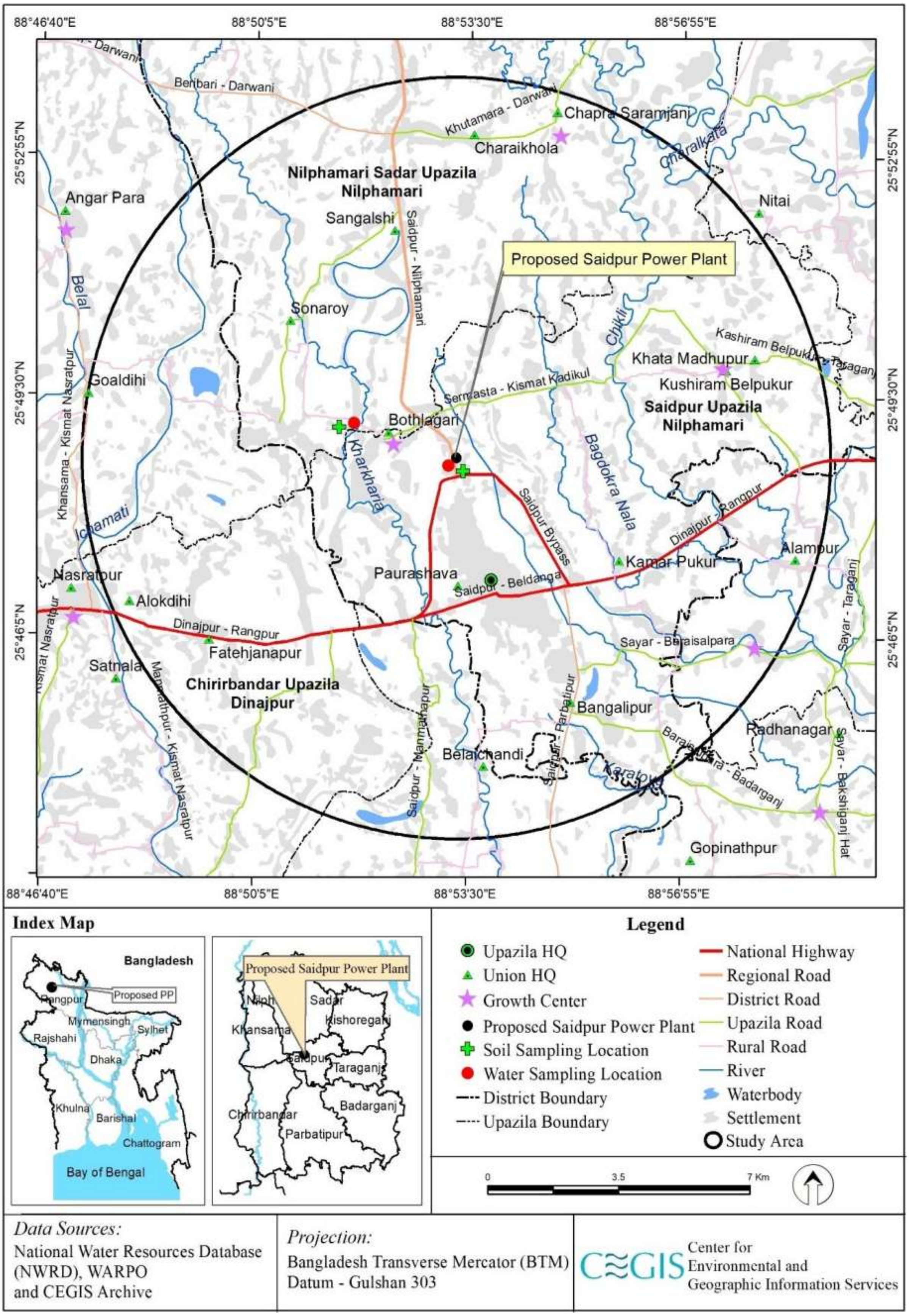


Figure 5.13: Water and Soil Sampling locations of the study area

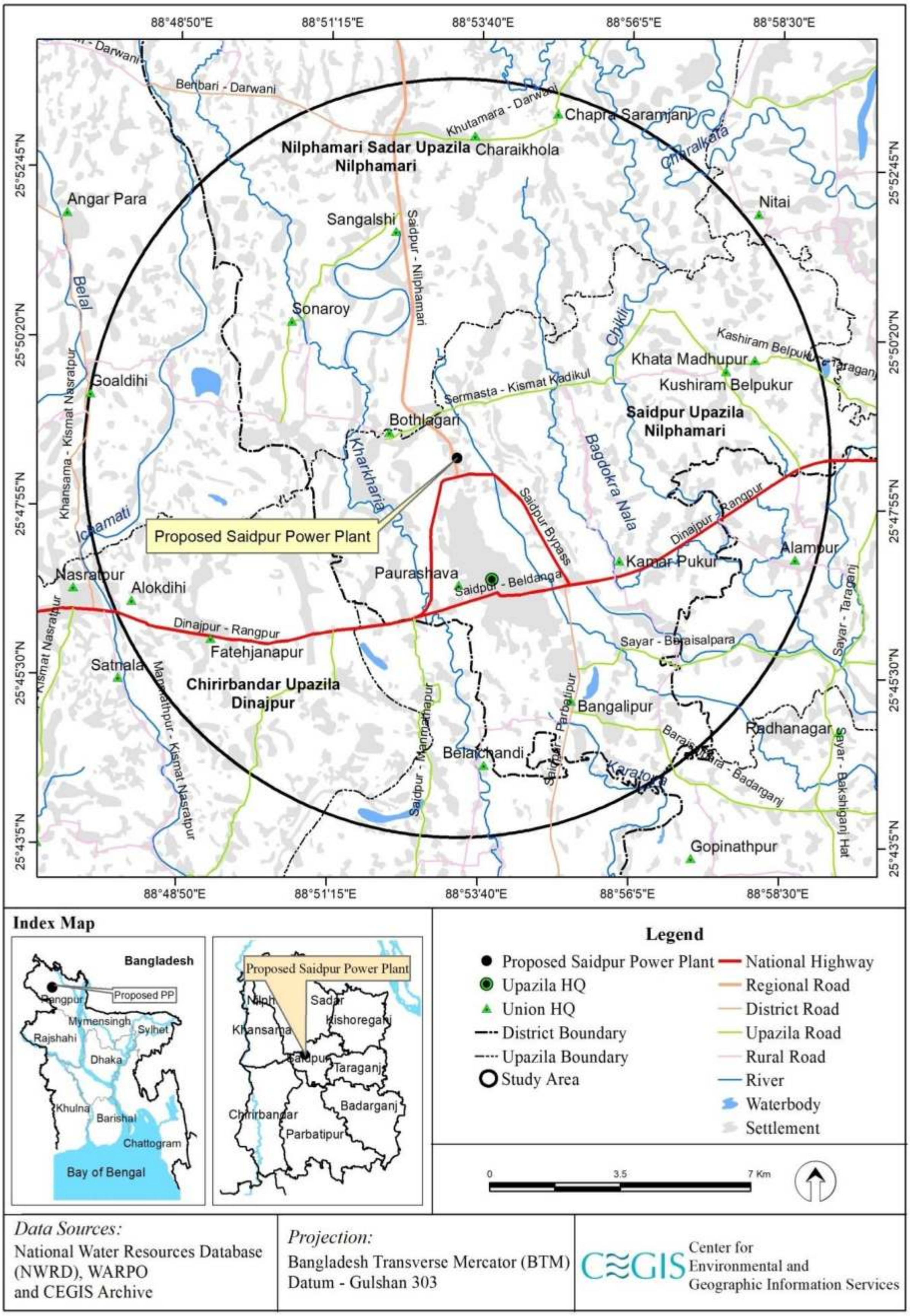
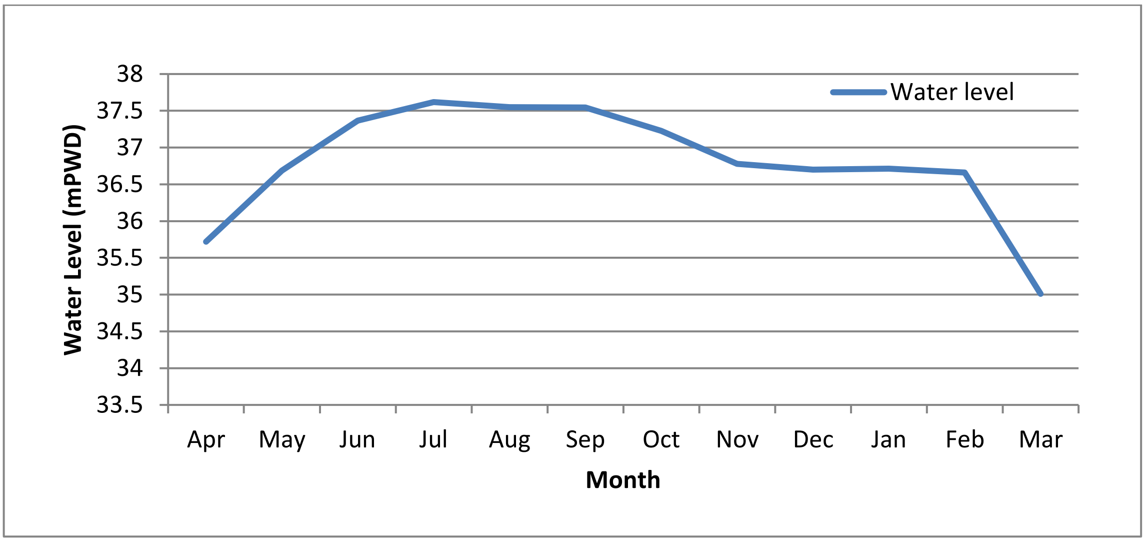


Figure 5.14: Water Resources Map within the Study Area

Figure 5.15: Kharkharia River and Pond in the study area

Surface Water Level

Water level data of Kundal station (BWDB ID: 156A) on the Kharkhuria River has been used for the period of 1987 to 2017 to investigate the surface water situation of the study area. Average monthly water level of this station is presented in **Figure 5.16**. Water level of the station ranges from 35.0 mPWD to 37.6 m PWD.



Source: National Water Resource Database

Figure 5.16: Average daily Water Level at Kundal station, Saidpur, Nilphamari (1987-2017)

Water Resources Issues and Functions

The following sections briefly describe the functions of water in the study area.

Water Use

Water is used for agriculture and commercial purposes in the wet season inside the study area. Local people opined that they prefer Submersible Pump and Deep Tube Wells (DTWs) for drinking water and other domestic uses to meet their daily requirements. Overall, water availability in the study area is not a major concern as local people stated that they have access to enough groundwater to fulfill their daily need for drinking and other domestic purposes.

During construction phase, ground water will be preferred as there is no available source of surface water near the project area.

During operation phase, water will be used for NO_x and other heat control.

Flooding

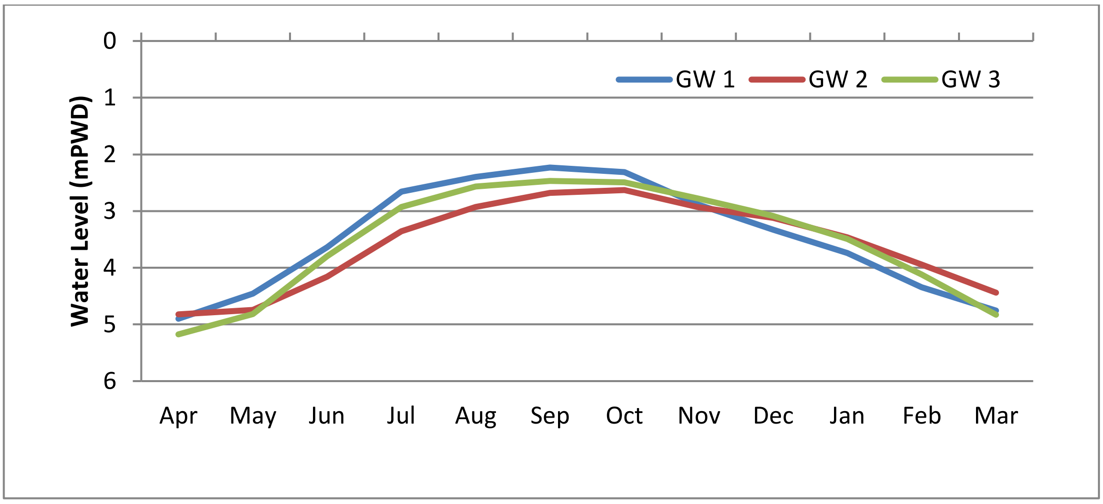
Flooding is not a common problem in the study area. The land topography of this region is higher than the other portions of Bangladesh. In the monsoon if excessive rainfall occurs, floodwater appears in the agricultural lands but does not reach the household areas. Catastrophic flood occurred in the area during 1988 and 1998 and about 80% of the study area was inundated.

Drainage Congestion and Water Logging

The Kharkharia River provides the drainage services in the study area and drains out the runoff generated from around 10 sq. km area. Drainage congestion and water logging do not cause severe problem inside the study area. The flood water stays in this area for nearly 5 days and afterwards it drains out smoothly through Dakdokra and Kadikhol Khal and finally merges into the Kharkharia River in the monsoon period.

Ground Water

Groundwater data of Saidpur stations 1, 2 and 3 were collected for the period of 1987-2016 and analyzed to understand the status of groundwater availability in the study area. **Figure 5.17** shows the monthly variation of groundwater depth in the above mentioned three stations. According to the figure, groundwater in the study area usually starts to deplete at later stages of monsoon (end of August) and continues up to end of March. Thereafter, with the beginning of monsoon, it starts to increase due to aquifer recharge. Maximum groundwater depth in Saidpur station 1,2 and 3 occur in April which are around 4.89 m, 4.82 m and 5.17 m respectively. On the other hand, minimum depth at those stations in October and are 2.23 m, 2.48 m and 2.63 m respectively.



Source: National Water Resource Database

Figure 5.17: Average Monthly Groundwater Depth Inside the Study Area Land Resources

As surface water is not available throughout the year and of sufficient quantity in and around the Project area, groundwater is the only dependable water supply source for the operation of the proposed Power Plant. Therefore, necessary water required for operation of the Power Plant will need to be extracted from underground sources (aquifer) through sinking of Deep Tube Well (DTW).

Potential recharge of ground water has been calculated using the following formula:

Potential Recharge (PR) = $A+B*\log_{10}^{AR}$

Where,

A & B are recharge parameter,

A = - 3112.57

B = 1051.12

AR (Annual Rainfall in the area) = 2061.04 mm *(source: NWRD)*

Considering Recharge Availability = 75% of Potential Recharge (PR);

Potential Recharge of Saidpur area = $A+B*\log_{10}^{AR}$

= (-3112.57) + (1051.12*Log^2061.04)

= 370.95 mm

= 0.37 m per year

Therefore, Recharge Availability = 75% of 0.37 m

= 0.278 m per year

The radius of influence of the Deep Tube Well has been considered as 548.64 m (1800 ft.)

The volume of recharged water (available water) within the area of radius of influence of the DTW

= π*(radius of influence)^2 * recharge availability

= 3.14*548.64*548.64*0.278

= 262952.60 m^3/year

= 720.42 m^3/day

5.2.5 Land Resources

Agro-Ecological Zone (AEZ)

The study area has fallen under three (3) agro-ecological regions: Tista Meander Floodplain (AEZ 3), Level Barind Tract (AEZ 25) and North Eastern Barind Tract (AEZ 27) (BBS, 2017). Detailed AEZ of the study area is presented in **Figure 5.18.** Physico-chemical properties of these AEZs are presented below:

Teesta Meander Floodplain (AEZ 3)

This region occupies most of the Tista Floodplain as well as the Atrai, Little Jamuna, and Karatoya, Dharala and Dudhkumar and rivers.

Most areas have broad floodplain ridges and almost level basins. There is an overall pattern of olive brown, rapidly permeable, loamy soils on the high floodplain ridges, and grey or dark grey, slowly permeable, heavy silt loam or silty clay-loam soils on the lower land and parent materials rich in wheatherable minerals. Eight general soil types occur in the region of which, Non calcareous Grey Floodplain and Non calcareous Brown Floodplain soils predominate. They are moderately acidic throughout, low in organic matter content on the higher land, but moderate in the lower parts. Fertility level, in general, is low to medium. Soils in general have a good moisture holding capacity.

Level Barind Tract (AEZ 25)

The region is developed over Madhupur Clay. The landscape is almost level, locally irregular along river channels.

The predominate soils have a grey, silty puddled topsoil's with plough pan which either directly overlies grey, heavy, little weathered Madhupur Clay or merges with the porous silt loam or silty clay loam subsoil's having strongly acid clay at greater depth. Shallow Grey Terrace soils and Deep Grey Terrace soils are the major components of general soil types of the area. The soils are low in available moisture holding capacity and top soils are very strongly acidic to neutral in reaction. Organic matter status is mainly low and most of the nutrients are limiting.

North Eastern Barind Tract (AEZ 27)

This region occupies several discontinuous areas on the north-eastern margins of the Barind Tract. It stands slightly higher than adjoining floodplain land.

The region has silty or loamy topsoil and clay loams to clay subsoils and grades into strongly mottled clay. The Madhupur Clay underlying this region is deeply weathered. Deep Red Brown Terrace soils and Deep Grey Terrace soils are the major components of the general soil types of the area. The soils are strongly acidic in reaction. Organic matter of the soils is low. General fertility level is poor.

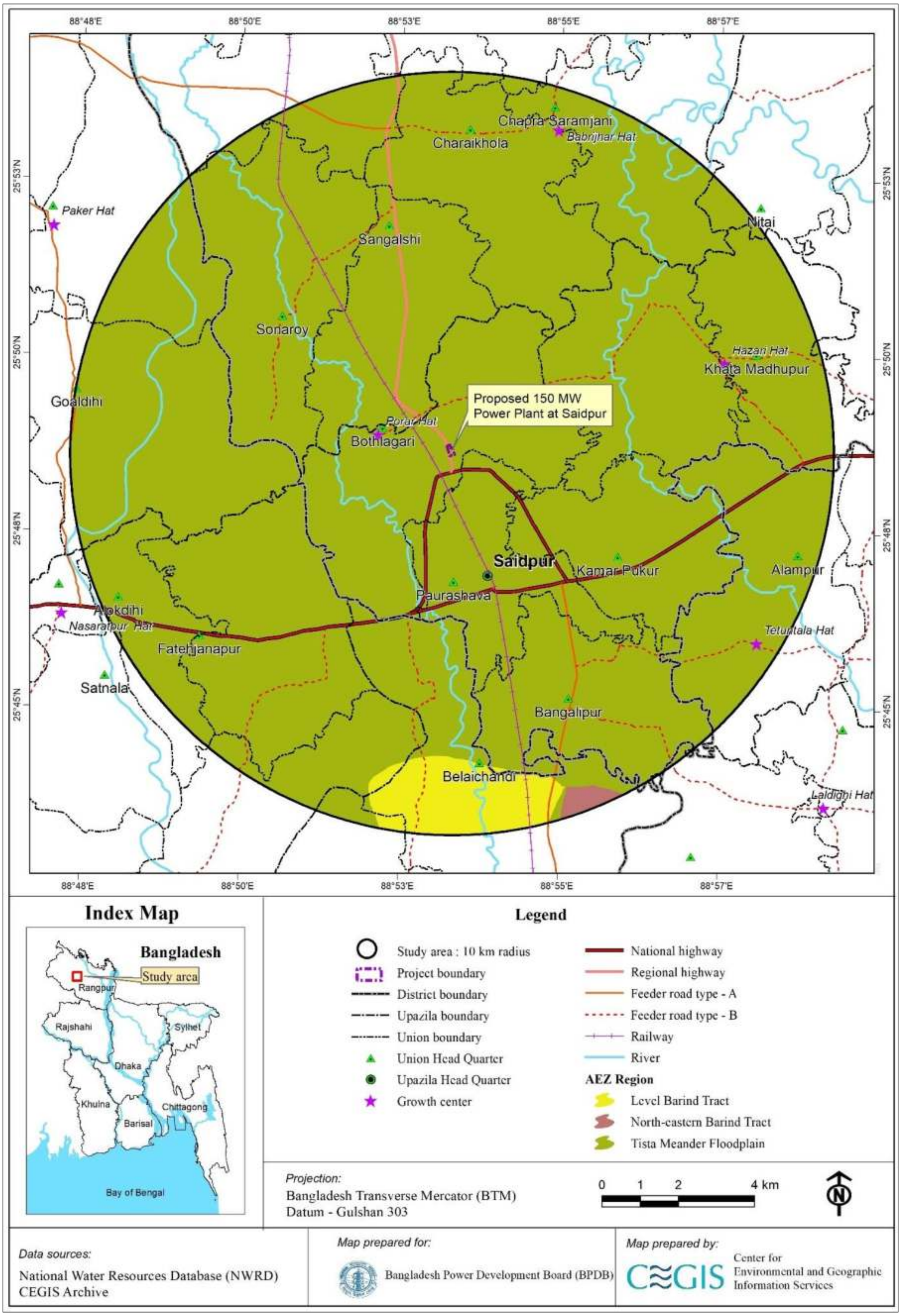


Figure 5.18: Agro-ecological Zone of the Project and Study Area

Land use

The total study area is considered as 10 km radius from the proposed 150 (±10%) MW Simple Cycle (HSD based) Power Plant in Saidpur Upazila under Nilphamari District. The project area is 7.28 ha of which 3 ha land will be used for power plant and remaining 4.28 ha land will be used for future conversion of this simple cycle to combined cycle power plant. The total study area is 31,419 ha, of which 20,784 ha (66.15%) is available for cultivation in the total study area. The rest (33.85%) are covered by rural settlement, water bodies (Rivers, Ponds and Khals), orchard and others (Airport, Brickfield, Built up, and Industry) area. Detailed land use of the study area is presented in **Table 5.11 and Figure 5.19**.

Table 5.11: Land use of study area

Land use	Area (ha)	% of gross area
Agriculture	20,784	66.2
Rural Settlement with homestead vegetation	8,191	26.1
Water bodies (Rivers, ponds and khals)	1,125	3.6
Orchard	43	0.1
Herb/Shrub	6	0.02
Sand	10	0.03
Others (Airport, Brickfield, Built up, Industry)	1,259	4.0
Grand total	**31,419**	**100**

Source: Satellite images of 2019 and google earth images

Land type

Land type is a system of classifying cultivated land based on the seasonal inundation depth of normal flooding. According to Soil Resources Development Institute (SRDI, 1988) five land types high land (F0), medium high land (F1), medium low land (F2), low land (F3) and very low land (F4) have been classified in terms of depth of flooding on agriculture land. In the study area, three types of land were identified. About 63.8% area is covered by medium high land followed by 35.9% is high land and 0.3% is medium low land respectively. Detailed land type of the study area is presented in **Table 5.12**.

Table 5.12: Land type of the study area

Land type	Area (ha)	% of gross area
High land (F0)	7,465	35.9
Medium High land (F1)	13,263	63.8
Medium Low land (F2)	56	0.3
Low Land (F3)	0	0.0
Very Low Land (F4)	0	0.0
Grand total	**20,784**	**100**

Source: SRDI, 1995

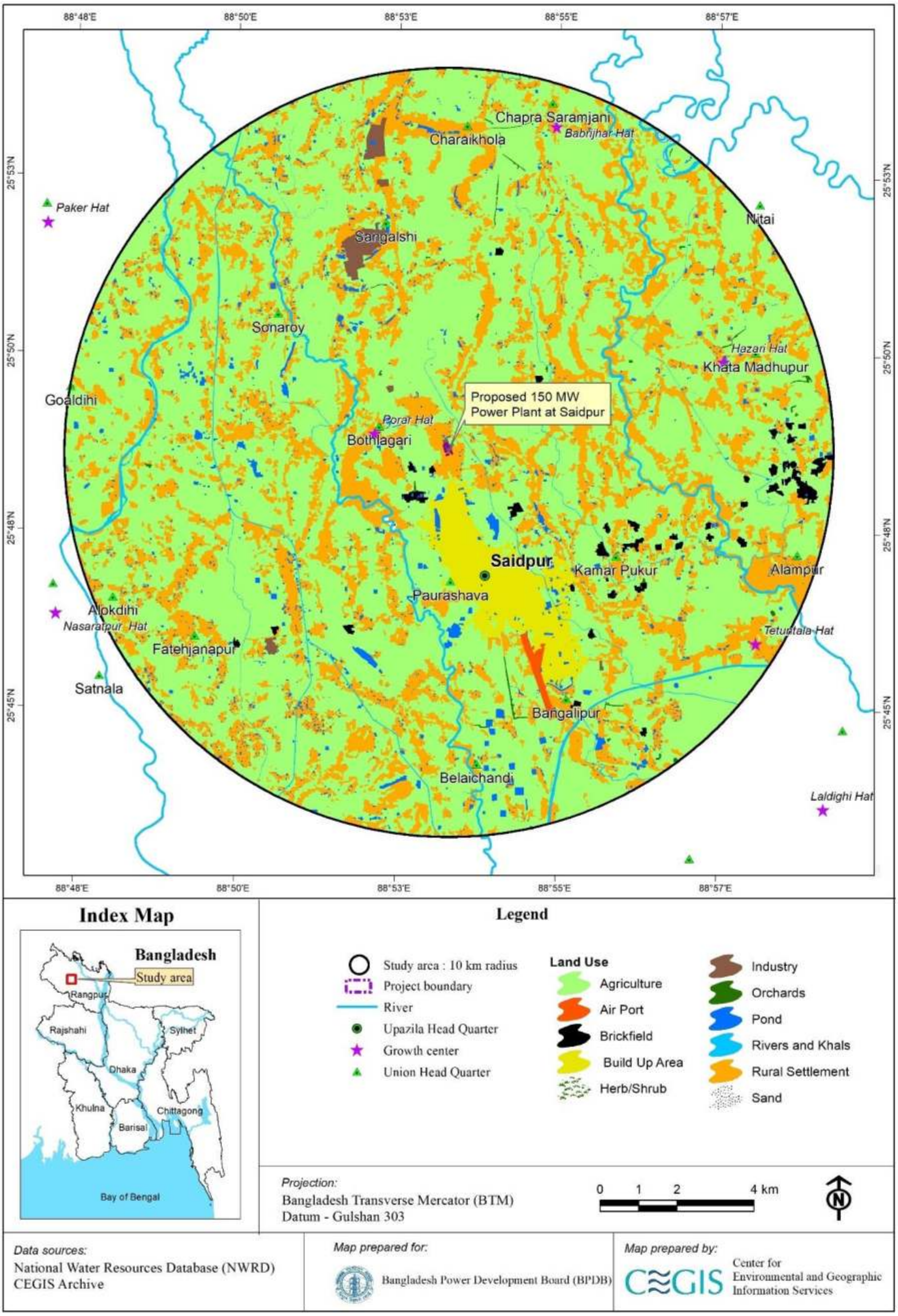


Figure 5.19: Land Use Map of the Study Area

Soil condition

Soil texture

Soil texture is an important soil characteristic that determines crop selection, crop production and also field management. It influences many other properties of great significance to land use and management. Soil texture is the relative proportions of sand, silt and clay. In the study area, most (89.77%) of the NCA is under loam soil texture which is followed by clay loam (6.03%), clay loam/loam (3.19%), sand (0.76%, peat (0.21%) and sandy loam (0.05%) respectively. Detailed soil texture of the study area is presented in **Table 5.13**.

Table 5.13: Soil texture of study area

Soil texture	Area(ha)	%
Clay Loam	1,251	6.0
Clay Loam/Loam	663	3.2
Loam	18,658	89.8
Peat	44	0.2
Sand	158	0.8
Sandy Loam	10	0.1
Grand total	**20,784**	**100**

Source: Soil Resource Development Institute (SRDI), 1995

Soil Quality

The proposed 150 (±10%) MW Simple Cycle (HSD based) Power Plant Project area has fallen in Saidpur Upazila under Nilphamari District in Bangladesh. The study area is mostly covered by thirteen types of soil series namely: Pirgasha, Polashbari, Jamun, Gongachora, manda, Imadpur, Kaunia, Vimpur, Noldanga, Belab, Nowadoda, Amnura and Guldah. Location of the collecting soil samples for checking the soil quality of the study area is presented in **Figure 5.13**. **Table 5.14** shows the soil quality based on plant nutrient within the Study Area. It was observed that, pH ranges of the study area is slightly to strongly acidic. Level of Nitrogen (N) and Organic Matter (OM) content of the study area is low to medium. The concentration of Phosphorus (P), Iron (Fe), Manganese (Mn) is rich in nature. Zinc (Zn) level is medium; Copper (Cu) is medium to high; B (Boron) is low to high and Sulphur (S) content is low- medium in nature. The concentration of Magnesium (Mg) and Potassium (K) is low.

Table 5.14: Soil quality based on plant nutrient of the study area

Parameters	Unit	Max	Min	Average
pH	-	5.9	5.05	5
OM (Organic Matter)	(%)	1.77	0.89	1
Active acidity	Meq/100g	0.50	0.10	0
Ca (Calcium)	Meq/100g	3.6	0.9	2
Mg (Magnesium)	Meq/100g	1.00	0.03	1
K (Potassium)	Meq/100g	0.32	0.03	0
N (Nitrogen)	µg/g	80	07	44
P (Phosphorus)	µg/g	83	1	42
S (Sulphur)	µg/g	23	6	15
B (Boron)	µg/g	0.87	0.29	1
Cu (Copper)	µg/g	9.8	2.4	6

Parameters	Unit	Max	Min	Average
Fe (Iron)	µg/g	224	112	168
Mn (Manganese)	µg/g	37.4	3.3	20
Zn (Zinc)	µg/g	4.2	2.3	3

Source: SRDI, 1997

In addition, three (3) soil samples were collected from three locations in two layers from each during field visit. Soil reaction (pH), Organic Matter (OM), Major nutrients such as Nitrogen (N), Phosphorus (P), Potassium (K), Sulphur (S) along with some heavy metals Chromium (Cr), Cadmium (Cd), Lead (Pb) and Nickel (Ni) has been analyzed. The results will be incorporated in the report after having the analyzed. Location of soil sampling area is presented in **Table 5.15** and **Figure 5.13**.

Table 5.15: Soil sampling location of the study area

Location	GPS Co-ordinate	Date	Sample quantity	Parameter
Kadikhol, Saidpur	N-25°49'05.2" E-088°51'35.1"	18/02/19	2	pH, OM, N, P, K, S, Pb, Cd, Cr and Ni
Hajipara, kamarpukur	N-25°47'05.1" E-088°56'00.1"	18/02/19	2	
Wabdar more, Botlagari	N-25°48'27.3" E88°53'21.01"	19/02/18	2	

Source: Field visit, 18-19th February; 2019

According to **Table 5.16**, it has been observed that pH level is slightly acidic to neutral in nature. On the other hand, organic matter contents are medium to very low. Macronutrients (N, K and S concentration of soils are higher than the optimum/critical limit of SRDI, Bangladesh. Therefore, the level of 'P' is lower than optimum level of SRDI, Bangladesh. However, based on the analytical results heavy metals concentrations (Pb, Cd, Cr and Ni) are found within the limit of DoE standard of Bangladesh.

Table 5.16: Analytical result of soil samples

Location	pH	OM	Available N	Total N	Available K	Total K	Available P	Total P	S	Pb	Cd	Total Cr	Ni
		%	mg/kg										
Kadikhol, Saidpur	6.20	1.3	196	854	378	3900	6.1	49	150	5	<2	41.0	23
	6.53	0.44	84	380	197	4460	8.8	34	110	5.4	<2	39	22
Hajipara, Kamarpukur	5.60	2.30	280	1234	220	3260	4.4	11	380	8	<2	29	19
	6.12	0.77	129	506	142	3680	5.8	20	150	6.2	<2	55	30
Wabdarmore, Botlagari	6.20	1.53	185	949	108	2540	8.8	53	230	7.0	<2	42.0	23.0
	7.31	0.51	67	348	103	3520	7.2	29	110	5.2	<2	36	19
Optimum level, SRDI, Bangladesh	-	-	-	-	0.27-0.36	-	15.8-21.0	-	22.5-30.0	-	-	-	-
Critical limit, SRDI, Bangladesh	-	-	-	-	0.12	-	7.00	-	10.00	-	-	-	-
DoE Standard Value (Bangladesh)	-	-	-		-	-	-	-	-	100	1.5	100	50

Source: Mitra S. K. Bangladesh (Pvt.) Ltd. Laboratory analysis, March; 2019

5.3 Biological Environment

The biological environment is the part of a broad ecosystem of agricultural along with livestock, land use, fishery and ecological resources. Land type, cropping pattern, cropping intensity, crop damages, livestock with covering population and diseases are the part of this chapter to be discussed. Similarly, diversity of fishes along with capture and culture fisheries will get avenues will discuss in the broader aspect. The other component in this subsection is ecological resources having terrestrial and aquatic ecosystems both in the project and study/buffer that has been considered bring to light in this baseline chapter.

5.3.1 Agricultural Resources

The agriculture sector is the single largest contributor to income and employment generation and a vital element in the country's challenge to achieve self-sufficiency in food production and reduce rural poverty and foster sustainable economic development. Baseline condition of agricultural resources has been established through collection of primary and secondary data from the study area. During field visit, three (3) questionnaires were filled up from three locations i.e. Botlagari, Kamarpukur and Bangalipur Unions under Saidpur Upazila, Nilphamari for the interest of the study. Besides this, consultation with Upazila Agriculture Officer (UAO) and Agriculture Extension Officer (AEO) was held to validate the field data.

Farming Practices

Farming practices in the study area are controlled by physical, biological, climatological and socio-economic factors. Agricultural crops are grown by cropping seasons. There are two cropping seasons in a year. They are Kharif and Rabi seasons. The kharif season starts from March and ends in October while the *rabi* season starts from November and ends in February. Based on crop suitability and farming practice, the *kharif* season has been further sub-divided into the *kharif-1* (March-June) and the *kharif-II* (July-October) season. The climatic condition in *kharif-I* season is characterized by the uncertainty of weather of alternating dry and wet spells.

The Kharif-II season comprises wet and cloudy environment and heavy rainfall but uneven distribution, low solar radiation, high temperature and humidity. The Kharif-II season starts from July and ends in October. The Rabi season starts from November and ends in February. During this season, crops are favored with high solar radiation, lower humidity and temperature but lack of adequate soil moisture depresses the crop yield.

In the study area, HYV Aus, vegetable and maize are grown in the kharif-I season. HYV Aman and vegetable are grown in the Kharif-II season. Rabi season crops such as HYV Boro, mustard, maize, vegetable such as cauliflower, cabbage etc. and potato, spices i.e. onion, garlic and chilli are practiced in the Rabi season. However, ginzer and turmeric are annual crops in the study area.

Cropping Pattern by Land Type and Intensity

The dominant cropping pattern in the study area is Fallow- HYV Aman –HYV Boro of which covers 24.18% of the NCA. Cropping intensity of the study area is 236%. Detailed cropping patterns by land type and cropping intensity is presented in **Table 5.17** and **Figure 5.20**.

Table 5.17: Cropping pattern by land type of the study area

Land type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (November-February)	Area (hectare)	% of NCA
Study area					
High land (F_0)	HYV Aus	HYV Aman	HYV Boro	114	0.55
	Vegetable	Vegetable	Vegetable	727	3.5
	Fallow	HYV Aman	HYV Boro	5,023	24.17
	Zinger	Cont'd	Cont'd	8	0.04
	Turmeric	Cont'd	Cont'd	8	0.04
	Vegetable	HYV Aman	HYV Boro	1,580	7.6
			Sub-total	7,455	35.9
Medium high land (F_1)	Fallow	HYV Aman	HYV Boro	2,103	11.47
	Fallow	HYV Aman	Potato	2,100	10.12
	Fallow	HYV Aman	Wheat	1,417	6.82
	Fallow	HYV Aman	Mustard	1,503	7.23
	Vegetable	HYV Aman	Maize	3,020	14.53
	Fallow	HYV Aman	Chilli	711	3.42
	Maize	Vegetable	Potato	2,122	10.21
			Sub-total	13,245	63.8
Medium low land (F_2)	Fallow	Fallow	HYV Boro	62	0.3
			Sub-total	56	0.3
			Grand total	20,755	100
			Cropping intensity	236	
Project area					
	Fallow	Fallow	Fallow	3	100

Sources: CEGIS estimation based on field information and DAE, February 2019

Transplanted HYV Boro rice in Kamarpukur

Mustard field adjacent Debiganj Bazar


Maize and potato field in Botlagari union

Source: CEGIS Field visit, 18-19th February, 2019

Figure 5.20: Crop land in the study area

Cropped Area, Yield, Production and Damage

Total cropped area is 48,936 hectare of which rice crop area is 27,019 hectare (55%) and non-rice crop area is 21,917 hectare (45%) respectively. The annual total crop production stands at 306,614 metric tons after the loss of 6,683 metric tons. Among the crop production rice crop is 86,146 metric tons (28%) and non-rice crop is 220,468 metric tons (72%) respectively. Detailed crop area, yield, production and crop damage of the study area is presented in **Table 5.18**.

Table 5.18: Cropped area, yield and annual production and damage in the study area

Crop name	Crop area (hectare)	Damage free		Damaged		Total production (metric ton)	Production loss (metric ton)
		Area (hectare)	Yield (metric ton/ hectare)	Area (hectare)	Yield (metric ton/ hectare)		
Study area							
HYV Aus	114	102	2.8	12	1.8	307.2	12
HYV Aman	17,741	15,068	3.2	2,673	1.9	53296.3	3,475
HYV Boro	9164	6,880	3.9	2,284	2.5	32,542	3,196
Total rice	**27,019**	22,050	0	4,969	-	**86,146**	**6,683**
S. Vegetable	8,176	8,176	14		-	114,464	-
W. vegetable	727	727	12		-	8,724	-
Potato	4,225	4,225	14		-	59,150	-
Wheat	1,417	1,417	2.5	-	-	3,543	-
Mustard	1,503	1,503	1.1	-	-	1,653	-
Maize	5,142	5,142	6.2	-	-	31,880	-
Chilli	711	711	1.3	-	-	924.3	-
Zinger	8	8	12.4	-	-	99.2	-
Turmeric	8	8	3.8	-	-	30.4	-
Total non-rice	**21,917**	21,917		-	-	**220,468**	-
Total	**48,936**	44,048	-	4,969	-	**306,614**	**6,683**

Sources: CEGIS estimation based on field information 18-19th February, 2019 and DAE

The crop damage data have been collected from the fields for the last three years from the areas under study area with consultation of concerned farmers and officials of DAE of the study area. Therefore, annual crop damage (rice production losses) in the study area has been evaluated. Detailed cropped area, crop damaged area, yield rate of damaged area, damaged area production and production loss have been presented in **Table 5.18**.

Crop calendar

The detailed crop calendar of different crops of the study area is presented in **Figure 5.21** and related questionnaire used for information collection for this study is attached in **Annex 5**. It was observed that the raising of seedlings of HYV Aman generally starts in early-July and end- August and transplanting starts in early-August and continues up to Mid-September depending on rainfall. Transplanting of Aus generally stats from early-June and continues till end- June. HYV Boro crops are transplanted during late-December to late-January. Some vegetables are very sensitive to temperature. Therefore, the time of sowing and harvesting of vegetables also vary.

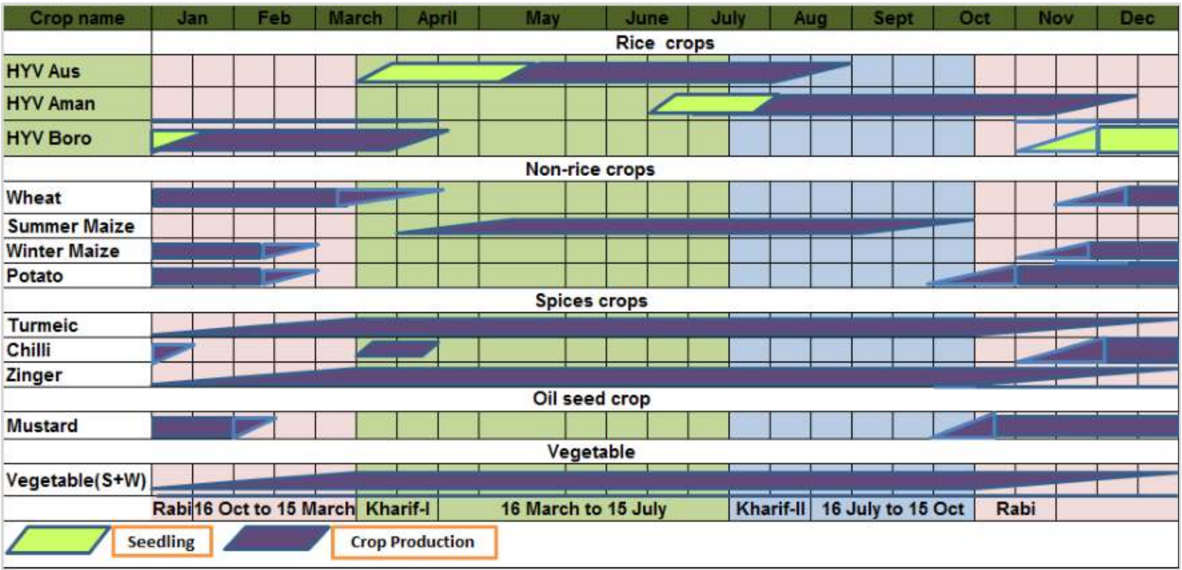


Figure 5.21: Crop calendar of the study area

Agricultural Input Use

Seed, labor, fertilizer and pesticides are the major inputs for crop production. The detailed agricultural inputs are presented below.

Seed, labor, fertilizer and pesticides

The role of seed is very important for growing crops. Good quality seeds have some criteria, i.e. they are to be free from disease infestation, have germination ability of more than 85%, have the capacity for producing higher yields, are improved crop cultivars etc. Seeds are to be selected carefully. According to the local farmers, DAE of Saidpur, Nilphamari, they are using different variety of seeds such as HYV Aus: BR 6, BRRI dhan29, BRRI dhan 48, HYV Aman: BR11, BR22, BRRI dhan34, BRRI dhan 49, HYV Boro: BRRI dhan 28, BRRI dhan 29, BRRI dhan 58, and BRRI dhan 74. Hybrid Boro: Shorna, Sampad, Moyna, Hira. The seed rate for different crops varies from crop to crop depending on size and management practices.

The rate of fertilizer use per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability etc. The major fertilizers used in this area are Urea, TSP/SSP, MP and Gypsum. Cow dung is used in vegetables, homestead farming and fuel purposes. The use of pesticides depends on the degree of pest infestation. The major insects as reported by the farmers and pesticides and fertilizer dealers are Stem borer, Ear cutting cater pillar, Aphid, Cut worm, Green leaf hopper, Rice bug and Brinjal fruit and shoot borer. According to local people, farmers and DAE officials, it has been reported that farmers are using different types of pesticides such as: Basudin, Furter, Vittako etc. The seed rate (kg/ha), labor/ha, fertilizer and pesticides used by the farmers are presented in **Table 5.19**.

Table 5.19: Seed, labor, fertilizer and pesticides use in the crop fields

Crops name	Seed (Kg/ha)	Labor (No. /ha)	Farmers using fertilizer (Kg/ha)					Pesticide using by farmers	
			Compost	Urea	TSP	MP	Gypsum	No. of application	Liq. (ml/ha) approx.
HYV Aus	45	120-150	-	100-120	100	50	-	2-3	200-400
HYV Aman	50	160-170	-	180-220	80	50	0-40	1-2	400-700
HYV Boro	50	160-180	-	200-250	120	60	50-100	2-3	500-700
S. Vegetables	8-10	120-140	50-100	200-300	120	120	-	2-3	300-700
W. vegetables	6-7	120-140	50-100	100-120	50	40	-	1-2	300-700
Potato	1500	150	-	100-200	80	60	20-40	2-3	300-700
Wheat	120	125	-	180-200	40	20	-	1-2	400-800
Mustard	8	90	-	100-180	50	40	30-40	1-2	300-700
Maize	25-30	140	-	140-160	80	60	30-40	1	300-500
Chilli	2.5	120-140	-	120-150	80	50	-	1-2	400-700
Zinger	1500-1800	120-140	5,000	-	-	-	-	2-3	500-800
Turmeric	2500	120-140	-	-	100-130	60	50	1-2	500-700

Sources: CEGIS estimation based on field information 18-19th February, 2019 and DAE

<u>*Irrigation*</u>

Both surface and ground water are being used for irrigation in the crop land. But ground water is the main source of irrigation for crop cultivation under the study area. The source of surface water is river (Korotoya, Ichamoti, Chikli and Kharkharia), pond and khal. Teesta barrage channel is also used for surface water irrigation under Saidpur Upazila. In dry season, Boro rice, Vegetables and Rabi crops are grown with the help of ground water irrigation by extraction of Shallow Tube Wells (STWs) and Deep Tube wells (DTWs). Detailed information on irrigated area is presented in **Table 5.20**.

Table 5.20: Irrigation facilities in the study area

Crop name	Study area					
	Irrigation (Surface water)			Irrigation (Ground water)		
	Irrigated area (hectare)	% of NCA	Charge (BDT/hectare)	Irrigated area (hectare)	% of NCA	Charge (BDT/hectare)
HYV Boro	-	-	-	9,136	20	10,000-12,000
Winter Vegetable	-	-	-	740	2	7,000-7,500
Wheat	-	-	-	1,415	3	7,500-8,000
Potato	-	-	-	4,224	9	8,000-8,500
Mustard	1500	3.25	5,000-6,000			

Sources: CEGIS estimation based on field information 18-19th February, 2019 and DAE

Integrated crop Management (ICM)

Recently, Integrated Crop management (ICM) is practiced in some areas that were covered by the study area. DAE has taken active part on ICM. In this system, insects are controlled biologically. Farmers of the ICM areas use branches of trees, bamboo and jute sticks etc. to make favorable perches for birds in fields with standing crops. The birds eat the insects which help control infestation. In this process, the crops are protected without applying pesticides. Trap is another technique for controlling pests under ICM. This system is used in the agriculture fields especially on rice and vegetables for attracting insects. At the base of the trap, there is a sheet generally made of steel that slopes downward. Thus, it is possible to control the harmful insects without the application of pesticides. In the study areas the ICM technique is mainly applied on rice crops. Field information (Farmers, UAO of DAE) indicates that ICM is being practiced in the fields covering about 15-20% of the cultivated areas in the study area and the impact has been found very encouraging.

Crop production constraints

The main constraints of crop production in the study area are scarcity of irrigation water during dry season; Pest and diseases infestation etc. also affect normal crop production to some extent.

5.3.2 Livestock Resources

Livestock and poultry, being an essential element of integrated farming system, play an important role in the economy and cultural role of study area. Cow dung is used as a source of manure and fuel, meat, milk and eggs are used for human consumption and a ready source of cash earning to poor people. Most of the households raise livestock (cattle, buffalo, goat, and sheep) and poultry (chicken, duck) that significantly reduce (**Figure 5.22**) poverty through generating income and employment. Detailed information on livestock and poultry resources is presented in **Table 5.21**.

Table 5.21: Status of livestock and poultry in the study area

Livestock/Poultry	% HH having livestock/poultry	Number of livestock/poultry
Cow/Bullock/	45	50,74,875
Buffalo	2	2,25,550
Goat	12	13,53,300
Sheep	3	3,38,325
Duck	35	39,47,125
Chicken	95	1,07,13,625

Source: CEGIS estimation based on field information, 18-19th February, 2019

Feed and fodder of livestock and poultry

Fodders and feed are the most important input of livestock rearing. Crop residues and naturally grown grasses alongside roads, river bank, etc. are the main feed for the livestock in the study area. Rice straw, oil cake, rice husks are also used as fodder. The owners of the livestock population are facing problems due to the dried up grazing land during the month of December to April. Poultry population at family level survives by scavenging and generally no feed supplements are provided. However, at times kitchen waste becomes feed to the poultry.

Livestock and poultry diseases

Production of livestock and poultry of the study area are mainly constrained due to diseases and death of the population. Outbreak of diseases causes considerable economic loss in livestock farming. According to local people, every year livestock population is affected by different diseases. Major livestock diseases are Foot and Mouth Disease (FMD), Golafula, Mastitis, Diarrhea and Sheep Paste Des Petits of Ruminants (PPR). Major poultry diseases are Ranikhet (New castle), Cholera, Fowl pox and Duck plague. During monsoon season, the soggy condition of the animal shelter promotes various kinds of diseases to the bullocks and cows. However, some diseases are spreading round the year.

Source: CEGIS Field visit, 18-19th February, 2019

Figure 5.22: Livestock and poultry in the study area

5.3.3 Fisheries Resources

The proposed Project site is a fallow land, having no waterbody, located at Bothlagari union of Saidpur, Nilphamari district. The study area possesses Rivers and Khal, which function as capture fish habitats seasonally and fish ponds as culture fish habitats. The Kharkharia, the Ichhamati, the Chikli, the Bagdorka Nala and the Karatoya River pass through the study area and yield floodplains elsewhere nearby the rivers in the wet season. The study area is a drought prone area and thus the rivers become dry in the dry season except some pool areas. On the other hand, the ponds also get dry and become unsuitable for fish culture in the dry season in most cases.

Fish Habitats

The study area possesses both capture and culture fisheries. The capture fishery includes river, Khal and floodplain whereas culture fishery comprises only the aquaculture fishpond. The habitats are mostly remained unsuitable for fish habitation during dry season as they retain low or no water except in the pool areas. The pool areas function as over wintering refuges and keep important role in recruitment of progeny in the next season. Different types of fish habitat in the study area are shown in **Figure 5.23** and represent the study area fish habitats.

Figure 5.23: Different Types of Fish Habitat in the Study Area (Dry season)

Fish Habitats and Production Assessment in the study Area

The estimated total fish habitat in the study area is about 1,189 hectare (ha), where the project area has no any fish ponds. Fish habitat distribution in study area is shown in **Table 5.22.** The estimated total annual fish production in the study area habitats is about 2,596 Metric ton (MT) where the project area has no any contribution. In the total fish production, the culture fishery contributes about 98% and the rest is shared by the capture fishery. The breakdown of fish production for the study and Project area is presented in **Table 5.22**.

Table 5.22: Fish Habitat and Production Analysis in Study Area

Habitat Category	Habitat Type	Study Area	
		Habitat Area (Ha)	Fish Production (MT)
Capture	River and Khal	390	20
	Floodplain	64	3
	Sub-Total=	**454**	**23**
Culture	Semi-intensive Pond	735	2,573
	Sub-Total=	735	2,573
	Grand Total=	**1,189**	**2,596**

Source: CEGIS estimation based on satellite imaginary and Field Survey, 2019

Fisheries Diversity

During consultation at Tishamot, Kadikhol at Bothlagari Union, local fishermen and elderly people reported that the fish biodiversity has been declining over the years due to water unavailability in the waterbody round the year. Discharge of untreated effluent in the Kharkharia River from a Paper Mill located at Rabeyar Morr has been polluting the river water. This has been causing damage to aquatic biodiversity of that area including fish and leading to decline in species diversity.

The riverine major fish species are: Boal (Wallago attu), Rui (L. rohita), Katol (Catla catla), Shol (Channa striatus) Boro baim (Mastacembelus armatus), Batasi (Pseudeutropius atherinodes), chela (Salmostoma bacaila), Kaski (Corica soborna), Tengra (Mystus tengara), Bele (Glossogobius giuris), Taki (C. punctatus).

The floodplain habitat functions as fish grazing, breeding and nursing ground for small indigenous fish species (SIS) like Punti (Puntius spp), Baila (Glossogobius giuris), Koi (Anabas testudineus), Khoilsha (Trichogaster labiosus), Chanda (Chanda nama), Shing (Heteropneustes fossilis), etc.

Culture fish species include: Kalibaus (Labeo calbasu), Mrigel (Cirrhina mrigala), Silver carp (Hypophthalmichthyes molitrix), Grass carp (Ctenopharyngodon idela), Mirror carp (C.

carpio.), Common carp (Cyprinus carpio), Tilapia (Tilapia mossambicus), Nilotica (Tilapia nilotica), etc.

Fishing Status Efforts

Local people reported that very few people (about 5%) engaged in fisheries activities to support their families. Among them a handsome percentage of people are engaged in culturing fish and selling in the local market.

Fishing Gears and Crafts

Some specific nets and gears are used to catch fish in the study area. The major fishing gears are: cast net, push net, square lift net, conical trap, Dhormo jal, seine net, fish angles, fish line etc. The local fishers catch fish by using fishing boat and Dingi fishing boat in the river.

5.3.4 Ecological Resources

This section has covered terrestrial and aquatic ecosystems of the project area and the study area as well. The study area does not possess any ecological habitats of conservation importance. The details of ecological conditions of the Project and study area have been described below.

Bio-ecological Zone

The International Union for Conservation of Nature (IUCN), has divided Bangladesh into 25 Bio-ecological Zones in context of biological diversity (Nishat et al., 2002). The study area covers two Bio-ecological Zones namely Barind Tract (1,263 ha) and Teesta Floodplain (30,152 ha) and these two zones are presented in **Figure 5.24**.

Ecosystem of the Project Area

The project area occupies different species of flora and fauna. These two components are presented in detail below.

The Flora

The project area is a high land having terrestrial vegetation of different fruit, timber and bushy species. A detail of the vegetation trees is given in **Table 5.23**.

Table 5.23: Tree species in the project area

SN	English Name	Scientific Name	Quantity	Height (m)*	Threat Status**
1	Coconut	Cocos nucifera	3	15	NO
2	Mango	Mangifera indica	9	4	NO
3	Jackfruit	*Artocarpus heterophyllus*	19	5	NO
4	Wood Apple	*Limonia acidissima*	2	7-10	Rare
5	West Indies Mahogany	*Swietenia mahagoni*	7	10-12	NO
6	Litchi	Litchi chinensis	4	3-5	NO
7	Guava	Psidium guajava	1	2	NO
8	Rain Tree	*Albizia saman*	4	12-14	NO
9	Rosewood	Dalbergia sissu	22	10-12	NO
10	Neem	*Azadirachta indica*	3	8	NO
11	Weeping Tree	Polyalthia Sp.	20	10	NO

**indicates eye estimated measurement ** NO-Not Threatened*

Source: CEGIS Field Study, 2019

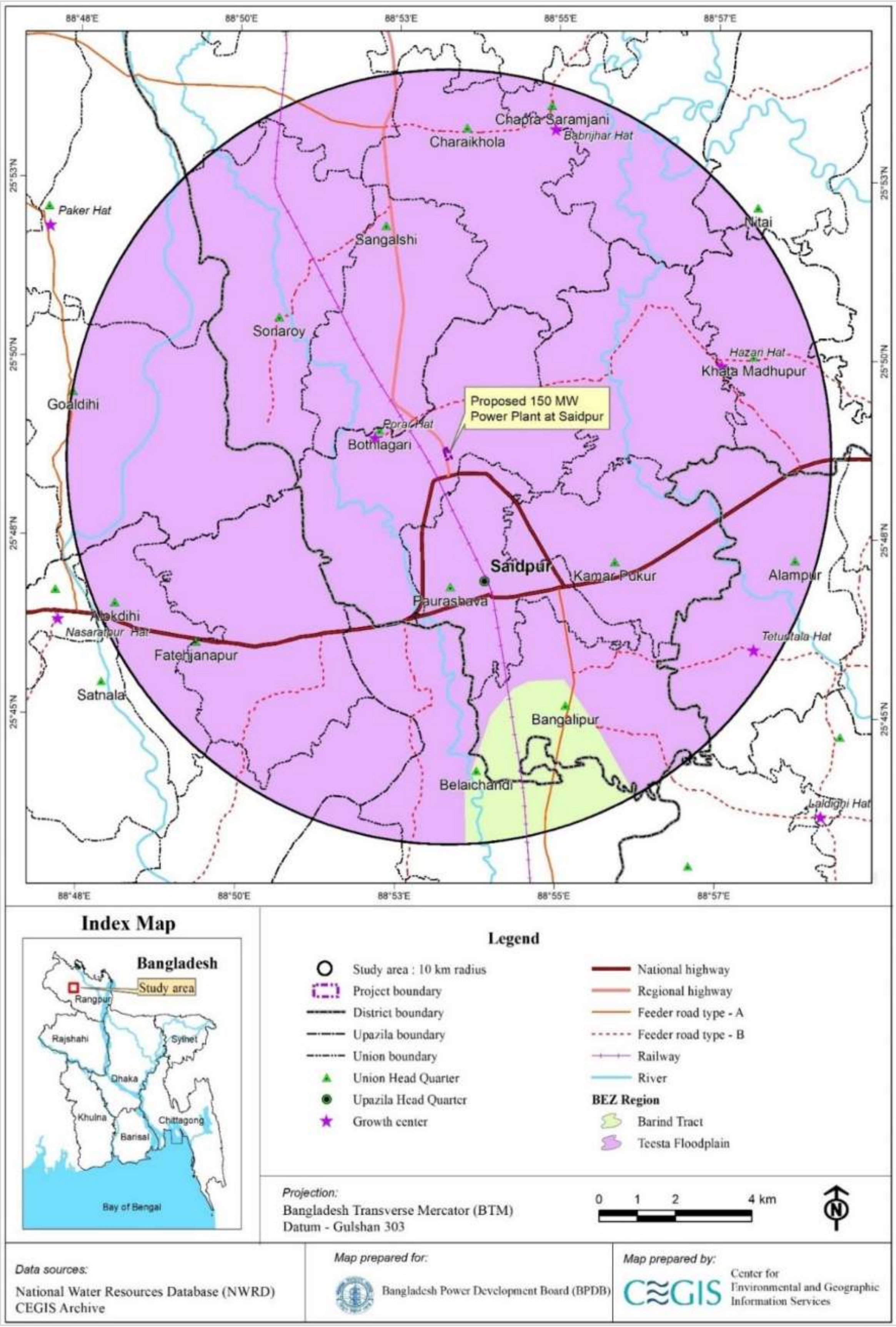


Figure 5.24: Bio-Ecological Zone of the Study Area

The photographs of vegetation of the proposed power plant site is presented in **Figure 5.25**.

Figure 5.25: Photographs of exisitng vegetation in the proposed Power Plant area

The other component of the project is diesel pipeline from Saidpur Railway Station to the Project Site. The proposed line will cross parallel to the railway line occupied with various herbs in slopes dominant with Glory Bower, Arum, Devil's Trumpet and other minor grasses. A small portion of the line will cross agricultural land of vegetables and paddy crops. In addition, it is said by the power plant officials that there has been another option to connect fuel (HSD) pipe line from other direction and the station is situated in Fatehjungpur Mor of Dinajpur district. The baseline situation of the transmission fuel (HSD) pipe lines regarding ecological resources occupied with roadside vegetation like Acacia and Eucalyptus along with marginal grasses i.e., Burmuda grasses. Photographs of the proposed fuel (HSD) transmission line sites are presented in **Figure 5.26** and **Figure 5.27**.

Figure 5.26: Partial view of the proposed diesel transmission pipeline alignment

Figure 5.27: Partial view of the proposed diesel transmission pipeline alignment (closer view)

<u>*The Fauna*</u>

The entire proposed power plant site has no undergrowth and marginal vegetation. This area is usually crowded with power plant officials and other employees. In addition, the planted tress area is quite clear and there is no vegetation patches for nesting to tiny/small wild fauna. A few small birds like Oriental Magpie Robin (*Copsychus saularis*), Black Drongo (*Dicrurus macrocercus*), and Common Myna (*Acridotheres tristis*) have seen reluctant while we visiting this place.

In the proposed pipelines area, some small avifauna like Red-vented Bulbul (*Pycnonotus cafer*), Black Drongo (*Dicrurus macrocercus*), Asian Pied Starling (*Gracupica contra*), and Common Myna (*Acridotheres tristis*) have found available. In this field visit no nests or core habitats were identified the proposed diesel and gas transmission lines.

Ecosystem of the Study Area

The entire study area possesses both terrestrial and aquatic ecosystems. These two broad categories are described below:

<u>*Terrestrial Ecosystem*</u>

The terrestrial ecosystem broadly contains two types of biodiversity, i.e., (i) floral biodiversity and faunal biodiversity. The floral biodiversity can be divided into three sub-categories based on their life-forms, patterns and characteristics namely homestead vegetation, roadside vegetation, crop-field vegetation, orchard, and social forest. An account of these sub-categories is presented in detail below.

Homestead vegetation: This type of vegetation occurs in the homestead backyards to support people's daily needs and earning cash through planting different species of fruit, flower, timber, fuel and medicinal plants. During this field visit Jackfruit, Mango, Guava, Blackberry, Banana, Mehogany, Acacia, Papaya, Eucalyptus, Bamboo Clump, and Litchi found dominant throughout the study area. Some species also occur rare and they are Tamarind, and Cotton Tree.

Roadside vegetation: Roadside vegetation means vegetation occurs in the road slopes. It can either be planted by Forest Department or communities on account of social involvement on public-private partnership framework. Dominant species in the road slopes are Acacia, Eucalyptus and the rest less dominant species namely Neem, West Indies Mahogany, and Rosewood. A few cases, Indian Olive also found planted in the road slopes especially in the closer locations of homesteads.

Crop-field vegetation: Crop-field vegetation is self-growing species found at around the crop-land. This type of vegetation is grown among crops, and peripheries of the croplands/isles. Diversity among crop-field vegetation in this buffer area is low and they are Jharadhan, Chechur, Burmuda grasses, etc.

Orchard: Orchard is firmly a full commercial vegetation with Litchi, Mango, and Banana. In some locations, orchard with Papaya has also found during the recent major field investigation in the project buffer area.

Social forest: Social forestry practice in this area is common and found everywhere with strip and block planations majority with Acacia, Eucalyptus, West Indies Mahogany, Cotton Tree, Kadamba, and Rosewood. A list of social forests exist in this area is given in **Table 5.24**.

Table 5.24: A list of social forests in the study area

SN	Name	Location	Length/ Area	Distance from proposed Power Plant
1	Kamarpukur-Dolua Plantation	Kamarpukur	3.00 km	5.00 km
2	Raja Filling Station-North Auskhai	Kamarpukur N 25º47'2.9" E 88º55'59.4"	5.00 km	4.00 km
3	Rangdhanu Park	Kondal N 25º46'26.2" E 88º52'49.0"	3.00 acre	2.00
4	Dangarhat-Choumohani Bazar	-	2.50 km	-
5	Panetinala	-	5.00 km	-
6	Guchhagram Social Forest	-		-
7	Digaldanghi Social Forest	Bothlagari	3.00 km	2.00 km
8	Jaichandi-Sonaroy Social Forest	Sonaroy	4.00 km	7.00 km
9	Baburhat Social Forest	Sonaroy	3.00 km	10.00 km
10	Patakuri Park	Saidpur Sadar	1.00 acre	2.00 km
11	Acacia Forest	Saidpur N 25º46'27.9" E 88º52'38.5"	0.20 acre	3.00 km

Source: CEGIS Field Study, 2019

The photographs of terrestrial vegetation of the study area is presented in **Figure 5.28**.

Homestead vegetation at Bothlagari, Saidpur

Roadside vegetation at Debiganj, Chirirbandar

Roadside vegetation at Kamarpukur, Saidpur

Social Forest (Strip plantation) at Dangarhat, Saidpur

Figure 5.28: Terrestrial vegetation of the study area

Of the fauna, the vertebrates like amphibians, reptiles, birds and mammals were considered to discuss under terrestrial fauna and these are given in **Table 5.25** with following their hierarchy.

Table 5.25: A list of common species in the study area

Class/Group	Common Name	Scientific Name	Local Status	IUCN-Bangladesh Status (2015)
Amphibia	Indian Common Toad	*Bufo melanostictus*	VC	LC
	Indian Bullfrog	*Hoplobatrchus tigerinus*	C	LC
	Common Tree Frog	*Polypedates maculates*	UC	LC
	Ornate Microhyla	*Microhyla ornata*	C	LC
Reptilia	House Gecko	*Hemidactylus flaviviridis*	VC	LC
	Common Garden Lizard	*Calotes versicolor*	VC	LC
	Little Skink	*Mabuya macularia*	C	LC
	Indian Rat Snake	*Ptyas mucosa*	C	LC
	Common Skink	*Mabuya carinata*	C	LC
	Bengal Lizard	*Varanus bengalensis*	C	NT
	Buff-striped Keelback	*Amphiesma stolata*	C	LC
	Checkered Keelback	*Xenochrophis piscator*	C	LC
	Monocled Cobra	*Naja kaouthia*	Rare	NT
Aves	House Crow	*Corvus splendens*	VC	LC
	Asian Pied Starling	*Sturnus contra*	VC	LC
	Large-billed Crow	*Corvus macrorhynchos*	C	LC
	Black Drongo	*Dicrurus macrocercus*	VC	LC
	House Sparrow	*Passer domesticus*	C	LC
	Spotted Dove	*Streptopelia chinensis*	VC	LC
	Red-vented Bulbul	*Pynonotus cafer*	C	LC
	Chestnut-headed Beeeater	*Merops leschenaulti*	Rare	LC
Mammalia	Asian House Shrew	*Suncus murinus*	C	LC
	Little Indian Field Mouse	*Mus booduga*	C	LC
	House Mouse	*Mus musculus*	C	LC
	Common Mongoose	*Herpestes edwardsii*	UC	LC
	Bengal Fox	*Vulpes bengalensis*	UC	VU
	Jungle Cat	*Felis chaus*	C	NT
	Five-striped Palm Squirrel	*Funambulus pennantii*	C	LC
	Indian Flying Fox	*Pteropus giganteus*	C	LC
	Indian Pipistrelle	*Pipistrellus coromandra*	Rare	LC

Source: CEGIS Field Study, 2019; VC-Very Common, C-Common, UC-Uncommon; LC-Least Concern, NT-Near Threatened, VU-Vulnerable

Habitats of the above-mentioned terrestrial fauna ranges scrub jungle to homestead includes secondary vegetation, and roadsides environment nevertheless each group belongs to some isolated habitats and home territories.

Aquatic Ecosystem

The buffer/study area belongs to a few wetlands like rivers and ponds. Most of the wetlands do not inundate throughout the year and they called as seasonal wetlands. According to locals, Chikni and Khora Rivers has been blessings to this area for irrigation and other limited household use. In addition, some ponds also occur in this area and they play important roles for support household works. The prominent ponds can be mentioned as Dolua Pukur, Kuni Pukur, Debri Doba, Chhorapukur Beel, and Ruji Pukur having waters all the year-round. Interviews on aquatic biota shows a limited number of species namely Water Snowflake, Water Lily, and Water Hyacinth (*Eicchornia crassipes*) presence as flora and Skipper Frog (*Euphlyctis cyanophlyctis*), Little Egret, Little Cormorant (*Microcarbo niger*), Intermediate Egret, Common Snipe, Kaime, and Asian Openbill among fauna. Photographs of wetlands in this study area is provided in **Figure 5.29**.

Khora River at Bothlagari

Homestead Pond, Saidpur

Figure 5.29: Aquatic ecosystem in the study area

5.4 Social Environment

Socio-Economic characteristics like basic demography, settlement and housing, public utilities, economy and employment status and other relevant socio-economic features in the study area are presented in this section. This information helps to understand the socio-economic condition of the study area. Findings of this chapter are arranged, based on secondary and primary data. The secondary information was collected from Expenditure Survey, 2010 & 2016 and the primary information was collected from the field survey.

5.4.1 Area and Location

Area of the proposed project comprises 15 unions under 6 respective Upazilas of 3 districts in Rangpur Division. The following **Table 5.26** shows proportionate distribution of the study unions within the study area. It is noted that the area of each union within the 10 km radius from the center of the project area is considered for to fall in the study area for assessing the relevant impact. The project site is located within the existing boundary of the BPDB which encompasses the administrative boundary of Saidpur Paurashava and Bothlagari Union. Resources Map of the study area is shown in **Figure 5.30**.

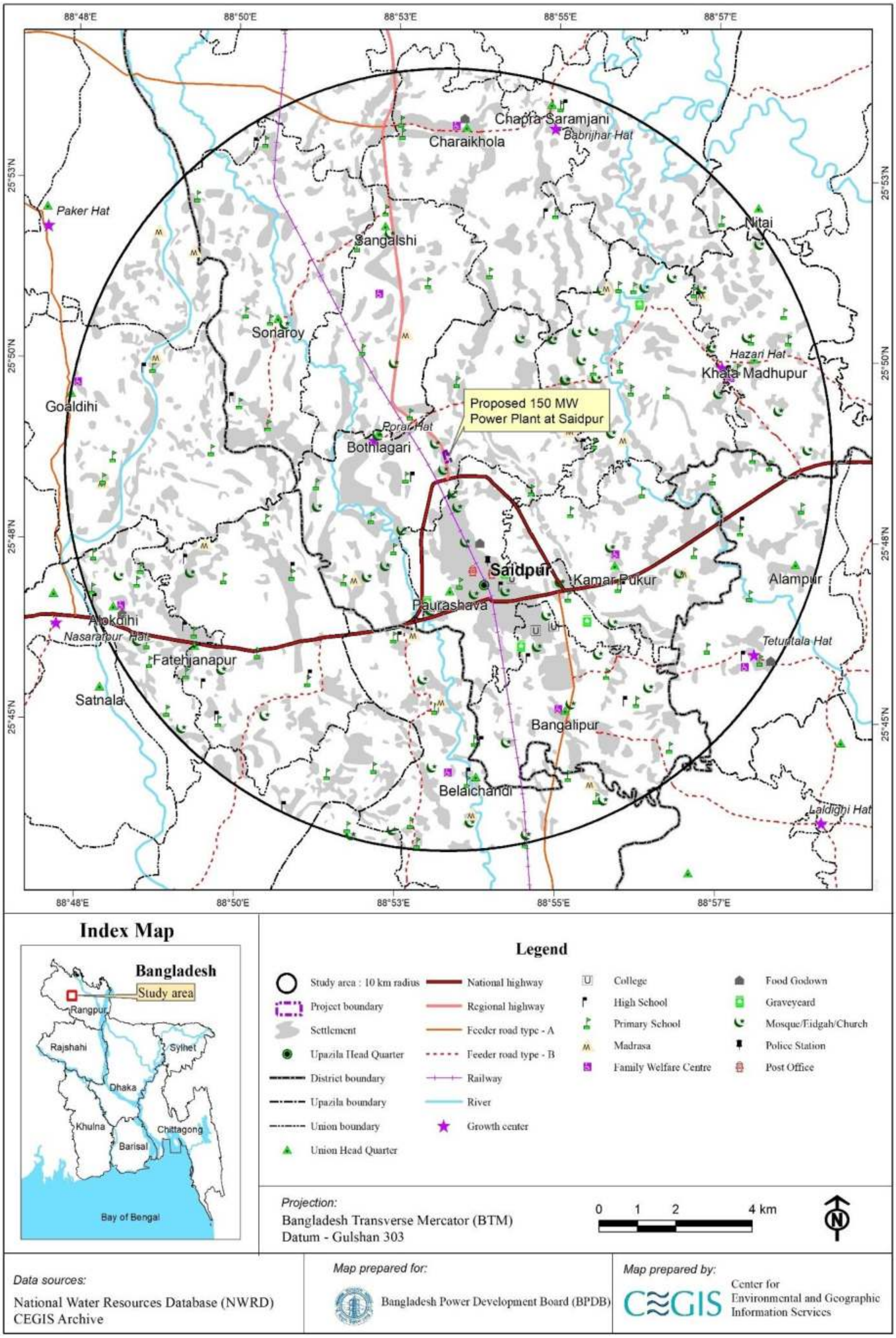


Figure 5.30: Resource Map of the study area

Table 5.26: Location and union coverage of the study area

District Name	Upazila Name	Union Name	% of union
Dinajpur	Chirirbandar	Alokdihi	80
		Fatehjanapur	100
	Khansama	Goaldihi	77
	Parbatipur	Belaichandi	51
Nilphamari	Nilphamari Sadar	Chapra Saramjani	56
		Charaikhola	97
		Sangalshi	100
		Sonaroy	100
	Saidpur Sadar	Bangalipur	99
		Bothlagari	100
		Kamar Pukur	100
		Khata Madhupur	72
		Kushiram Belpukur	100
		Saidpur Paurashava	100
Rangpur	Taraganj	Alampur	68

5.4.2 *Communication System*

Transportation system is very important for project development and subsequent activities. Development of such a project will directly or indirectly influence the socio-economic development of the adjacent areas. The following sections discuss the road and water communication system of the study area.

Roadways Communication System

The project site is located adjacent to the Saidpur-Nilphamari regional road and Saidpur Bypass road. The site is approximately 4 km away from Dinajpur-Rangpur Highway. This will facilitate the construction material transportation for the power plant as the project site is located at the corner of the regional road and Saidpur Bypass road. Trucks and other transport vehicles will easily reach the construction site during construction phase. Besides, there is an established road network to have access to the project site within the PDB colony, which will favor faster movement of construction waste along with bringing necessary construction materials. During operational phase, equipment necessary for power generation will also be brought to the plant using roadway communication.

Navigation System

There is no perennial river available in the study area. The existing rivers within the area lack availability of water. Therefore, the communication system completely depends on Roadway.

5.4.3 *Demographic Profile*

Households and population

The study area comprised of 112,775 households with a total population of 503,558 i.e., 4 to 5 persons per household in average which is higher than the national household size i.e., 4 persons per households (Household Income and Expenditure Survey-HIES, 2016). There were 253,684 male and 249,874 female in the study area with the average density of 1,351 people per kilometer excluding the Saidpur Paurashava area in 2018 (**Table 5.27**).

Table 5.27: Demographic scenario of the study area

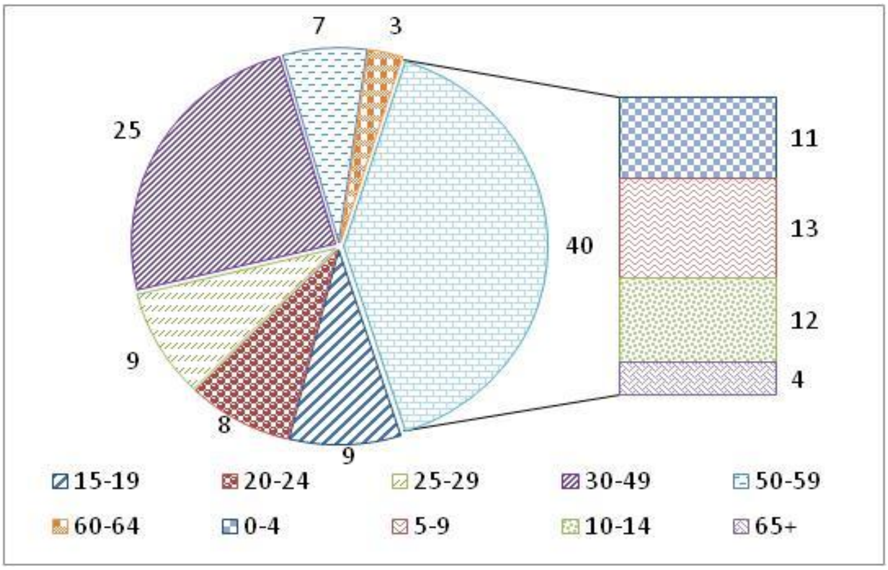
District	Upazila	Unions	Total HHs	Both	Male	Female	Sex Ratio	Population Density (sq.km)
Dinajpur	Chirirbandar	Alokdihi	2619	11290	5672	5618	101	1305
		Fatehjanapu	7323	31264	15326	15938	96	1214
	Khansama	Goaldihi	5220	23359	11861	11498	103	1001
	Parbatipur	Belaichandi	5761	23352	11740	11612	101	1175
Nilphamari	Nilphamari Sadar	Chapra Saramjani	4036	16909	8398	8511	99	1307
		Charaikhola	7549	33173	16642	16531	101	1437
		Sangalshi	5593	25382	12850	12532	103	1275
		Sonaroy	7343	32651	16269	16382	99	1252
	Saidpur Sadar	Bangalipur	4978	21879	10814	11064	98	1554
		Bothlagari	9034	42221	21186	21035	101	1766
		Kamar Pukur	6651	28715	14394	14321	101	1716
		Khata Madhupur	4339	17889	8919	8970	99	1266
		Kushiram Belpukur	8724	35174	17635	17539	101	1582
		Paurashava	29337	141721	72542	69179	105	
Rangpur	Taraganj	Alampur	4268	18580	9436	9144	103	1069
Total/Average			112775	503558	253684	249874	102	1351*

Source: BBS, 2011, Estimated by CEGIS for 2018

**Average excluding the Density of Paurashava area which is not identified by BBS.*

Age structure

Analysis of age structure showed that about 36% of total population are children (age ranges up to 14 years), 60% of total population are regarded as potential labor force (age ranges from 15 to 64 years) as per the definition of International Labor Organization (ILO) and the rest 4% of total population belong to old category (age ranges above 65 years). The following **Figure 5.31** shows that the highest 25% people are from the age group 30 - 49 years' regarded as most potential workforce.



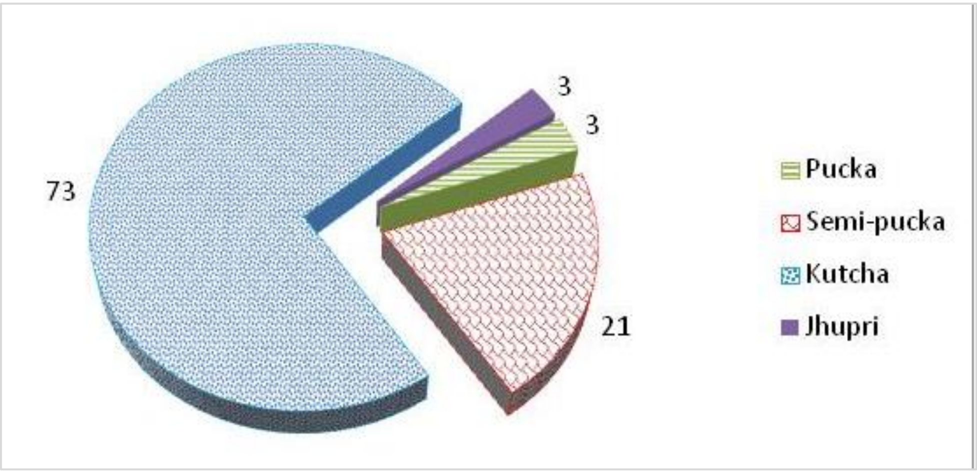
Source: BBS, 2011, BBS 2012

Figure 5.31: Age structure of the studied population

5.4.4 Settlement and Housing

Housing Structure

The BBS, 2012 showed that the majority of households used kutcha houses (73%) made by mud, straw and corrugated iron sheet (*tin*). The remaining housing structures were dominated by semi-pucka (about 21%) followed by pucka and jhupri as shown in **Figure 5.32**. The households resided in pucka houses (about 3%) were lower in compared national average, which was 10.37% as per HIES 2010.



Source: BBS, 2012

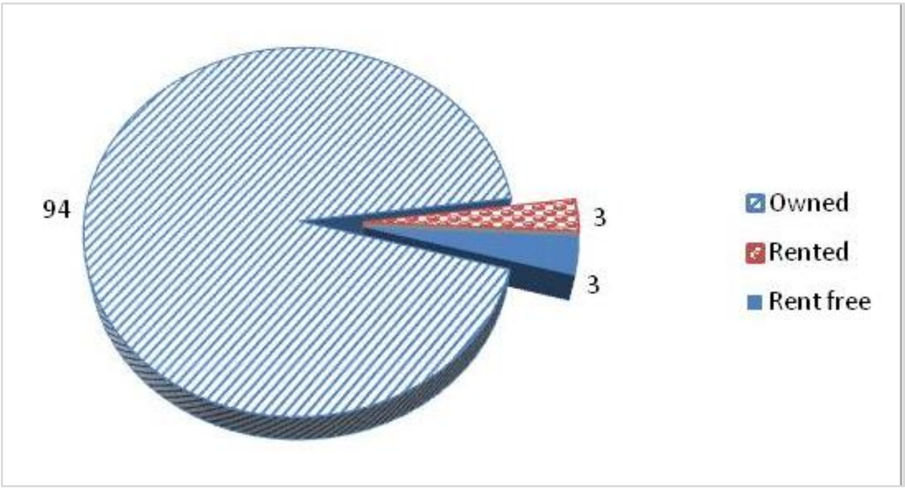
Figure 5.32: Type of housing structures in study area

Figure 5.33: Concrete stuctures will be demolished opposite side of the plant boundary

Figure 5.34: Structure in the project area

Housing Tenancy

According to the BBS 2012, most of the households (about 94%) resided in owned houses. A few percentage of people came from outside of the study area and lived in rented houses at Saidpur Paurashava and Kamarpur union in the study area (**Figure 5.35**).



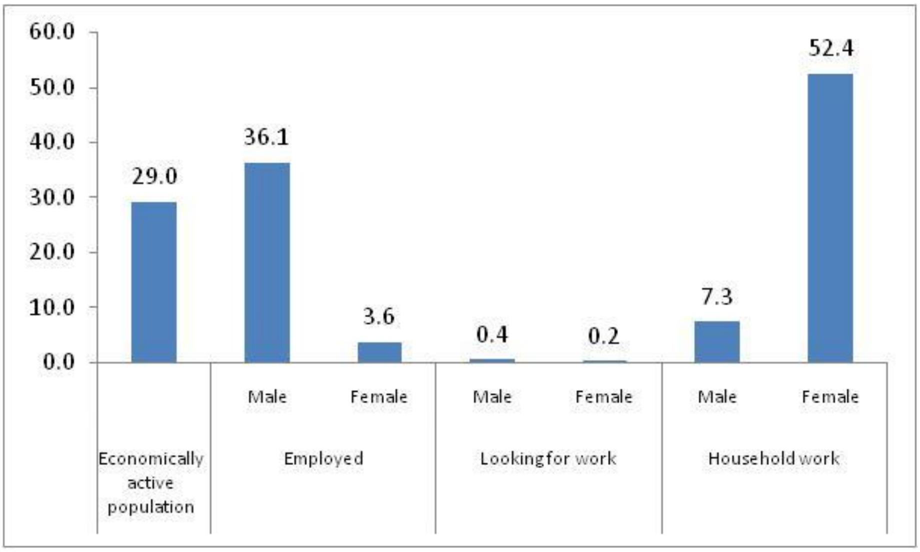
Source: Population and Housing Census 2011, BBS 2012

Figure 5.35: Housing tenancy in the study area

5.4.5 *Economy and Employment*

Occupation and Employment

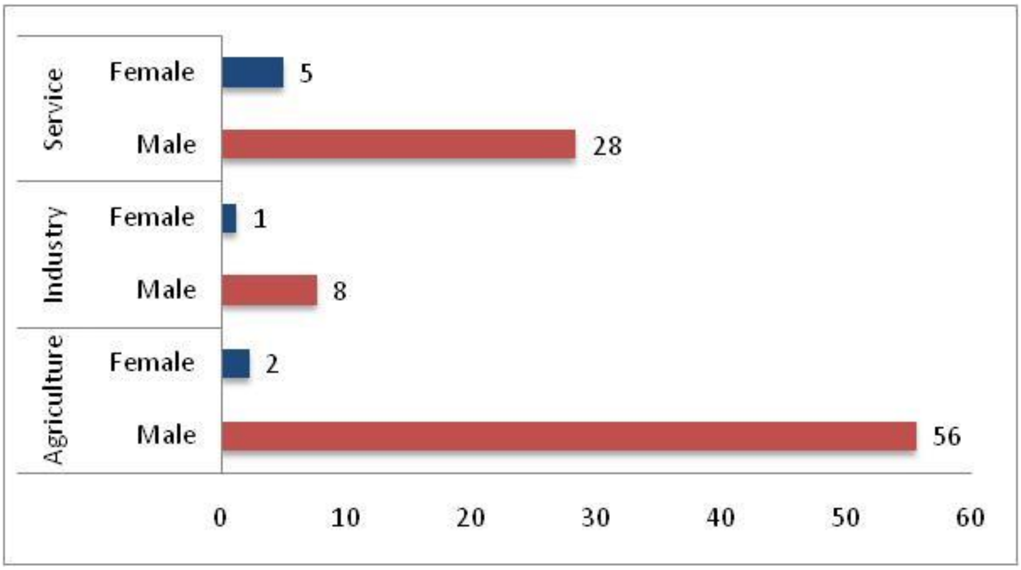
People aged over 7 years old and having scope of employment are considered in figuring out the status of occupation and employment. In BBS 2012, about 29% of total population were economically active in the study area of which about 40% were employed and 0.6% still looking for job. During field survey, people stated that both male and female are working in agriculture and non-agricultural field in the study area. The employment status of the study area is detailed out in the **Figure 5.36**.



Source: Population and Housing Census 2011, BBS 2012

Figure 5.36: Proportionate distribution of employment in the study area

As per the reference period of the 2011 census, distribution of occupational groups showed that 58% people were engaged in agricultural activities, followed by 33% in service (**Figure 5.37**). As per the information of HIES 2016, poverty rate of the "Agriculture, Forestry & Fisheries" professionals is highest (18.2% for lower poverty and 32.0% for upper poverty) compared to the other professions in the country. In the study area, farmers also expressed their dissatisfaction regarding profitability in rice farming and further mentioned that it was the prime reason why some of the farmers changed their profession to the small businessmen. In the study area, business on small local garments, dry fish whole selling, rice mill, sack factory, engineering workshops etc. have high potential in present days.



Source: Population and Housing Census 2011, BBS 2012

Figure 5.37: Proportionate distribution of population by field of activity

Labor market

The present wage rate varies between BDT 300 to BDT 350 per day for male agriculture laborer and BDT 400 to BDT 450 for non-farming labors (**Table 5.28**). As per the local people, as the wage rate is low in the study area, therefore laborers of this area out-migrated to other districts for laboring activities. Female are also highly engaged in farming and non-farming activities simultaneously with male counterparts in the study area but their wage rates are quite low compared to the male labors. It is noted that, the laborers are also provided a mid-day meal with the wage rate. Wage rate figures for male and female workers are provided in the table below:

Table 5.28: Wage rate of labors in the study area

Types of labor	Male wage rate (in BDT/day)	Female wage rate (in BDT/ day)
Farming Labor	300-350	150-160
Non-farming labor	400-450	150-180

Source: CEGIS fieldwork, 2019

Household income and expenditure

Household income and expenditure is categorized and presented in **Table 5.29**. It is found that, most of the households belong to Tk. 9,000 – 20,000 income and expenditure category. In the study area a considerable percentages of households is also belonging to the highest income category (more than BDT 20,000).

Table 5.29: Monthly income and expenditure level

Range in Taka	Percentage (%) of Households	
	Income	Expenditure
Less than 5,000	5	5
5,000 – 9,000	15	15
9,000 – 20,000	60	70
More than 20,000	20	10

Source: CEGIS fieldwork, 2019

Land Price

Land price in the Project mouza is high compared to the most of the other mouzas in Nilphamari District. This is so as the proposed Project area consists of the administrative area of Saidpur Paurashava and Bothlagari Union. The land price of these two administrative units are reflected in the following **Table 5.30**. In the two areas, land price is higher in the Paurashava area than that in Bothlagari Union.

Table 5.30: Land price two main units of the study area

Type of land	Land price (BDT/dec) in Saidpur Paurashava	Land price (BDT/dec) in Bothlagari union
Agricultural	80,000-100,000	60,000-80,000
Household land	300,000-350,000	150,000-200,000
Commercial land	500,000-550,000	300,000-350,000

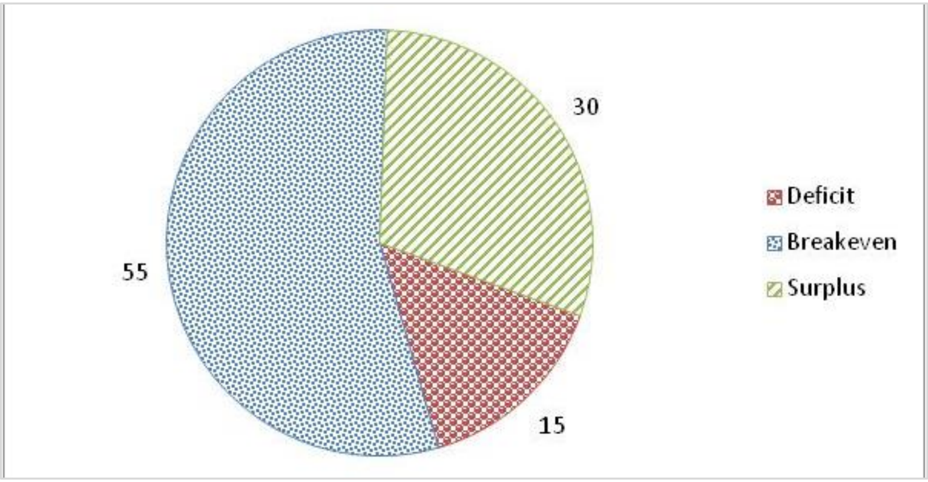
Source: Field Survey by CEGIS, 2019

Poverty Status

The household whose monthly income is below to the upper poverty (BDT 9,538) is considered poor. The national per capita income of Upper Poverty Line has been inflation-adjusted from 2011 to 2018 using Consumer Price Index (CPI) method of Bangladesh Bank. In accordance with household's monthly income (**Table 5.29**) in the study area, approximately 22% of total households (estimated 24,800 HHs) are estimated to live below the upper poverty line. However, local people provided satisfactory opinion in living in the study area as almost all the families can manage their food for at least three times in a day (RRA 2019).

Poverty is also measured through self-assessment of the local people in the study area. This measurement is mainly based on fiscal value. In this process the respondents were asked to evaluate the overall condition of people living in the study area. Their responses are assembled into three categories such as deficit, balance and surplus.

According to the observation of local people, on an average 55% of total households are in balance or breakeven category in the study area relying mainly on subsistence activities. (**Figure 5.38**). People also stated that around 15% of households belong to deficit category and these households have to borrow money to meet-up their family-need throughout the year.

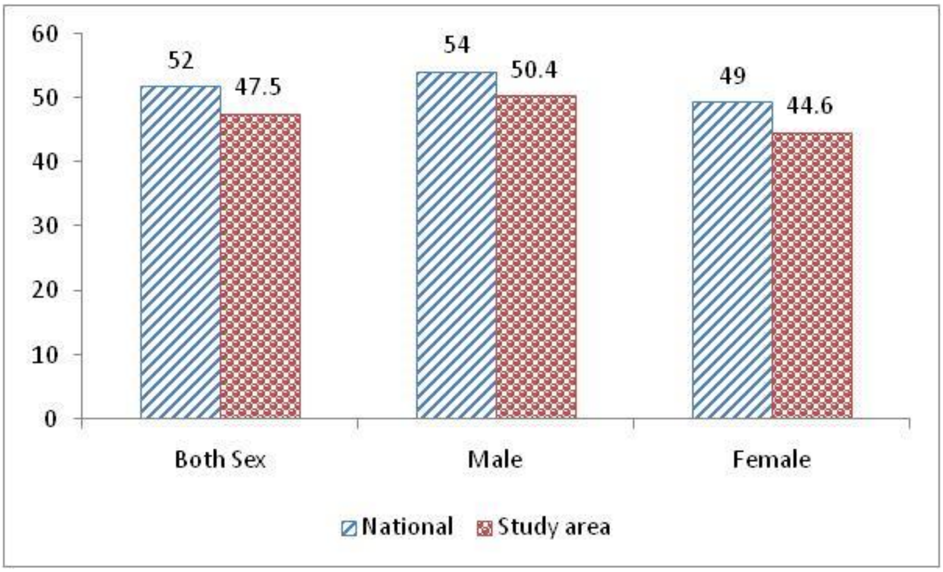


Source: RRA, 2016

Figure 5.38: Poverty status in terms of distribution of households in the study area

5.4.6 Literacy Status

The rate of literacy was reported for the population aged 7 years and above in BBS 2012, with a definition of "ability to write a letter in any language". In this context, overall literacy rate of the study area appeared to be lower than that of in national level both for male and female (**Figure 5.39**) However, the present field finding shows that literacy rate in all of the study union have tremendously increased over last few years and is higher compared to the national level of literacy rate (65.6% in HIES 2016).



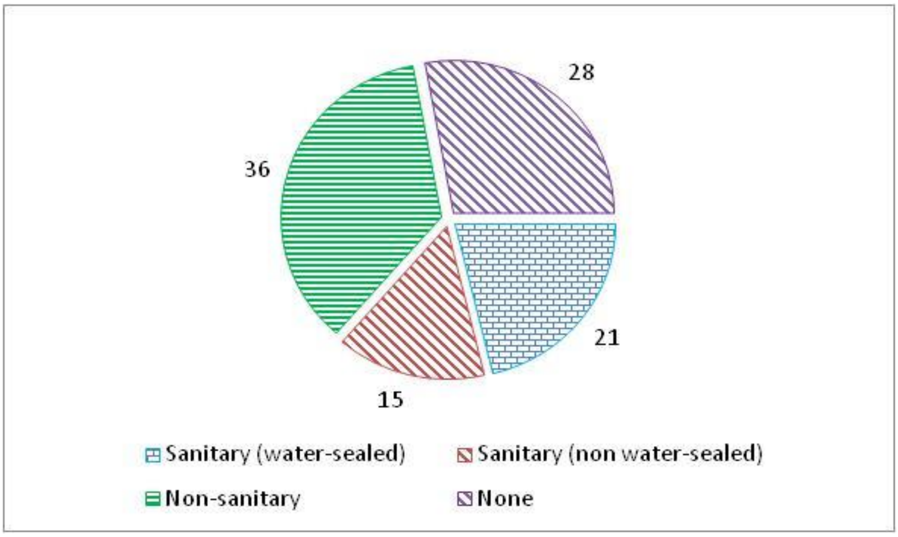
Source: Population and Housing Census 2011, BBS 2012

Figure 5.39: Distribution of Household by literacy rates

5.4.7 Public Utilities

Sanitation

Sanitation facilities in the study area showed that about 36% households used sanitary latrines of which 21% used water-sealed sanitary latrines (**Figure 5.40)** which is higher to the national level (18.37%) in HIES, 2010. The information of HIES 2016, reflects much improving feature with 25.61% of water-sealed sanitary latrine nationally while the present field survey also observed the similar pattern regarding water-sealed sanitary latrine in the study area.



Source: Population and Housing Census 2011 and BBS 2012

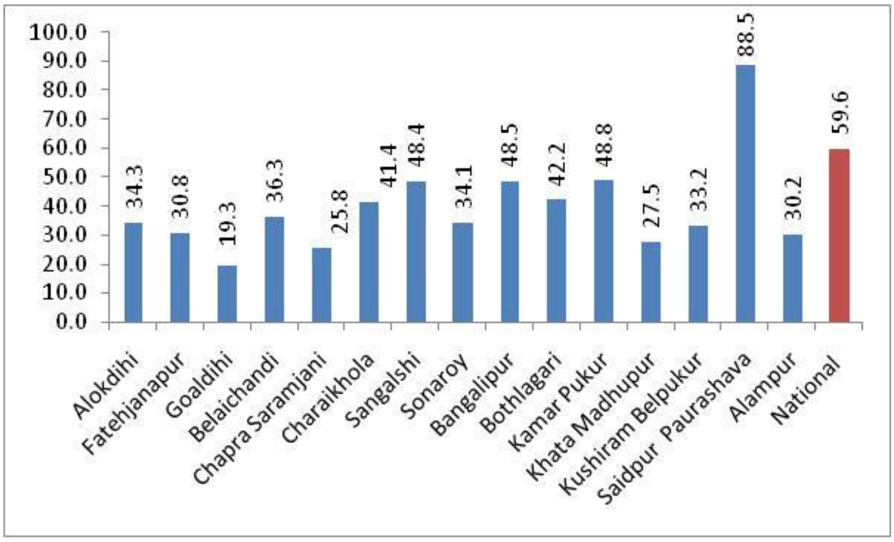
Figure 5.40: Sanitation facilities in the study area

Drinking Water

Collection of drinking water from tube-well was predominant (about 97%) throughout the study area where tab water was only about 1% mostly confined in the Saidpur Paurashava and from other sources it was about 2% in the deep rural area (Source: BBS 2012).

Electricity Coverage

As per BBS 2012, electricity coverage in household level was lower in the study area (except to the Saidpur Paurashava) compared to national level of electricity coverage, which is about 60% (**Figure 5.41**). During field survey, people responded that by 2018, most of the unions in the study area contained over 70% of electricity coverage. Among the unions, some have the full electricity coverage, which was a remarkable progress over last few years.



Source: Population and Housing Census 2011, BBS 2012

Figure 5.41: Electricity coverage in the study area

Traffic and Transport

Road communication through Divisional Headquarter (Rangpur) to Project area is quite good and all types of heavy and light vehicles are found operational on that road. The extension work of Dinajpur - Nilphamari Highway link road is progressing, which is creating disturbances to public movement but this a temporary matter and people accepted such disturbances considering the easement in future. This disturbance may arise from Dinajpur Highway and extend to the entrance gate of the proposed project site (about 400m).

There is no navigational network in the study area, except some small country boats, which are operating in the Khaddor River during monsoon for carrying crops mainly.

5.4.8 Community Access to Health

People living in surroundings areas of the project usually receive medical treatment from local pharmacy/dispensary, qualified and non-qualified doctor's chambers for general ailments. However, in case of emergencies, they obtain service from local government hospitals (union health complex, community clinic, 100-bed government hospital in Saidpur) and in case of inability to provide service, the patients rush to the Rangpur Medical. Some of the well-off households received services from private hospitals located in Saidpur Paurashava and Rangpur City.

5.4.9 Safety nets

About 54 NGOs worked in the study area with the objective of eliminating poverty, achieving women empowerment, employment generation, health facilities, environmental management and so on. Some of the highly successful NGOs are BRAC, TMSS, RDRS, ASA, SKS and so on. The main activities of these NGOs are providing loan, free health service, awareness build-up, skill development training and so on.

5.4.10 Sites of Important Properties

There are a primary school, a high school and a mosque in the BPDB compound area which are within 800 meter away from the proposed site. A picnic spot namely "Rangdhanu Park" is located about 3.5 km away from the project site. The Saidpur International Airport is located at about 5 km away from the project site. The railway junction and upazila complex are about 3.5 km to 4.0 km away from the proposed site respectively.

5.4.11 Social Relation

The local community are found to be residing in friendly environment and there was no major conflict among them. However, it was observed that there was dissatisfaction among the communities in close vicinity of BPDB area, as they reported installation of number of transmission towers rapidly decreasing their land value despite high demand of their land falling within the Paurashava area.

6. Stakeholder Consultation

6.1 Introduction

Stakeholder consultation is a definite initiative to ensure people's participation in conducting EIA study. Peoples' participation is regulatory part of EIA which is mandatory for getting Environmental Clearance in all 'Red Category' projects from the Department of Environment (DoE). Stakeholder consultation make the project proponent able to get opinion on the proposed project along with necessary feedback and input on the project intervention. Consequently, stakeholder consultation becomes a dictatorial issue of the EIA study to facilitate the participation of stakeholder concerned. The goals of stakeholder consultation are to promote people's understanding and acceptance about the proposed development activity and/or project/program; and to draw out a plan for minimizing potential negative impacts and/or enhancing positive impacts through participatory approach. Stakeholders' feedback is also used as a constructive input to improve project planning, design, implementation and O&M activities.

6.2 Regulatory Requirements

6.2.1 Bangladesh Guidelines

The EIA guideline formulated by DoE in 1997 (**Chapter 4, Section 4.11**) stated that since the general public is the ultimate recipient of the economic benefit and environmental damages, an EIA study should involve the public as part of decision making process development. To achieve effective public participation, it is necessary to communicate with as many people as possible, as early as possible and through as many different ways as possible. This requires pre-planning, resources, identification of target groups and several of techniques for effective communication.

6.2.2 Objectives of Stakeholder Consultation

The overall objectives of the stakeholder consultation for the ESIA study were to inform the local people about the project and make them interact with the proposed project activity by sharing their views and ideas about the interventions. The specific objectives of consultation are:

- To collect the opinion on proposed project design;
- To collect opinion on identification of probable problems and solutions that would be induced by the proposed project intervention;
- To share major outcomes of the proposed project;
- To collect people's perception about potential impacts of the project;
- To provide key information among important stakeholders to seek out valuable observation about implementation modalities of the project; and
- To seek probable indigenous suggestions on planning, design, implementation and O&M of the proposed project.

6.3 Approaches and Methodology of Consultation

A participatory approach was followed for carrying out the stakeholder consultation through (i) conducting Key Informant Interviews (KIIs) and official meeting with the BPDB plant officials; and Rapid Rural Appraisal (RRA) with local primary and secondary stakeholders. The consultants followed systematic process for facilitating those discussion sessions as mentioned below:

- Checklist used to maintain uniformity and relevancy in discussion and properly recorded the opinions and views of the participants;
- Socio-Economic, agricultural, hydrological, fisheries, and ecological issues were discussed in detail, including potential impacts of the interventions on environmental and social parameters;
- Stakeholder’s problems, possible solutions and their views on the project intervention were discussed showing necessary maps and figures.

A team of multidisciplinary experts led by the Socio-Economist visited the project site for collecting information and conduct consultations (RRAs, KIIs and formal/informal meetings) with the primary and secondary stakeholders. The consultant team showed project related documents, maps, figures and shared initial concepts on proposed interventions; and facilitated discussion for seeking stakeholder’s responses as well

6.3.1 Identification of Stakeholders

Stakeholders included all those who would affect and/or would be affected by policies, decisions or actions within a particular system. Stakeholders included groups of people, organizations, institutions and sometimes-even individuals. Stakeholders can be divided into primary and secondary stakeholder categories.

Primary Stakeholders

Land owner of the proposed project area as well as livelihood of the people depending on that land are considered the primary stakeholder of the proposed Project. BPDB is the only primary stakeholder for the proposed project. KIIs were conducted with the Saidpur BPDB officials.

Secondary Stakeholders

In this project, local community of different occupational groups, relevant government departments and line agencies working in the study area are considered as secondary stakeholders. Key Informant Interviews (KIIs) and Informal Group Discussions (IGDs) were conducted with the secondary stakeholders in the study area.

6.4 Details of Consultation Meetings

6.4.1 Informal Discussion

A number of occupational groups and other relevant stakeholders were consulted informally. These consultations were made on spot when the team was visited in the Project area. This was done to create awareness and clear any misunderstanding about the Project and eventually obtain support from the local communities to conduct baseline environmental, ecological, fisheries, and socio-economic surveys. No formal questionnaire was used rather peoples were consulted by the individual team member in terms of sectors (i.e. agriculture, fishery, socio-economic, etc.) to which he/she is assigned.

6.4.2 *Locations of Stakeholder Consultations*

A number of formal and informal consultation meetings/discussions were conducted at different locations in and around the proposed Project area.

Brief on KIIs and IGDs

KIIs were conducted with BPDB officials (Saidpur) for understanding about the proposed project and its proposed site. Also with UNO Saidpur, UP Member (Bothlagari), and councilor ward no 1 for seeking their opinion about the proposed project and for identifying probable challenge or problem regarding implementation of the proposed power plant project.

IGDs were conducted with villagers of Bothlagari, Sangalshi, Kamarpukur Unions and with surrounding communities of existing diesel pumping station at Railway. In IGDs, probable risks and problems as well as potential benefits, mitigation measures and outcome were briefly discussed, that can be occurred during implementation of the project.

Detail about the discussions are given in the following **Table 6.1**.

Table 6.1: Detail of KIIs and IGDs

District	Upazila	Union/ Paurashava	Mouza/ Village	Type of Consultation	Date	Participants (Nos)
Nilphamari	Saidpur	Kamar Pukur	Union Parishad Complex	IGD	18.02.19	10
		Paurashava	Pumping house, Railway station	IGD	18.02.19	8
		Paurashava	UNO Office, Saidpur	KII	19.02.19	UNO
		Paurashava	Ward Councilor office	KII	19.02.19	Councilor, Ward-1
		Bothlagari	Union Parishad Complex	KII	18.02.19	Ward Member
		Bangalipur	Union Parishad Complex	IGD	19.02.19	5
Nilphamari	Nilphamari Sadar	Sangalshi	Union Parishad Complex	IGD	19.02.19	8
Dinajpur	Chirirbandar	Fatehjanapur	Debiganj Bazar	IGD	19.02.19	5

6.5 Identified Issues discussed in Consultation

At the outset of the interviews and discussions, an overview of the proposed project including the ongoing activities of the implementing agencies and the necessity of EIA study was shared with the participants. Subsequently, the discussed key aspects regarding environmental and socio-economic issues are listed below.

- Civil engineering and water resources issues
- Hydrological issues of the river

- Cropping pattern, intensity and irrigation facilities
- Fish habitat and diversity
- Homestead vegetation, wildlife habitat, diversity and availability
- Occupation and employment
- Poverty
- Education (poor literacy rate, non-schooling, less female education, drop out etc.)
- Health and safety condition
- Quality of life (poor housing and sanitation facilities, drinking water, electricity supply, fuel and fodder etc).

6.6 People's perceptions and suggested measures

The findings of different aspects/ disciplines have been assembled as per the discussions with participants through KII and IGA. The findings help to identify people's opinion about the project and its potential benefit or negative impact due to project intervention.

The Executive Engineer, BPDB shared the perception about design of the proposed project and helped to identify the location of the proposed site. He stated that, risk of the proposed Simple Cycle Power Plant is minimal, as its fuel will be Diesel, and there have no discharge of cooling water for implementing the project.

The UNO Saidpur presumed that the proposed Plant will be more positive for economic growth of the study area, but the authority should have concern about the airport, cantonment, densely populated area and properly manage of the ETP.

As coal will not be used as the fuel of the proposed Project therefore all other interviewees (ward councilor, ward member etc.) positively accept the proposed Project, though they shared their concern about noise pollution and other safety security issues.

During IGD, people mainly highlighted the noise issue and sometimes accidental occurrence in transformer within the existing 20 MW Power Plant. They also appreciated the decision of using BPDB own land for constructing proposed 150 MW Power Plant, however some landowners are concerned about the transmission of the power which may affect lots of their productive land.

People of Kamar Pukur union stated that the proposed Project may open the scope of high tech businesses in the study area. Irrigation facilities will be improved due to incessant power supply. They also stated that except the medical facilities all other facilities are quite good in Saidpur even that of in Rangpur City Corporation. They assumed that they will get the facilities of gas soon as Prime Minister committed, so the availability of gas and electricity will definitely boom the economy of Saidpur.

A combined Table on diversified problems and solution found in formal and informal discussion is presented in following **Table 6.2**.

Table 6.2: Identified Problems and Suggested Solutions

Aspects	Problems/Concerned Issues	Suggested Solutions
Socio-economic	***Land Value*** • Land value of the plant surrounding area is lower compared to other land in that mouza. • Livelihood of some people will be affected while the power will be distributed transmitted through the towers. • Income depending on the land of project surroundings may be impacted.	• Project authority should consider the impact of the project to the densely populated area • The authority should minimal impact to the highly productive land and residential area as well • Corporate Social Responsibility (CSR) should be introduced from the beginning of the project.
	Environmental and Health Safety issue • Local ambient atmosphere • Medical facilities for treatment both in normal and accidental event • Aquatic habitat and future fisheries status • Solid and liquid waste in the plant area will be increased	• All types of environmental friendly technology should be introduced for this power plant project • Medical facilities need to be develop in BPDB premises for all types of PAPs • Should take necessary measure to sustain the aquatic habitat in the study area • Waste collection system should be developed and waste disposal facilities should be established.
Land and Agriculture Resources	• Land use would be changed due to the construction of power plant. • Soil quality would be disturbed due to the clearance of vegetation and dismantling wastes • Agricultural land might be changed to industrial and others infrastructural development	• Project related activities should be done sequentially. • The top soil from the vegetation areas should be preserved for re-use during plantation. • A local/regional plan should be prepared by the concerned Government Authority to guide the plan induced development and conserve agricultural land from the conversion. • Efforts should be made to use fallow land for new industrial development.
Ecological	***Biodiversity Conservation*** • Damage of terrestrial vegetation during site preparation; • Wildlife habitat destruction in the power plant and diesel pipeline sites; • Wildlife death due to construction activities; • Disturb to wildlife and their habitat by emitting high frequent sound during construction and operation phases	• Plan new plantation program to cover the loss of vegetation during construction of the project works around the Power Plant and Pipeline sites; • Put temporary boundary wall to avoid death of local wildlife residing on or adjacent to the project sites; and • Use low sound emission machines to minimize disturbance to wildlife and their habitat both construction and operation phases.

6.7 Photographs and participant List

Some photographs those were taken during consultation at different locations of field.

Figure 6.1: Consultations with stakeholders at the study area

Table 6.3: Participant List

SL	Name	Age	Occupation	Address/Mobile
1.	Mr. S.M. Kibria	35	UNO, Saidpur	01733-390666
2.	Mr. Md. Abu Said	38	Ex En, BPDB, Saidpur	01712-274931
3.	Mr. Rezaul Karim Lokman	50	Business, UP Chairman- Kamar Pukur	01721-219114
4.	Mr. Helal Chowdhury	40	Chairman, Bothlagari	01711-144324
5.	Mr. Abu Sayed Ali	55	Member Ward No. 2	Bothagari, 01737-794486
6.	Mr. Shahin	58	1 no. Ward Councilor, Saidpur Paurashava	01722-080145
7.	Mr. Atiur Rahman	55	Business	Kamar Pukur, 01719-207829
8.	Mr. Mukul	48	Teacher, Degree College	Kamar Pukur, 01741-456859
9.	Mr. Abdur Rahim	58	Chairman Assistant, Kamar Pukur	Kamar Pukur, 01795-024877
10.	Md. Maharul Islam	42	Farmer	Kamarpukur, 01937368608
11.	Md. Ansarul Islam	40	Farmer	Kamarpukur, 01722460046
12.	Mr. Abdul Matin	45	Furniture	Railway station Saidpur, 01713-744193
13.	Mr. Abul Kalam	52	Hawker	Railway station Saidpur
14.	Mr. Delowar Hossain	56	Mechanical staff,	Railway station Saidpur, 01936-902042
15.	Mr. Arman	30	Hawker	Railway station Saidpur, 01798-927678
16.	Mr. Babu	28	Business	Railway station Saidpur, 01400-536401
17.	Mr. Rafiz uddin	55	Mechanical, Railway workshop	Railway station Saidpur, 01733-038646
18.	Mr. Samsuzzaman	42	UP office assistant, Bothlagari	01764-973023
19.	Mr. Aminur Rahman	54	Office secretary, Bothlagari UP	01838-304651
20.	Mr. Nuruzzaman	45	Electrician	Bothlagari, 01719-515871
21.	Mr. Altaf	32	Mill worker	Bothlagari, 01723-712227
22.	Mr. Rashidul Islam	37	Mill worker	Bothlagari,
23.	Mr. Abu Sayed Ali	60	Businessman and Member, Ward-2 Bothlagari UP	Botlagari union, 01737794486
24.	Mr. Abdur Rahim	57	Farmer	Debiganj, Fatehjanapur,
25.	Mr. Shafiqul	35	Van Driver	Debiganj, Fatehjanapur, 01790-001693
26.	Mr. Jasimuddin	37	Rickshaw driver	Debiganj, Fatehjanapur,
27.	Mr. Gopal Chandra Roy	48	Paribahan Ticket Counter Manager	Debiganj, Fatehjanapur, 01767-235170
28.	Mr. Mizu Khan	32	Conter In-charge	01795-001080
29.	Mr. Julfiqar Ali	52	Business, Ward members,	Bangalipur UP, 01961-056191
30.	Mr. Sabed	50	Business, Ward members,	Bangalipur UP, 01726-420403

SL	Name	Age	Occupation	Address/Mobile
31.	Mr. Jahangir Alam	42	Village Police	Bangalipur UP, 01964-752270
32.	Mr. Abdul Mannan	42	Union Parishad Secretary	Sangalshi UP, 01710-630735
33.	Mr. Alam Hossain	27	Village Police	Sangalshi UP, 01768-908503
34.	Mr. Faridul Islam Sabuz	42	Business	Sangalshi, 01711-880180
35.	Mr. Fazlul Haque	62	Farmer	Sangalshi
36.	Md. Jahangir Alom	55	Businessman	Rabeya more, 01907766455

6.8 Public Disclosure Meeting

A formal Public Disclosure Meeting (PDM) was held at 10:30 am on 25th September, 2019 (Wednesday) at Union Parishad Conference Room. Admin officers from different occupational groups, officials from NGO and GOs, Journalist, Civil Sargent, BPDB officials related with this Project along with the local people those are affected were invited in this meeting. Local people were invited through poster (**Figure 6.2**) and advertisement in the local renown Newspaper named "[illegible]" (**Figure 6.3**). Different officials from GOs and NGOs were invited issuing the invitation letter. CEGIS representative visited them personally and invited all of them and also confirmed their presence in the meeting over phone. The date and the venue for the PDM were selected with the consent of the UNO, Saidpur. A power point presentation was presented in front of the participants on EIA findings. Discussion was lively and participants participated actively in the discussion. Some of them gave their valuable suggestions for the study. All the issues raised in the disclosure meeting and their responses are given in the **Table 6.4**.

Figure 6.2: Invitation of local people through poster

দৈনিক
করতোয়া
The Daily Karatoa

বিজ্ঞপ্তি

রূপকল্প-২০২১ অনুযায়ী পাওয়ার সিস্টেম মাস্টার প্লান, ২০১০ ও ২০১৬ এর আলোকে ২০২১ সালের মধ্যে দেশের সকল ঘরে বিদ্যুৎ পৌঁছে দিতে বর্তমান সরকার প্রতিশ্রুতিবদ্ধ। সরকারের এ লক্ষ্যে পূরণের উদ্দেশ্যে বাংলাদেশ বিদ্যুৎ উন্নয়ন বোর্ড (বিপিডিবি) নীলফামারী জেলার সৈয়দপুরে একটি ১৫০ মেগাওয়াট (±১০%) সিম্পল সাইকেল (এইচএসডি ভিত্তিক) বিদ্যুৎ উৎপাদন কেন্দ্র নির্মাণের কাজ হাতে নিয়েছে। উক্ত প্রকল্প নির্মাণের প্রেক্ষাপটে সম্ভাব্য পরিবেশগত ও আর্থ-সামাজিক প্রভাব নিরূপনের জন্য পানি সম্পদ মন্ত্রণালয়ের অধীনস্থ সরকারি ট্রাস্ট CEGIS-কে দায়িত্ব প্রদান করা হয়েছে। এরই অংশ হিসেবে সংশ্লিষ্ট বিভিন্ন সরকারি ও বেসরকারি প্রতিষ্ঠান এবং জনগনের সুচিন্তিত মতামত ও পরামর্শ গ্রহনের লক্ষ্যে আগামী ২৫ সেপ্টেম্বর ২০১৯ইং তারিখ, রোজ- বুধবার সকাল-১০.৩০ ঘটিকায় সৈয়দপুর উপজেলা পরিষদ সম্মেলন কক্ষে একটি মতবিনিময় ও অবহিতকরণ সভার আয়োজন করা হয়েছে। উক্ত সভায় উপস্থিত থেকে এ বিষয়ে আপনাদের সুচিন্তিত মতামত প্রদান করার জন্য সবিনয় অনুরোধ করা যাচ্ছে।

আহ্বানে
প্রকল্প পরিচালক

পি-৩৯২৩/১৯

Figure 6.3: Advertisement in Daily Newspaper

Table 6.4: Issues raised in the meeting and response

Sl. No.	Name of the Respondents	Comments	Responses
1.	Mr. Raj Kumar Poddar, Owner, Aluminium Ware Factory	1. Having scarcity, ground water uses for the power plant should be discouraged;	The nearest Rivers the Chikli and the Kharkharia are 5 km and 3 km away from the proposed Power Plant site. Moreover, these rivers suffer from unavailability of water at some segments during the period of November to June. Therefore, it is difficult to use these river water for the Plant and potable purposes. Hence, it is better to use ground water as it required a negligible water for the Plant and related other purposes.
		2. Reservoir should be constructed for retaining monsoon water for power plant use as ground water is scarce;	The nearest Rivers the Chikli and the Kharkharia are far away from the Plant site which is difficult to carry water from those rivers. Moreover, it may require double lifting technology to store these water in the reservoir, hence, it will be expensive.

Sl. No.	Name of the Respondents	Comments	Responses
2.	Shahina Begum, Agriculture Officer (Addl. Charge) DAE, Saidpur	1. Local people living close to the Power Plant use ground water for drinking and household purposes and also use this water for irrigation purposes. Currently they are facing severe water scarcity due to drawdown effect of excessive ground water extraction. Reasonably, they use submersible pump for drawing ground water as it is a sole source of domestic water.	Refer to: **Section: 4.2.4**: Ground water 1. From the study it has been found that, the present ground water recharge rate is 720.418m^3/day. On the other hand, proposed Plant will extract 11 m^3/day which is only 1.53% of the present recharge rate. Therefore, this will not deplete the water table. Thus, groundwater may safely be withdrawn without affecting the water table of the study area.
		2. Increase water room in the Chikli River for ensuring surface water supply to the Power Plant.	Government has the provision of implementing wetland restoration program all over the country under the auspices of the Ministry of Water Resources. Once the program is implemented surface water may be available in Chikli and Kharkharia River. Accordingly, the proponent may arrange surface water for the proposed Power Plant in the reservoir at the Plant site. However, both the rivers are far away from the proposed Project site, it might be difficult to store this river water for the Plant by using double lifting technology which is also very expensive.
		3. From the pollution point of view, consider natural gas as an alternative fuel since there is a gas pipeline installation program in this area.	If the Gas Pipeline construction is completed before the expiry of the Plant's economic life, the present oil firing system can be replaced by gas firing system with a small modification of firing system in the combustor.
3.	Md. Moksedul Momin, Upazila Chairman, Saidpur and Md. Azmal Hossain, Vice Chairman, Saidpur	1. In Saidpur Upazila there are 5 unions in which Bothlagari Union faces water scarcity more and the Power Plant to be installed in this union will aggravate the situation. Moreover, this year, Water scarcity at Ward no. 7, 8 and 9 emerges in October. So, the proponent should seek other provisions of water source.	The proposed Power Plant will have Closed cooling technology and requires a minimum quantity of water which is about 11m^3/day or 0.45 m^3/hr (**Section 3.6.1**). Moreover, considering the number of local and expatriate labors, officials and others in different phases, around 42.45 m^3/day of water is required for potable and other purposes. Ground water availability calculation carried out under **Section 5.2.4** reveals that in total, around 54 m^3/day of groundwater may easily be

Sl. No.	Name of the Respondents	Comments	Responses
			withdrawn over the entire life span of the Plant without affecting the existing domestic use within the influenced area.
4.	Sani Khan Majlish, Senior Upazila Fisheries Officer, Saidpur	1. In lieu of ground water, use of surface water from the river and canal for the cooling and other purposes of the proposed Power Plant may hamper the aquatic biodiversity including planktons. How did the study consider this issue?	Use of surface water for the Plant use is remote considering current situation of the surface water availability. Therefore, impact on Plankton and aquatic biodiversity in this regard is out of question.
		2. Is there any financial analysis of gain and loss of fisheries due to installation of the proposed Power Plant?	There is no surface water body near the Plant site. Ground water will be used for meeting of the Plant requirement. The ground water assessment suggested that the available recharged water is much higher than that of the power Plant withdrawal. This will not hamper the local aquaculture pond. Therefore, the financial analysis of gain and loss of fisheries in connection to the Plant deemed redundant.
5.	DPHE official	1. Excessive ground water extraction has been causing aquifer loss and currently it needs to install submersible pump up to 200 ft. (about 60 m) depth.	According to the Ground water availability calculation carried out under **Section 5.2.4**, the required amount of groundwater (**Section 3.6.1**) for the Plant and other relevant purposes, may easily be withdrawn over the entire life span of the Plant without affecting the existing domestic use within the influenced area.
		2. Area of influence due to ground water extraction should be covered in the Report.	Ref to the **Section 5.2.4**
		3. Aquifer test should be conducted under this study for ascertaining the ground water availability.	In detailed design phase of the Plant EPC contractor will conduct necessary test for assessing the ground water availability at the Project area for the set-up of deep tube-well.
6.	M. M. Rezaul Haque, Program Manager, SEDOP, Saidpur	1. Is there any possibility of discharging warm water to the open environment? If yes how it will be managed environmentally?	No warm water will be discharged to the atmosphere reference to the **Section 3.6.1**.
		2. Replenish tree felling through adequate plantation.	Refer to Green Belt Development **Section 9.8.10**.

Sl. No.	Name of the Respondents	Comments	Responses
7.	Dr. Md. Rafiqul Islam, Upazila Livestock Officer (In Charge), Saidpur, Nilphamari	1. There is a prevalence of lung disease of goat. So, air quality issue and its impact on the livestock should be covered in the Report.	Increase of SPM beyond permissible limit in air affects respiratory system of human being and other animals by damaging lungs leading to asthma, bronchitis and other lung diseases. To keep SPM at low level the Project area will be covered with grass. Water will be spade periodically in the open spaces to reduce dust spreading. IN addition to that, green belt will be developed in and around the Project area.
8.	Meherunnisa, Journalist correspondent, “The New Nation”	1. Employment opportunity for the local people should be emphasized.	Refer to **Section 3.14**
		2. To what extent, socio-economic factors are covered in this study?	Socio-Economic characteristics like basic demography, settlement and housing, public utilities, economy and employment status and other relevant socio-economic features in the study area are covered in the **Section 5.4**.
9.	Parimal Kumar Bishwas, AC land Officer, Saidpur	1. Consider dual options for water supply i.e., surface water during monsoon by constructing reservoir and ground water in dry period.	Refer to **Section 9.9**: It is suggested to create reservoirs along with the provision of rainwater harvesting facilities as per the BNBC so that water can be reserved during wet period which may be used for the Power Plant cooling system and other purposes.
		2. Increase water room in the Chikli and the Kharkharia River for ensuring surface water supply to the Power Plant.	The nearest Rivers to the Project site, the Chikli and the Kharkharia Rivers suffer from unavailability of water at some segments during the period of November to June. Therefore, the river system may be managed by prolonging water retention period, creating water room. Moreover, as the nearest distances of the Kharkharia and the Chikli River from the proposed Power Plant are about 3 km and 5 km respectively.
		3. Mention the standard of noise level and explain reasons of exceedance of noise level at the power plant school site.	Refer to **Section 5.2.3** and **Section 7.6**: Noise level have been measured at six locations including silent zone, residential area and commercial area within the Study area and found exceedance from the Standard at two locations which is under the silent zone. The level was measured when the school was running, hence, the level was slightly exceeded at that place. For

Sl. No.	Name of the Respondents	Comments	Responses
			attenuating noise, construction of boundary wall has been suggested around the Project site which is mentioned in the Report. Green belt development around the Project site also has the attenuating role.
		4. Prescribe proper mitigation measures for avoiding sludge induced water contamination.	Refer to the **Section 3.10.6**.
		5. Consider aerodrum in fixing chimney height of the Power Plant	Refer to the **Section 3.6.1**: As per Bangladesh Civil Aviation Authority (BCAA), permissible limit of the chimney height for the proposed Power Plant is 260 feet including plume. From the air quality modeling output the required chimney height of the Plant would be about 160 feet (50 m) which is within the permissible limit.
		6. What should be the nearest safe distance of settlement area from the power plant? Does there any provision of compensation of the nearby dwellers?	By definition there is no safe distance for the settlement. However, from noise modeling output it is found that intensity of noise diminishes after propagating a distance of 150m from the source point.
10.	Mohammad Ekramul Haque, Muktijuddha commander, Saidpur	1. Local people and other sectors of the area if not hampered by the Power Plant, people will be supportive to the Project.	**a.** Refer to the **Section: 3.1:** The proposed Power Plant will be built on modern and advanced technology which will emit very low noise and pollutants to the environment, hence, it is an environment friendly Plant. Therefore, it is assumed that the Plant will not keep any significant adverse impact to the local people and environment. **b.** Refer to the, **Section: 7.6, Table 7.18** (Social Environment)**:** The Power Plant will engage local people in its every phase based on their skills. This will accelerate the local economy and the livelihoods.

Figure 6.4: Some Pictures of Public Disclosure Meeting

7. Environmental and Social Impacts and Mitigation Measures

7.1 General

The proposed new 150 MW ±10% HSD-based Simple Cycle Power Plant will be constructed within the boundary of the Saidpur Power Station (SPS). All the sensitive receptors including settlements, educational institutes, religious places, eco-elements, industries, airport were in under consideration while describing the baseline condition of the proposed project site and the study area. The proposed major activities for the proposed power plant will involve construction of labor-shed for labor accommodation in the project site or renting accommodation, site preparation, transportation of machinery and ancillaries, storage of equipment and materials for construction, civil works (in-terms of construction of foundation structures), gas turbine, civil structures decommissioning (including removal of foundation), segregation of hazardous materials etc. which may cause some environmental consequences. Among the impacts from the proposed activities, some are temporary or short-term in nature and limited to pre-construction and construction period, and others are permanent in nature during the operation period. The estimated life cycle of HSD based Power Plant is considered 25 years. Potential environmental and social impacts were identified on the basis of the review of feasibility reports, field visits, environmental quality baseline monitoring, ecological, agricultural and fisheries surveys, and stakeholder consultations.

7.2 Selection of IESCs

7.2.1 Physical Environment

Air Quality

Dust Generation

Ambient air quality might be considered an IEC as it would be generated from the site preparation & construction phases of the Project. Particulate matters (PM) e.g. PM2.5, PM10 including DSM might be increased due to exposure of loose soil during construction, demolition, removal of debris, vehicular movement, landfilling and relevant activities.

Exhaust Emissions

Existing power plant, brick kilns, vehicular movement, cooking, etc., are responsible for increasing the baseline concentration of criteria pollutants in ambient air. Exhaust emission from the movement of heavy equipment by large vehicles; installation of diesel pipelines; operation of diesel generators and other diesel based construction machineries during construction phases may deteriorate the air quality. Moreover, processing of diesel fuels during operation phase may generate volatile chemicals including different types of organic compounds. Considering all, air quality has been considered as IECs in this study.

Ambient Noise Level

Ambient noise level of the Project area and nearby study area is expected to increase during the construction and operation period of the Project. Such increased noise level may impact the local inhabitants and the environment. Hence, ambient noise is considered as an IEC.

Waste Generation

Non-hazardous waste generation

Considering the amount and type of waste generated demolition of structures, land development activities and construction activities, generated wastes may impact on the environment, hence, it is considered as an IEC.

Hazardous waste generation

Liquid wastes may be generated due to demolition of oil tanks in the pre- construction phase and from cooling tower blow down, water from leaks and vents, wastewater from turbine floor and workers' colony and offices and oily water separation unit during operation phase. It is important to dispose and maintain this waste properly otherwise it may washout to nearby low laying land which may have an impact on the aquatic ecosystem. Considering the amount and type of waste generated, it is considered as an IEC.

Water Resources

Drainage

The impact on drainage during pre-construction and construction period is significantly low. Waste water will be generated from demolition of existing structure and construction activity. Besides, household and official activities will also generate scanty amount of waste water. Therefore, drainage is considered IEC.

Land Resources

Agricultural Land Use

The project area is non-agricultural land and power plant will be constructed in this land. The construction of the power plant might increase the number of industries along with amount of industrial activities based on the source of power from the new power plant. It might cause change in agricultural land use in future. Hence, it has been selected as an IEC.

7.2.2 Biological Environment

Agricultural Resources

Crop Production Loss

Construction of the proposed power plant would increase the availability of electricity in the study area due to this area will be power hub in future. This might influence to change the land use pattern of the project as well as the study area through establishment of new industries. Valuable agricultural land might be converted to non-agricultural development through construction of industries or other infrastructure. Therefore, crop production would be hampered. As such, crop production loss has been considered as an IEC.

Ecological Resources

Terrestrial Vegetation

Any intervention will have impact on the existing status of the environment. The proposed project is located within the terrestrial ecosystem with different terrestrial vegetation are susceptible to interventions. In this case, setting of construction machines and offer other related necessary activities may change their status. Therefore, terrestrial vegetation has been identified as an IEC.

Wildlife Habitat

The wildlife habitat is the composition of different dense vegetation of any given area. During project site preparation the existing micro and /or macro habitats may be changed for site clearing for construction works. As a consequence, it would incur changes to the existing wildlife habitat as well as wildlife species, too. Hence, wildlife habitat has been taken as an IEC.

7.2.3 Socio-economic Environment

Disturbance for Local People and Workers

Noise of dismantling the existing structures as well as construction activity may generate noise which may disturb to the local community living in the close vicinity of the project area. As it was also currently found that the operation of the existing power plant generates noise, to which the exposed local people are feeling disturbed, particularly during the night time. Therefore, this has been selected as an ISC.

Health and Safety

Different types of risky and hazardous activities can be conducted during dismal of existing structure and construction activity of the proposed power plant. In this regard, ensuring health and safety of working labors and local community can be the main concern. Thus, health and safety is considered as an ISC.

Employment Generation

During the construction phase, a considerable number of manual and technical workers will be needed for land preparation, land development and other associated activities; which, eventually, will likely to generate employments for local people. Therefore, this has been selected as an ISC.

Traffic Management

Movements of vehicles for carrying necessary equipment as well as other construction materials will increase which may cause congestion in the nearby bypass road. Therefore, traffic management has been selected as an IEC.

7.3 Environmental Impacts during Pre-Construction

7.3.1 Ambient Air Quality

Average recorded baseline concentration of $PM_{2.5}$ in dry season is relatively higher compared to both ECR as well as IFC standard. Although baseline concentration of PM_{10} was recorded within acceptable limits, the concentration of that pollutant has been observed significant enough within the project airshed. During the Pre-Construction stage, major sources of dust emission in this area are paved and unpaved Roads, pollen and construction activities. Existing power plant, brick kilns, vehicular movement, cooking etc., are also responsible for increasing the baseline concentration of air pollutants. Demolition of civil structures and materials handling, clearing of vegetation and transportation activities before construction may contribute for further air quality deterioration. Emission of dust may increase health risks due to particle inhalation.

7.3.2 *Impact on Ambient Noise*

Site preparation works like demolishing of some existing structures, clearing bushes, felling of trees, removal of debris, cutting and filling and levelling of some pools, puddles and rat holes etc. will be performed. Demolition activities would lead to an increased noise level, particularly during daytime. On top of that, heavy movement of traffic and machineries would collectively raise the noise level significantly. Unless the situation is properly taken care off, this increased noise level due to demolition and construction activities could lead to disturbances, increased stress level, increased blood pressure and other health complications to the staffs, workers, nearby communities and local people.

7.3.3 *Impact on Water Resources*

Drainage: The impact on drainage during pre-construction is due to demolition of existing power plant and office buildings. The debris generated from the demolition may hamper the drainage flow of the project area for a certain time but will not affect the drainage of the entire study area. The overall drainage impact in the study area regarding demolition is negligible.

Ground water withdrawal: Referring to the **section 3.6.1** and **5.2.4** (ground water part) it is revealed that, potable water for drinking and other uses would be withdrawn from ground which is negligible amount compared to the recharged ground water amount. Therefore, it will not hamper surrounding ground water uses including domestic use.

7.3.4 *Non-Hazardous Waste Generation*

During pre-construction phase, a huge number of debris would be generated due to demolition of existing structures. Besides, sewage solid waste and liquid waste will also be generated from the temporary settlement of labor shed. Other wastes like perishable waste, plastic, papers, metal or plastic binders, etc. may be generated in this stage.

Solid Waste

Demolishing of existing structures, old oil tanks as well as sludge pond will be done in the pre-construction stage. Afterwards, land development would require clearing of debris generated from the demolition works and clearing of existing vegetation like bushes, fruits, timber and medicinal plants within the proposed Project site, which would eventually generate a huge amount of vegetation and wooden debris. Disposal of such wastes and scraps demands good housekeeping, good management and safeguarding to environment.

There would not be any major pollution from this waste. However, the impact would be for a temporary period, limited within the Plant premises, reversible and may happen only in worst-case scenario (i.e. no management of solid waste). On the other hand, the impact on the residents of the Power Plant is low as it can be easily mitigated by adopting proper waste management plan. Significance of the impact would be **minimal adverse** and needs to be controlled by adopting Environmental Code of Practices (ECPs).

Kitchen waste

About 125 number of laborers for demolition works with 10 mangers to monitor the demolition works and 100 number of laborers for site development works and 10 managers to monitor site development activities will be engaged during pre-construction. In the site development period, out of total number of workers, around 75 people will live at the labor shed would be constructed by the EPC contractor outside the Project site. Rests of the workers will be recruited locally. **Table 7.1** below shows the estimation of kitchen waste during pre-construction and land development period.

Table 7.1: Estimation of Kitchen Waste during Pre-construction and Land Development Period

Sl No	Economic Classes of Employee	Project employee/Worker	Rate of kitchen waste generation (kg/ day/ capita)*	Total generated waste (kg/ day)
1	High Income Group (>20000 tk/month)	10	0.44	4.4
2	Low Income Group (< 10000 tk/month)	125	0.27	33.75
	Total	**135**		**38.15**

Source: (JICA, Pacific Consultant Internationals, & Co, 2005)

It is estimated that around 38 kg of kitchen waste will be generated each day from the labor-shed and employee's residents. Careless disposal of these wastes would create pollution, odor problem, nuisance and aesthetic tiring. However, the impact would be for a temporary period, limited within the labor shed premises, reversible and may happen only in worst-case scenario (i.e. no management of kitchen waste). On the other hand, sensitivity of this impact to the residents of the proposed Power Plant is high as presently there is no Kitchen Waste Management System. Thus the significance of the impact would be Medium adverse and needs to be minimized by EMP.

Sewerage

During pre-construction, roughly 75 number of laborers would be living at Plant site as residence (24 hrs period) and rests of the laborers would be day laborers for demolition and land development activities. It is estimated that maximum 5.0 m^3 [Considered as 0.29 wt. (kg)/ person/ day and 312 L/day per capita for Lower Income Group; and as 0.6 wt. (kg)/ person/ day and 264 L/day per capita for Higher Income Group] sewerage would be generated from temporary labor sheds and officers' residence in six months period. A small portion of this sewerage may escape sewerage collection and disposal system. The fecal sludge would go to the existing septic tank and septic tanks of the temporary toilets constructed for laborers. The laborer contractor would consider the volume of generated estimated organic waste before construct the septic tank.

This added sewerage from the officers' residence would not have any significant impact on the existing sewerage system and the sewerage coming from the labor shed is expected to be managed properly by following the Schedule 9 of the ECR, 1997. The magnitude of the impact would be minor and sensitivity would also be low. Thus significant of the impact would also be minimum adverse and can be easily controlled by adopting ECP.

7.3.5 Impact on Ecological Resources

Terrestrial vegetation: In the process of site establishment, it requires some works like site preparation, labor shed, sanitation and approach road to facilitate transportation of goods for construction works. A large number (n=94) of fruits, timber and medicinal plants need to be cut within the project boundary. In addition, other project sites i.e. diesel and gas transmission lines to be developed for the fuel consumption of proposed power plant will require removal of herbs exist in the proposed locations from railway station to Power Plant site. It is mentionable that gas transmission to the project site will execute later subject to availability of gases. The impact associated with the activities in this phase will incur major adverse to this IEC and it will be non-reversible.

Wildlife habitat: The vegetation occurs in the project sites is home to small number of birds and found perching in tree branches for taking sunbaths. The mammal like Common Mongoose (*Herpestes edwardsii*) frequently visit these project sites. It is anticipated that during site establishment process the above-mentioned wildlife habitats and their movement will fall disturbances. Therefore, impact related activities in this phase will be on wildlife habitat moderate and non-reversible.

7.3.6 Impact on Social Environment

Displacement of quarter dwellers at project site: Noise of dismantling the existing structures may disturb to the local community living in the close vicinity of the project area.

Health and Safety: Different types of risky and hazardous activities can be conducted during dismantle of existing structure in the proposed power plant. In this regard, it is necessary to ensure health and safety of working labors and local community. Also, transportation of heavy vehicle, carrying construction materials may cause accidental occurrences.

7.4 Environmental Impacts during Construction

7.4.1 Ambient Air Quality

During Construction stage, dust will be generated from transportation activities, excavation of soil to create building and equipment foundations, stockpiles of materials, waste, loose earth, handling and moving excavated material, transporting wastes on vehicles etc. If dust concentration becomes noticeably higher, it may increase health risks due to inhalation of particulates. Exhaust emissions may result from movement of heavy equipment by large vehicles, installation of diesel pipeline, operation of diesel generators and other diesel based construction machineries.

7.4.2 Impact on Ambient Noise

The noise generated from different stationary (concrete mixture machine, grinding machine, piling, etc.) and mobile sources during the construction period may have adverse impacts on the existing acoustic environment. Prolonged exposure to such high noise might create disturbances, hearing difficulties, discomfort, loss of concentration, high blood pressure etc. among the workers, site engineers and nearby residents.

7.4.3 *Impact on Water Resources*

Drainage: The Power Plant, stations and control unit, storage sections, disposal zone etc. will be constructed at this stage. The drainage in the Project area may be affected due to stocking of construction materials, sand dumping and malfunctioning of the drainage system. However, no impact would occur on drainage in the study area.

Flooding: No impact would occur on flooding within the project site. Although floodwater appears in the agricultural lands of the study area, the water drains smoothly. Therefore, the overall effect of flood in this area is negligible.

Ground water withdrawal: Referring to the **section 3.6.1** and **5.2.4** (ground water part) it is revealed that, potable water for drinking and other uses along with construction purposes a minimum ground water would be withdrawn which is negligible compared to the recharged amount of ground water of the studied area. Therefore, it will not hamper surrounding ground water uses including domestic use.

7.4.4 *Impact on Water Quality and Quantity*

River Water: There is no available source of surface water near the project site. Therefore, there will be no effect regarding water quantity.

Ground Water: The construction activities would require groundwater. Since, the annual groundwater recharge within the project area is high compared to withdrawal; there would be no impact on groundwater quantity.

7.4.5 *Non-Hazardous Waste Generation*

During construction phase, different types of non-hazardous solid and liquid waste would be generated due to construction activity (civil, mechanical and electrical). Besides, large amount of construction wastes including unused construction materials, debris, abandoned or broken machine parts, kitchen wastes, plastic, papers, cock sheet, cartons, etc. from construction site and labor sheds will be produced. Considering the amount and type of waste generated, the impact may be reversed through implementation of appropriate mitigation measures.

Solid Waste

During construction, large amount of construction waste that includes unused construction materials, construction debris, excavated spoils, abandoned or broken machine parts, debris, kitchen wastes from labourer sheds, packaging materials, used home appliances, etc. will be produced. Moreover, food waste, plastic, papers, cock sheet, cartons, metal or plastic binders, etc. may be produced as solid waste during this stage. If these wastes are not disposed and maintained properly, these would have impact on surrounding environment. Space for storage and disposal of stuffs and materials generated along with old and used equipment and materials is limited.

Unarranged piling up and disposal of construction waste will cause unhealthy situation in the area and become visual tiring. If not properly managed, this impact would remain during the life span of the Project but would be extended within the plant premises only. The impact is reversible. It is very likely to take place if proper management is not adopted, which is the requirement of national and international environmental regulations. Considering all of these, it can be assumed that the magnitude of the impact would be moderate. Sensitivity of this impact would be medium as the proposed Power Plant has the capacity to mitigate this impact by improving existing waste management plan. From the analysis of sensitivity and magnitude, it is apprehended that the significance of the impact would be moderate **adverse**.

Kitchen waste

During construction, it is assumed that around 230 labors along with 40 personnel are from EPC contractor, 10 persons from Owner's Engineers, supervision consultants, environmental consultants, BPDB will be living at site and rests will be day labor.

Table 7.2 below shows the estimation of kitchen waste during construction period.

Table 7.2: Estimation of Kitchen Waste during Construction Period

Sl No	Economic Classes of Employee	Project employee/ Worker	Rate of kitchen waste generation (kg/ day/ capita)*	Total generated waste (kg/ day)
1	High Income Group (>20000 tk/month)	50	0.44	22.0
2	Low Income Group (< 10000 tk/month)	230	0.27	62.1
	Total	**270**		**84.1**

source: (JICA, Pacific Consultant Internationals, & Co, 2005)

It is estimated that around 84 kg kitchen waste will be generated each day from the labor-shed and employee's residences. Careless disposal of this waste would create pollution, odor problem, nuisance and aesthetic tiring. However, the impact would be for a temporary period, limited within the plant premises, reversible and may happen only in worst-case scenario (i.e. no management of kitchen waste). On the other hand, sensitivity of this impact to the residents of the Power Plant would be comparatively higher if there is no Kitchen Waste Management System at Saidpur Power Station (SPS). Thus the significance of the impact would be **Medium adverse** and needs to be minimized by EMP.

Liquid Waste and Sewerage

During construction period, it is estimated that maximum 95.2 m^3 [Considered as 0.29 wt.(kg)/ person/ day and 312 L/day per capita for Lower Income Group; and as 0.6 wt.(kg)/ person/ day and 264 L/day per capita for Higher Income Group] sewerage would be generated from temporary labor sheds and officers' residence in around 2.5 years period. A small portion of this sewerage may escape sewerage collection and disposal system. The fecal sludge would go to the existing septic tank and septic tanks of the temporary toilets constructed for laborers.

This added sewerage would not have any significant impact on the existing sewerage system. The magnitude of the impact would be moderate and sensitivity would also be moderate. Thus significant of the impact would be **medium adverse** and needs to be controlled by adopting EMP.

7.4.6 Impact on Ecological Resources

Terrestrial Vegetation: It is anticipated that transportation of construction material and labor movement will deteriorate the status of the terrestrial vegetation along the roads because the construction materials will only be transported through a roadway. In this sense, vegetation occurs especially herbs are considered to be damaged during loading construction materials and labor movement in the loading locations and the way of transportation. In addition, transport of construction goods is responsible for spreading airborne particles which creates adverse impacts to plants in their transpiration system by blocking stomata which are functioning in physiological process in the healthy environment. This negative impact is supposed to be temporary and action ensure can minimize it.

Wildlife habitat: The wildlife habitats exist around the project area will receive negative impacts through transportation, labor movement and construction machines. The transportation is responsible in the same way of producing dust particulates to the nearby habitats of small wildlife. Similarly, construction machines generated high emission sound will disturb on wildlife daily activities. In addition, labor movement also responsible. In this construction period, the overall impacts will be highly adverse.

7.4.7 Impact on Social Environment

Disturbance of Local Community: Noise of construction activity may generate noise which may disturb to the local community living to the surroundings of the project area.

Health and Safety: Different types of risky and hazardous construction activities can be conducted in the proposed power plant. In this regard, ensuring health and safety of working labors and local community can be the main concern.

Employment Generation: During the pre-construction and construction phase, a considerable number of manual and technical workers will be needed for the construction of proposed plant.

7.5 Environmental Impacts during Operation

7.5.1 Impact on Ambient Air Quality

In respect of air quality, the proposed project influence area comprises of agricultural land, fish ponds high way, existing HSD based Power Plant, residential areas etc. Around 25 km from the center of proposed site has been considered as project influence area for air quality impact study depending on the impact potentially and sensitivity of the receptors surrounded of the proposed project. **Figure 7.1** and **Table 7.3** shows the location of the proposed Project with GPS co-ordinates.

Figure 7.1: Proposed Project Area

Table 7.3: Project Area Coordinates (UTM Zone: 45 R)

Model Domain		Easting (m)	Northing (m)
Center	45 R	689035.71	2856086.74
Project Area	North West	688971.68	2856314.00
	North West	688888.04	2856289.34
	South West	688972.06	2856023.04
	North East	335666.31	2683423.39

The project influence area or study area is relatively flat terrain resulting wind transport of the pollutants at long distances. Considering those issues, sensitivity of the location and proposed project location, the background air quality has been monitored.

Background Concentration

Criteria pollutants NO_x, PM_{10}, SO_2, $PM_{2.5}$, have been measured for an average period of 24 hours, on the other hand only CO has been measured for an average of 8 hours at two locations near the project site. Standard value for the ambient criteria pollutants provided by the World Bank (IFC, 2007) and Department of Environment, Bangladesh (ECR, 2005), have been taken into account to compare with the monitored background value and have been evaluated accordingly. However, **Table 7.4** shows the background ambient air pollution level in the study area.

Table 7.4: Air quality monitoring data in the study area

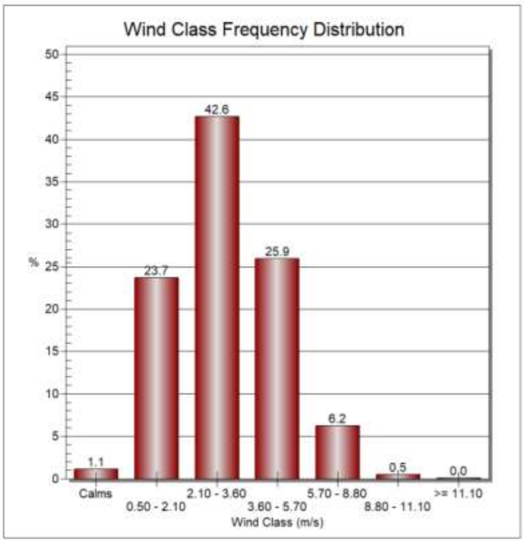
Criteria Pollutants	Sampling Period	AQ-1 (µg/m^3)	AQ-2 (µg/m^3)	Average (µg/m^3)	Standard Reference for Ambient Air Quality (µg/m^3)	
					ECR, 2005	IFC, 2007
NO_x	24hr	26.5	32.8	29.7	100 (Annual)	200 (1-hr)
SO_2	24hr	6.8	7.6	7.2	365	125 (IT-1)
CO	8Hr	0.67	0.78	1.5	40000 (1Hr)	-
PM_{10}	24hr	126.4	165.8	146.1	150	150 (IT-1)
$PM_{2.5}$	24hr	58.2	111.3	84.75	65	75 (IT-1)

The background ambient air quality has been monitored during winter season when the worst case situation prevails. Existing power plant, brick kilns, vehicular movement, cooking, construction activities and pollution from other sources outside the grid are responsible for increasing the criteria pollutants in ambient air. However, monitoring the air quality data at two locations are used to calculate the average air quality in the Project airshed. The above table depicts that, average recorded concentration of all the criteria pollutants are relatively lower with respect to World Bank Standard and Department of Environment Standard except for $PM_{2.5}$ which is relatively higher compared to both ECR as well as IFC standard (IT-1). On the other hand, though PM_{10} is recorded within acceptable limits but the concentration of that pollutant has been observed significant level in the project airshed. Major sources of dust emission in this area are paved and unpaved Roads, pollen and construction activities. However, the monitored air quality data has been used as baseline pollution concentration for modelling study.

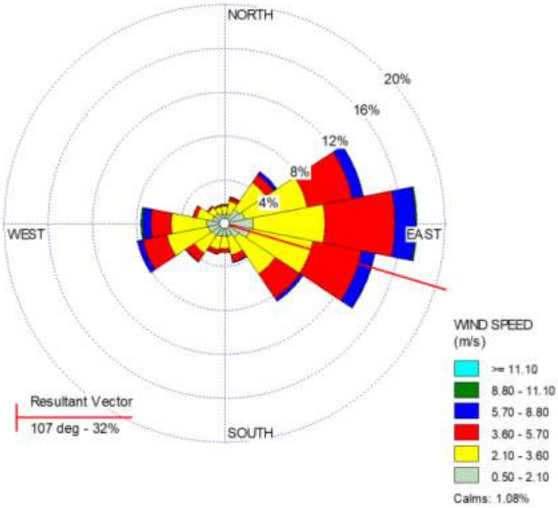
Meteorological condition

Meteorological data of Saidpur Airport, Nilphamari has been processed for preparing the surface meteorological file preparation. Moreover, ready upper air data for a whole year of 2018 has been processed though AERMET software.

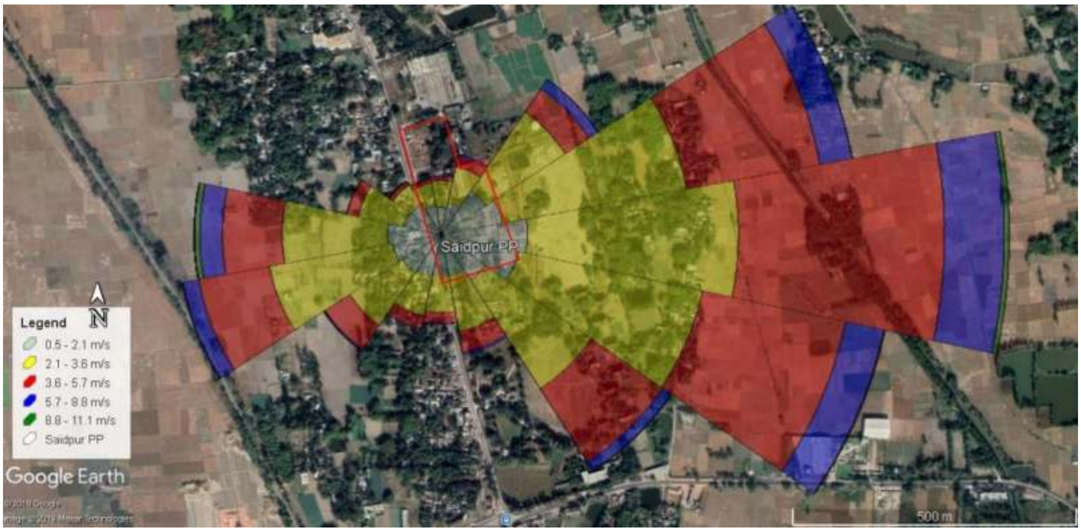
AERMET processes three types of data: 1) hourly surface observations that are typically, but not exclusively, collected at airports 2) twice-daily upper air soundings collected by the National Weather Station; and 3) data collected from an on-site or site-specific measurement program or prognostic meteorological data processed through a processor such as the Meso scale Model Interface. Data processing occurs in three distinct stages that are unrelated to the type of data being processed, each required to be run separately, but the stages areas. The first stage extracts the surface and upper air data from files in which the data are stored in specific archive formats. The quality of the surface, upper air, and site-specific data is also assessed during this stage. The second stage combines or merges the extracted surface and upper air data with the site-specific data into distinct 24-hour periods or blocks and writes the merged data to an intermediate file. The third and final stage reads the merged data file, calculates the boundary layer parameters required by AERMOD, and generates two AERMOD-ready meteorological data files. However, the regional meteorological conditions are assessed after analysis of meteorological processed AERMAT data of one year through WORPLOT. **Figure 7.2** shows the meteorological states of the study area related to the dispersion modeling.



a. Average wind speed histogram



b. Wind rose diagram



c. Plotting wind rose diagram into the Project air sheds

Figure 7.2: Wind speed and direction at the Project stack

Sensitivity Analysis for Stack Height

Stack position of the proposed project is 25°48'38.90"N and 88°53'8.40"E as per the layout drawing. Since the project will run through High Speed Diesel, SO_2 will be the major contributor which might have a potential impact on ambient airshed. Therefore, height of the stack has been fixed based on the sensitivity analysis of SO_2 emission. Optimal height has been determined considering the fact that, it will maintain the standard values of ECR, 2005 and IFC 2008 and reduce the maximum Ground Level Concentration with reasonable financial involvement. The sensitivity analysis of the stack height has also been conducted with AERMOD air dispersion modelling software. **Table 7.5** shows about the changes of height with respect to predicted concentration of SO_2 for the proposed Power Plant area. The rate of emission, stack diameter, flue gas rate and temperature has been assumed as constant during this sensitivity analyses.

Table 7.5: Sensitivity Analysis for Stack Height

Stack Height (m)	Max. GLC of 24hr SO_2 (μg/Nm^3)	Percentage (%) of National Standard (ECR, 2005)	Rate of decreasing in percentage from pervious stack heights
40	85.7	23.48	-
45	71.1	19.48	4.00
50	67.1	18.38	1.10
55	63.9	17.51	0.88
60	57.2	15.67	1.84

The above table represents the stack height corresponding to the variation in SO_2 concentration. From the table it has been evident that, with the increase of height from 40m to the stack ultimately reduces the maximum GLC of SO_2 up to 60m. In all cases, the maximum GLC for different stack height maintain the national and international standard limit which is less than 25% of national standard for 24hr SO_2 concentration. Figure 7.3 shows the rate of GLC reduction depending on the different stack height value.

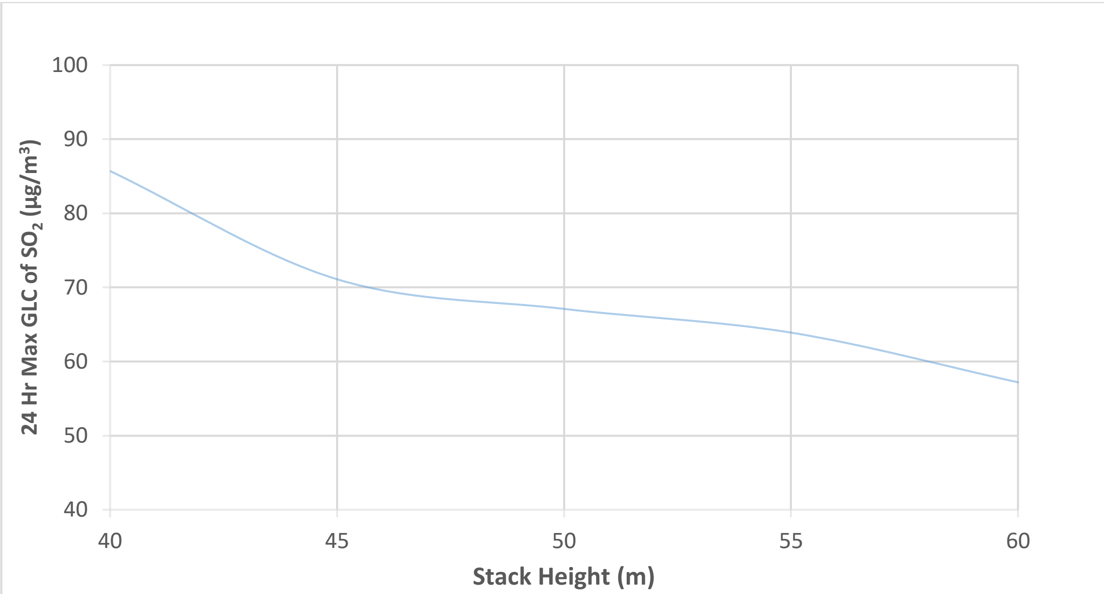


Figure 7.3: 24 hr average Max. GLC of SO_2

Figure 7.3 shows that the increasing stack height reduces the GLC of SO_2 in the project airshed. The level of maximum concentration of SO_2 reduces sharply as the height of the stack increase from 40 to 50m. After that, the rate of SO_2 is flowing gentle slope up to 60m. Hence, increasing height of the stack will have relatively less influence on GLC of SO_2 above 50m. Considering the financial perspective and pollution effects, 50m stack height has been recommended for emission of this Power Plant. However, the modelling study has been conducted based on 50m stack height.

Receptors

Selection of receptors are important to assess the pollution level at different points/areas during operation of this Power Plant. There are two types of receptors within the Model Domain such as A) Multi-Tier grid points and B) Discrete receptors. Multi-Tier grid points are sketched for predicting the grid pollution level around the Project site and discrete receptors are identified based on the sensitivity of the receptors aspects.

Multi-Tier Grid Receptors

Cartesian grid are sectioned into smaller tiers to capture more precise pollutant concentration after dispersion. The gridded receptors are placed based on the following spacing:

100m tier spacing within 1km distance from centre

500m tier spacing within 5km distance from centre

1000m tier spacing within 10km distance from centre

Discrete Receptors

In addition, discrete locations corresponding to specific sites of interest are included in this assessment. These receptors are broadly located at the places where mainly the children resides as there are many schools located near the project site. Moreover adolescents, senior citizens, middle aged people in brief people from all age group resides there. Around forty numbers of schools, religious institutions and family welfare centre are selected as discrete receptors around the Power Plant complex. The effects on air quality at these sensitive sites has been assessed in more detail. The list of sensitive receptors, their locations are given in **Table 7.6**.

Table 7.6: Locations of Sensitive Receptors

Sl No	Name of Sensitive Receptors	Location (m)	
		Latitude (UTM)	Longitude (UTM)
1	Primary School	687722.52	2852934.65
2	Madrasa	688214.90	2852955.65
3	Primary School	692251.40	2853056.87
4	Mosque/Eidgah/Church	689730.54	2853299.35
5	Mosque/Eidgah/Church	690547.78	2853765.29
6	Primary School	689413.14	2853952.49
7	Primary School	686382.36	2854220.21
8	Primary School	685035.29	2854556.77
9	Mosque/Eidgah/Church	687395.78	2854819.85
10	Family Welfare Centre	693450.57	2854840.08
11	Mosque/Eidgah/Church	689470.50	2854770.95
12	Mosque/Eidgah/Church	687808.39	2855206.99
13	Primary School	687071.60	2855357.76
14	Primary School	692262.69	2855631.84
15	Mosque/Eidgah/Church	689248.41	2855674.99
16	Mosque/Eidgah/Church	685589.49	2855786.52
17	Mosque/Eidgah/Church	689129.85	2856665.71
18	Primary School	691231.60	2856628.87
19	High School	688186.48	2856854.33
20	Historical Place	684278.40	2856858.44
21	Mosque/Eidgah/Church	688857.46	2857309.36
22	Madrasa	693576.06	2858086.21
23	Mosque/Eidgah/Church	687123.12	2858156.91
24	Madrasa	692183.38	2858552.47
25	Primary School	684324.94	2858480.51
26	Primary School	689891.00	2858853.89
27	Primary School	689222.75	2859197.23

Sl No	Name of Sensitive Receptors	Location (m)	
		Latitude (UTM)	Longitude (UTM)
28	Mosque/Eidgah/Church	691982.32	2859224.16
29	Primary School	693468.81	2859434.3
30	Mosque/Eidgah/Church	687508.15	2860283.52
31	Primary School	686742.47	2860597.19
32	Mosque/Eidgah/Church	690783.2388	2860891.182
33	Madrasa	687843.1741	2856084.11
34	Mosque/Eidgah/Church	692696.2399	2856279.11
35	Family Welfare Centre	687143.6645	2850826.34
36	Primary School	688418.4172	2852934.651
37	Primary School	690017.3689	2852955.65
38	AQ_1	689001.95	2853056.873
39	AQ_2	688649.79	2853299.354
40	Air Port Launge	691465.59	2853765.29

Air Quality Modeling

In this section, the modeling has been run predicting the maximum concentration levels in ambient air of the pollutants like SO_2, NO_x, $PM_{2.5}$, PM_{10} and CO for both the baseline Project contribution and Project contribution. Maximum GLC of different pollutants on Sensitive Receptors has been shown in latter table.

Project Emission

The detail information about the flue gas emission of proposed Project is very important for conducting the air quality modelling. Since the plant will use wet low NO_x burner, emission of NO_x has been estimated 53.19 gm/s considering the emission inventories of USEPA AP-42 guideline for NOx emission. According to IFC 2008 standard, the maximum emission from the gas turbine with liquid fuel permissible limit is 152mg/Nm^3 (74 ppmv) which corresponds to 62.7gm/s for this plant. All of the emission inventories of the criteria pollutants have been done with the assistance of AP-42 in **Table 7.7**. This information are used as inputs for running the AERMOD software and to determine the Project contribution during operation stage.

Table 7.7: Major Point Source Emissions in the Project Area

Pollutants	Emission Rate	No. of Stack	Stack Height	Flue Gas Temp.	Stack Inside Diameter	Gas Exit Velocity
	Unit (g/s)		Unit (m)	Unit (K)	Unit (m)	Unit (m/s)
CO	16.88	Single Stack (1)	50	823	3.5	25
SO_2	112.13					
NO_X	53.29					
PM_{10}	2.67					
$PM_{2.5}$	2.67					

Ambient GLC of NO_X

The contribution of NO_X during Project operation has been determined by using AERMOD modelling process. Baseline concentration of NO_x at the local air shed was monitored continuously for 24hrs at two locations which has been used as background concentration exist in the study area. **Table 7.8** shows the maximum GLC of NO_x during operation stage at the certain point in the air shed. In this study, all of the NOx has been assumed to be converted to NO_2 in the ambient state.

Table 7.8: Air Quality Modeling – NO_x

Pollutant NOx	Concentration (µg/m³)				Coordinates of Max Point (UTM:46)	
	Avg. Time	Peak Value	ECR, 2005	IFC, 2008	East (m)	North (m)
Background Concentration	24 Hr Avg.	29.7	100 (Annual)	200 (1hr) and 40 (Annual)	-	-
Project Max. GLC Contribution	1-hr	162.7	-	200	689035.69	2856086.75
	Annual	6.6	100	40	688335.69	2856186.75
Max. GLC during operation	1-hr	192.4	-	200	689035.69	2856086.75
	Annual	36.3	100	40	688335.69	2856186.75

This Project will add maximum 162.7 µg/m³ for 1hr (Figure-xx) and 6.6 µg/m³ of NO_x for annual averaging period to the ambient air shed. During the Project operation stage, the baseline condition will be increased to 192.4 µg/m³ for 1-Hr and 36.3 µg/m³ for annual average time. The Project GLC of NO_x remains within the limit for national standard for annual averaging period (ECR, 2005) and international standard (IFC, 2007) values both for 1-hr and annul averaging period but the concentration level still observed in much noticeable amount.

Ambient GLC of SO_2

The Contribution of SO_2 during project operation has been determined by using AERMOD modelling process. Baseline concentration of SO_2 at the local air shed was monitored continuously for 24 hrs at two locations which was 7.2 µg/m³ in order to assess the background situation. **Table 7.9** shows the maximum GLC of SO2 at different scenarios.

Table 7.9: Air Quality Modeling – SO_2

Pollutant SO_2	Concentration (µg/m³)				Coordinates of Max Point (UTM:46)	
	Averaging Time	Peak Value	ECR, 2005	IFC, 2008 (IT-1)	East (m)	North (m)
Background Concentration	24 Hr Avg.	7.2	80	-		
Project Max. GLC Contribution	24-hr	67.1	365	125	689035.69	2856086.75
	Annual	3.5	80	-	688335.69	2856186.75
Max. GLC during operation	24-hr	74.3	365	125	689035.69	2856086.75
	Annual	10.7	80	-	688335.69	2856186.75

This Project will contribute maximum 67.1 µg/m³ at ground level for 24hr and 3.5 µg/m³ for annual averaging period to the ambient airshed. On the other hand during operation stage the ambient SO_2 pollutant concentration will increase to 74.3 µg/m³ for 24hr and 10.7 µg/m³ for annual averaging period. It is observed that the SO_2 remains within the acceptable levels of international standard as well as but it national standard limit (ECR, 2005).

Ambient GLC of CO

The maximum ground level concentration of CO for has been determined by the AERMOD modeling process. The baseline concentration of CO at the local air shed was monitored continuously for 8 hr at two locations which has been used as background concentration. **Table 7.10** shows the project contribution during operation period of this power plant.

Table 7.10: Air Quality Modeling – CO

Pollutant CO	Concentration (µg/m³)				Coordinates of Max Point (UTM:46)	
	Averaging Time	Peak Value	ECR, 2005	IFC, 2008	East (m)	North (m)
Background Concentration	8-hr	0.7	10,000	-	-	-
Project Max. GLC Contribution	1-hr	181.9	40,000		689035.69	2856086.75
	8-hr	30.4	10,000		689035.69	2856086.75
Max. GLC during operation	1-hr	181.8	40,000		689035.69	2856086.75
	8-hr	31.1	10,000		689035.69	2856086.75

The project will contribute maximum 181.9 µg/m³ at ground level for 1hr and 30.4 µg/m³ for 8 hr. On the other hand during operation of this Project the ambient CO pollutant concentration will be 181.8 µg/m³ in 1hr and 31.1 µg/m³ in 8hr. Moreover, the background highest concentration level observed is 0.7 µg/m³. However, it is observed that the concentration of CO will be within the acceptable levels compared to national and international standards during operation period of this power plant.

Ambient GLC of PM_{10}

Maximum GLC of PM_{10} for 24hr and Annual averaging time has been predicted using the AERMOD modelling process. The baseline concentration of PM_{10} at the local airshed were monitored continuously for 24hrs at two locations which has been used as background concentration. Average 146.1 µg/m³ PM_{10} has been recorded in the ambient air around the project. **Table 7.11** shows the maximum GLC of PM_{10} during operation stage.

Table 7.11: Air Quality Modelling – PM_{10}

Pollutant PM10	Concentration (µg/m³)				Coordinates of Max Point (UTM:46)	
	Averaging Time	Peak Value	ECR, 2005	IFC, 200 (IT-1)	East (m)	North (m)
Background Concentration	24 Hr	146.1	150	150	-	-
Project Max. GLC Contribution	24-hr	9.2	150	150	689035.69	2856086.75
	Annual	7.7	50	70	688335.69	2856186.75
Max. GLC during operation	24-hr	155.3	150	150	689035.69	2856086.75
	Annual	153.8	50	70	688335.69	2856186.75

The air quality modeling of PM_{10} indicates that the Project contributes only 9.2 µg/m³ for 24hr and 7.7 µg/m³ for annual averaging period during operation period. Therefore, the Project will not increase the ground level concentration of PM_{10} significantly. Collectively, the maximum GLC of PM_{10} would be 155.3 µg/m³ for 24hr and 153.8 µg/m³ for annual averaging time. In other words the observed levels of PM_{10} exceeds both ECR, 2005 and IFC, 2007 standard levels. However, the baseline concentration of PM_{10} is responsible for the higher level of PM_{10} in the study area which would be beyond the national standard limit (ECR 2005) for annual averaging period.

Ambient GLC of $PM_{2.5}$

The highest GLC of $PM_{2.5}$ for 24 hrs and annual averaging time is estimated through the AERMOD modelling process using three years' meteorological data of the study area. The baseline concentration of $PM_{2.5}$ at the local air shed was on average 84.8 µg/m³ monitored continuously for 24 hrs at two locations which has been used as background concentration of the project air shed. **Table 7.12** shows the maximum GLC of PM_{10} during operation stage.

Table 7.12: Air Quality Modeling – $PM_{2.5}$

Pollutant PM2.5	Concentration (μg/m³)				Coordinates of Max Point (UTM:46)	
	Averaging Time	Peak Value	ECR, 2005	IFC, 2007 (IT-1)	East (m)	North (m)
Background Concentration	24 Hr	84.8	65	75	-	-
Project Max. GLC Contribution	24-hr	3.5	65	75	689035.69	2856086.75
	Annual	2.0	15	35	688335.69	2856186.75
Max. GLC during operation	24-hr	88.3	65	75	689035.69	2856086.75
	Annual	86.8	15	35	688335.69	2856186.75

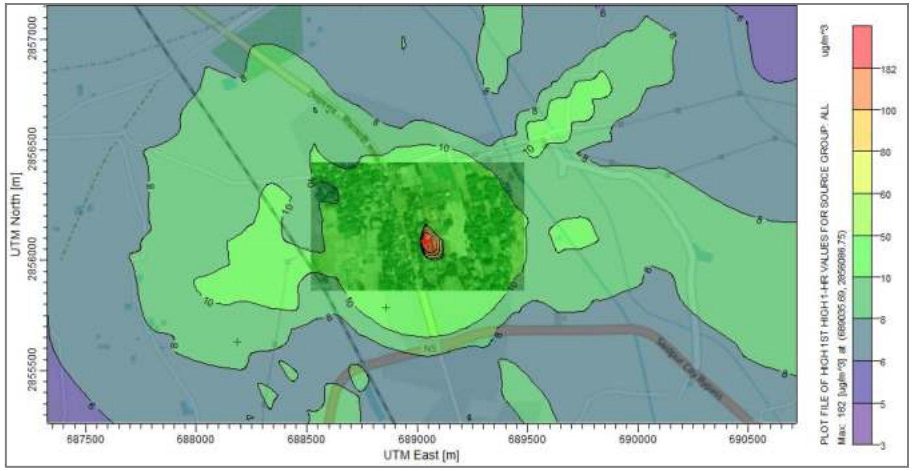
The Project contribution of $PM_{2.5}$ on the ambient air will be negligible 3.5 μg/m³ for 24hr and 2.0 μg/m³ for annual averaging period. This Project will increase the ground level concentration of $PM_{2.5}$ very less on the airshed. In total, the maximum GLC of PM_{10} would be 88.3 μg/m³ for 24hr and 86.8 μg/m³ for annual averaging time. However, the baseline concentration of $PM_{2.5}$ which already exceeded the standard levels of ECR and IFC, is responsible for the higher level of $PM_{2.5}$ in the study area which would be beyond the national standard limit (ECR 2005) and IFC 2007 for both 24hr and Annual averaging period.

This project will definitely increase the pollution level at the sensitive points which already determined during the baseline study. However, the maximum level of criteria pollutants contribution in each of the sensitive points have been estimated in **Table 7.13** for different averaging time.

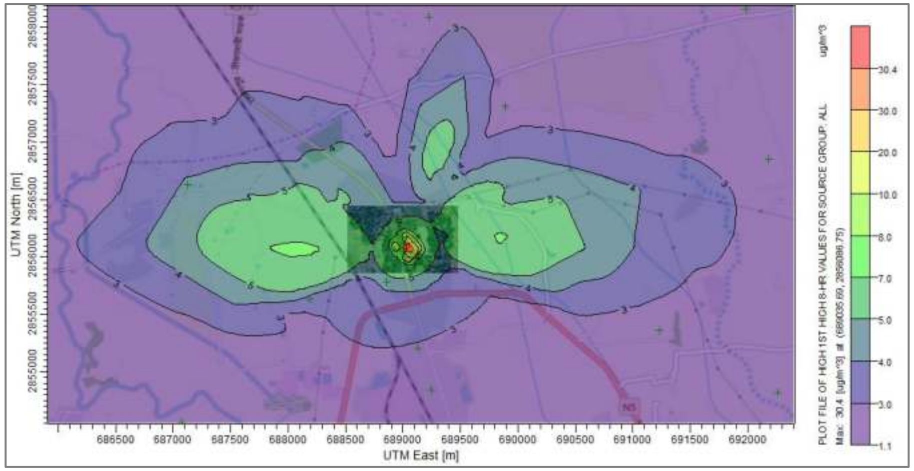
Table 7.13: Maximum GLC of the criteria pollutants at each of the sensitive receptors

Sl No	Name of Sensitive Receptors	NO_x		SO_x		CO		PM_{10}		$PM_{2.5}$	
		1-hr	Annual	24 hr	Annual	1-hr	8-hr	24 hr	Annual	24 hr	Annual
1	Primary School	20.04	5.76	3.74	1.54	5.75	1.76	7.70	7.64	1.96	1.90
2	Madrasa	19.79	5.76	3.38	1.53	5.67	1.60	7.69	7.64	1.95	1.90
3	Primary School	16.56	5.77	3.52	1.55	4.53	1.62	7.69	7.64	1.95	1.90
4	Mosque/Eidgah/Church	15.55	5.76	3.11	1.55	4.17	1.47	7.68	7.64	1.94	1.90
5	Mosque/Eidgah/Church	17.84	5.76	3.14	1.55	4.98	1.48	7.68	7.64	1.94	1.90
6	Primary School	20.43	5.77	3.26	1.56	5.89	1.53	7.68	7.64	1.94	1.90
7	Primary School	18.95	5.78	3.66	1.58	5.37	1.71	7.69	7.64	1.95	1.90
8	Primary School	18.90	5.79	3.82	1.60	5.35	1.79	7.70	7.64	1.96	1.90
9	Mosque/Eidgah/Church	25.99	5.79	3.80	1.60	7.85	1.79	7.70	7.64	1.96	1.90
10	Family Welfare Centre	28.24	5.79	3.67	1.61	8.64	1.69	7.69	7.65	1.95	1.91
11	Mosque/Eidgah/Church	15.67	5.79	3.91	1.61	4.21	1.83	7.70	7.65	1.96	1.91
12	Mosque/Eidgah/Church	23.11	5.81	4.07	1.66	6.83	1.90	7.70	7.65	1.96	1.91
13	Primary School	16.73	5.84	4.74	1.72	4.59	1.91	7.72	7.65	1.98	1.91
14	Primary School	22.22	5.83	4.25	1.71	6.52	1.85	7.71	7.65	1.97	1.91
15	Mosque/Eidgah/Church	21.15	5.84	5.23	1.72	6.14	2.42	7.73	7.65	1.99	1.91
16	Mosque/Eidgah/Church	19.46	5.90	5.13	1.86	5.55	1.94	7.73	7.65	1.99	1.91
17	Mosque/Eidgah/Church	24.15	5.88	6.33	1.81	7.20	2.92	7.76	7.65	2.02	1.91
18	Primary School	26.96	5.89	6.11	1.84	8.19	2.56	7.75	7.65	2.01	1.91
19	High School	30.13	6.06	8.84	2.24	9.31	3.52	7.82	7.66	2.08	1.92
20	Historical Place	18.43	5.96	5.66	2.00	5.18	1.89	7.74	7.65	2.00	1.91
21	Mosque/Eidgah/Church	38.83	6.01	9.97	2.13	12.37	4.53	7.84	7.66	2.10	1.92
22	Madrasa	17.67	5.87	4.94	1.79	4.92	2.08	7.72	7.65	1.98	1.91
23	Mosque/Eidgah/Church	21.90	6.26	11.18	2.72	6.41	4.17	7.87	7.67	2.13	1.93
24	Madrasa	20.28	5.94	6.56	1.95	5.84	2.74	7.76	7.65	2.02	1.91
25	Primary School	20.07	5.98	4.62	2.05	5.76	1.78	7.72	7.66	1.98	1.92
26	Primary School	19.35	5.93	5.63	1.94	5.51	2.44	7.74	7.65	2.00	1.91
27	Primary School	16.36	5.85	5.44	1.74	4.46	2.52	7.74	7.65	2.00	1.91
28	Mosque/Eidgah/Church	17.76	5.84	4.36	1.72	4.95	2.04	7.71	7.65	1.97	1.91

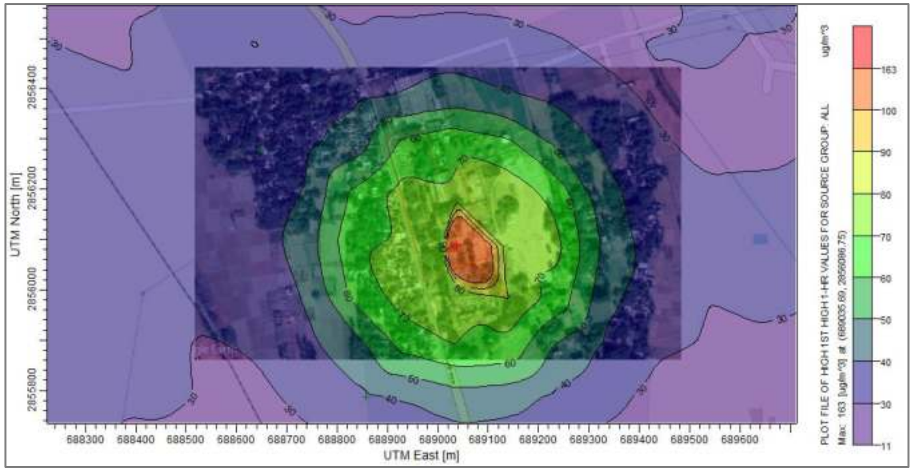
Sl No	Name of Sensitive Receptors	NO_x		SO_x		CO		PM_{10}		$PM_{2.5}$	
		1-hr	Annual	24 hr	Annual	1-hr	8-hr	24 hr	Annual	24 hr	Annual
29	Primary School	15.80	5.81	3.62	1.67	4.26	1.69	7.69	7.65	1.95	1.91
30	Mosque/Eidgah/Church	21.40	5.87	4.17	1.80	6.23	1.95	7.71	7.65	1.97	1.91
31	Primary School	25.09	5.88	4.42	1.81	7.53	2.00	7.71	7.65	1.97	1.91
32	Mosque/Eidgah/Church	21.39	5.80	4.34	1.64	6.23	2.03	7.71	7.65	1.97	1.91
33	Madrasa	17.57	5.81	3.57	1.66	4.88	1.68	7.69	7.65	1.95	1.91
34	Mosque/Eidgah/Church	19.32	5.79	4.19	1.62	5.50	1.96	7.71	7.65	1.97	1.91
35	Family Welfare Centre	16.13	5.80	3.59	1.63	4.37	1.69	7.69	7.65	1.95	1.91
36	Primary School	16.72	5.78	3.08	1.59	4.58	1.46	7.68	7.64	1.94	1.90
37	Primary School	16.99	5.78	3.41	1.58	4.68	1.61	7.69	7.64	1.95	1.90
38	AQ_1	73.34	5.83	16.68	1.71	24.53	7.56	8.00	7.65	2.26	1.91
39	AQ_2	32.40	6.42	11.53	3.09	10.11	4.80	7.88	7.68	2.14	1.94
40	Air Port Launge	19.85	5.75	3.22	1.52	5.68	1.44	7.68	7.64	1.94	1.90



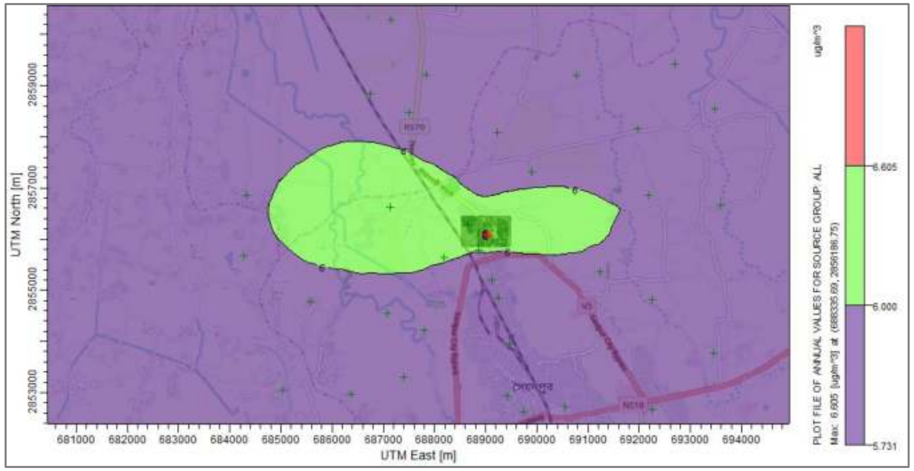
CO_1 Hr



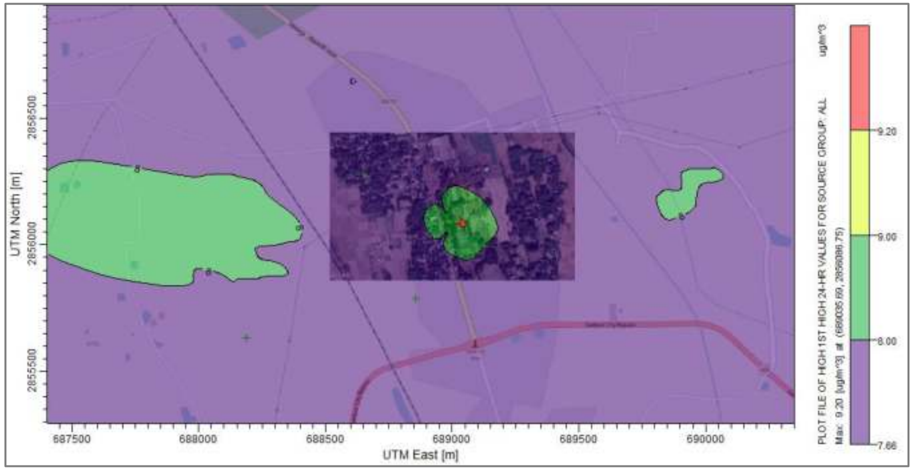
CO_8 Hr



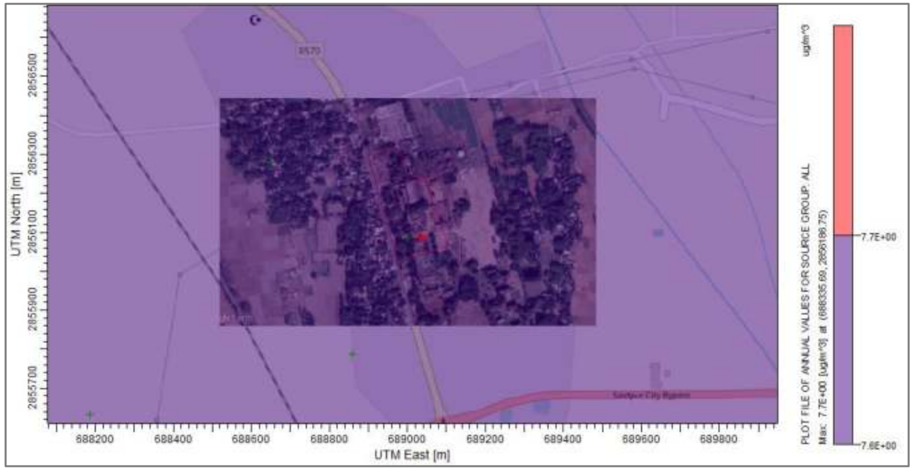
NO₂_1Hr



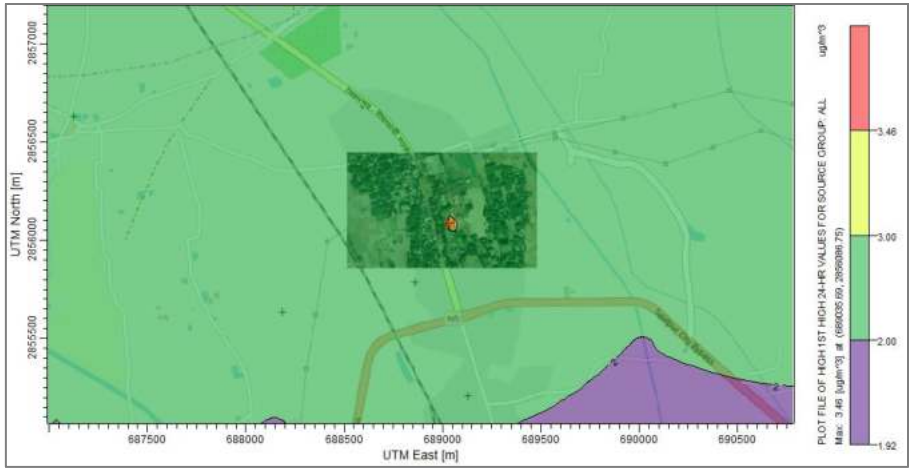
NO₂_Annual



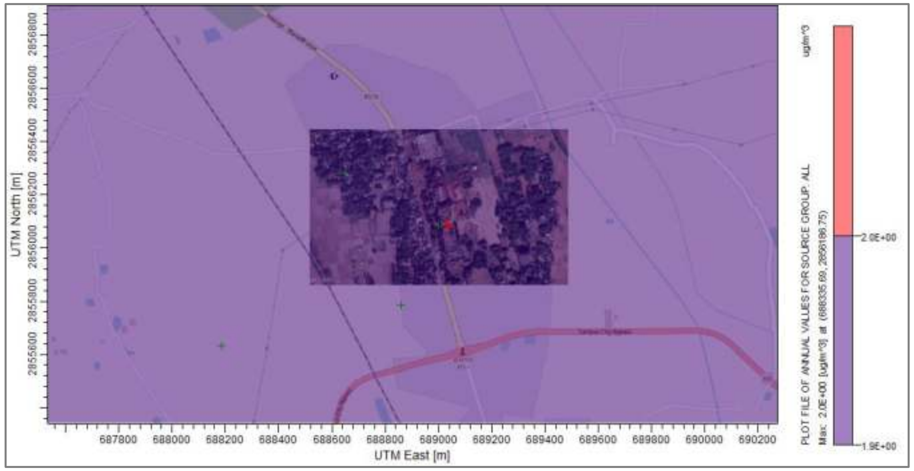
PM₁₀_24Hr



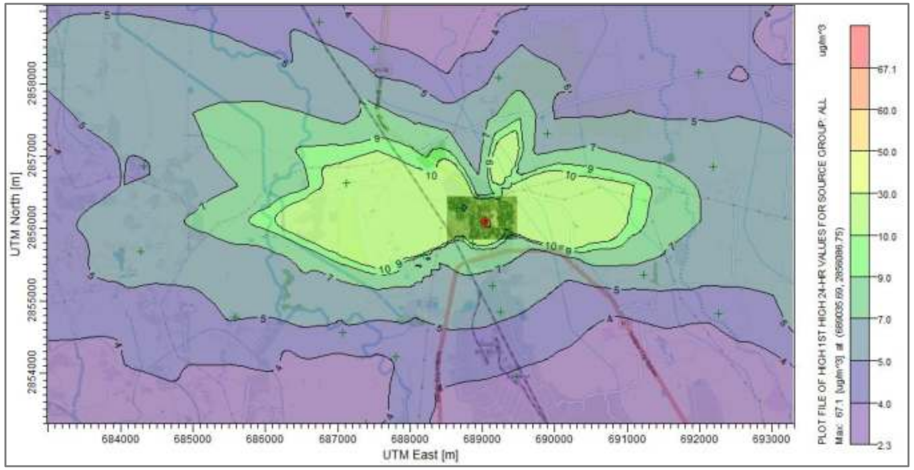
PM₁₀_Annual



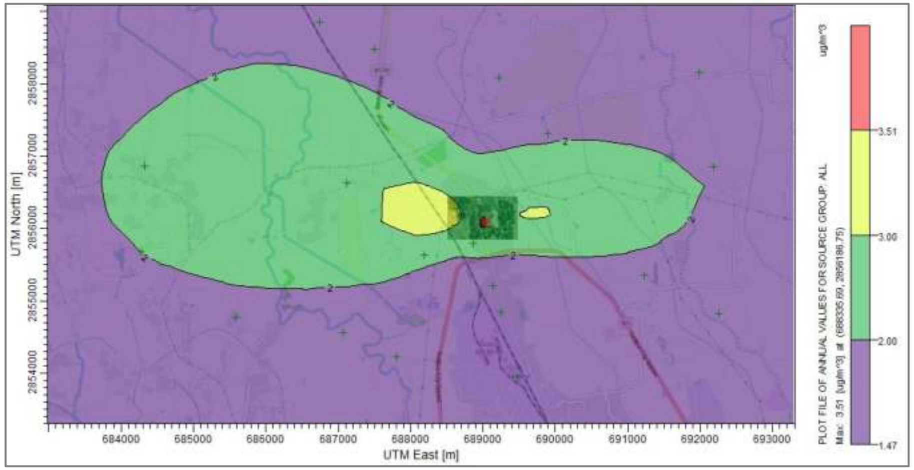
PM2.5_24Hr



PM2.5_Annual



SO_2_24Hr



SO_2_Annual

Figure 7.4: Output of the Air Quality Modeling Results

Cumulative Impacts on Ambient Air

There are a number of pollution sources like emission from brick kilns, road traffic, construction works and existing Power Plant which are responsible for such increase of pollution at background level. To reduce the criteria pollutants numbers of step has been taken by GoB like using Euro 4 or above vehicular machine, using cleaner fuel, implementing ECR, 2017, revising the air quality act and gradually phasing out the brick kilns and introducing updated technologies. Therefore, increasing vehicles movement in the air shed will not increase the pollution level except establishment of new industries.

Proponent has not confirmed any further development plan of their own adjacent to the project area. Lack of information about future development, availability of natural gas as fuel, baseline primary data monitoring etc. implies to use historical trend for cumulative impact assessment. Therefore, the peak monitoring values of ambient air quality has been used as historical highest record for cumulative study. These information are used as inputs for running the AERMOD software to determine the cumulative impact for future scenario. The estimation for the future Project is given in the **Table 7.14**.

Table 7.14: Maximum Ground Level Concentration of Pollutants for Cumulative Case

Pollutants	Averaging Time	Concentration (µg/m³)		Standard Limits (µg/m³)		Coordinates of Max Peak Point (UTM:46)	
		Project Case	Cumulative Case	ECR, 2005	IFC, 2008	East (m)	North (m)
NO_X	1-hr	192.4	195.5	-	200	689035.69	2856086.75
	Annual	36.3	39.4	100	40	688335.69	2856186.75
SO_2	24-hr	74.3	74.7	365	125 (IT-1)	689035.69	2856086.75
	Annual	10.7	11.1	80	-	688335.69	2856186.75
CO	1-hr	181.8	181.9	40,000	-	689035.69	2856086.75
	8-hr	31.1	31.2	10,000	-	689035.69	2856086.75
PM_{10}	24-hr	155.3	175.0	150	150 (IT-1)	689035.69	2856086.75
	Annual	153.8	173.5	50	70 (IT-1)	688335.69	2856186.75
$PM_{2.5}$	24-hr	88.3	114.8	65	75 (IT-1)	689035.69	2856086.75
	Annual	86.8	113.3	15	35 (IT-1)	688335.69	2856186.75

In future, the ground level concentration of NO_x will increase significantly for both 1-hr and annual averaging time. Therefore, the regulatory authority should give proper attention to manage of future development in project air shed. The maximum ground level concentration of PM_{10} and $PM_{2.5}$ will increase due to high contribution of background and future development activities. Therefore, policy level initiative should be adopted to control the Particulate Matter especially for longer period of time.

GHG emission

GHG emission is a great concern in today's world. In this regard emission of GHG gasses has also been monitored and assessed in this project considering DoE and IPCC standard. For the emission calculation of GHGs, three pollutants i.e. CO_2, CH_4 and N_2O has been accounted for this power plant project. Using the standard process of IPCC (2006), the emission of CO_2, CH_4 and N_2O have been estimated for HSD as fuel. Considering the 100 year global warming potentiality for CO_2, CH_4, N_2O, the collective GHG emission has been calculated and annually, this power plant will emit around 1.23 million ton of GHG during operation period collectively. **Table 7.15** shows in detail of the emission of total GHG per year.

Table 7.15: Annual GHG Emissions from Different Fuel Sources

Parameters of GHG	Million Ton
CO_2 (million tons/y)	1.22E+00
CH_4 (million tons/y)	1.04E-03
N_2O (million tons/y)	1.40E-03
Total (Million Ton/Year)	1.23E+00

Notes: Emission factor from 2006 IPCC Guidelines for National Greenhouse Gas Inventories. (Chapter 2: Stationary Sources)

7.5.2 Impact on Ambient Noise

The ambient noise level would increase during the operation period of the proposed Power Plant due to the propagated combined effect of noise of the proposed Power Plant. The generated noise will propagate to the adjacent areas both inside and outside of the project boundary. Several sensitive receptors located at different locations around the project site have been selected considering the impact potentiality and sensitivity of the receivers around. To understand the propagated noise level dispersed from the proposed Power Plant to different selected sensitive locations, noise propagation modeling was conducted considering the noise propagation during the operation of the Power Plant.

The noise propagation simulation was done by using Sound Plan essential 3.00 software which was developed by SoundPLAN GmbH. The ISO9613 calculation process is used for this modeling purpose. Different noise generation sources including nearby roads, railroads, and others were considered for predicting the noise level generating from the sources. For running the model, the average temperature and average relative humidity were considered as 28°C and 70%. Noise level from the existing and proposed Power Plant engine room was considered as 90dBA. Additionally, other noise emission data for noise modeling were collected from the field measurement and secondary sources as well. The predicted noise levels at different sensitive locations around the proposed project are presented in **Figure 7.5** and **Figure 7.6**.

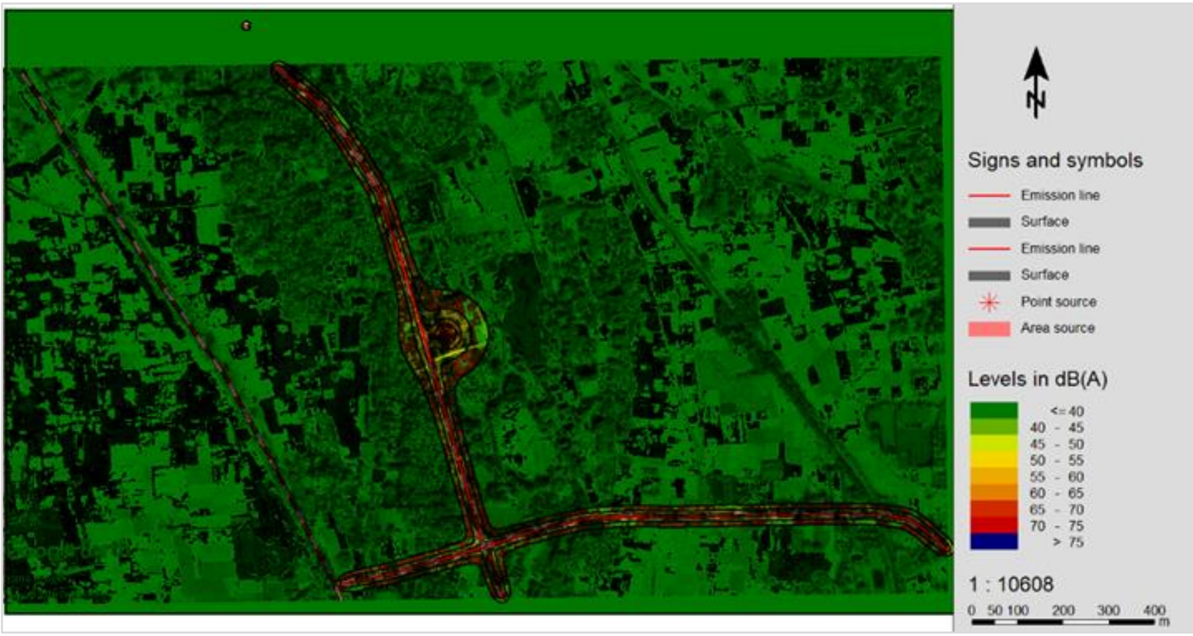


Figure 7.5: Predicted operation phase noise propagation during daytime

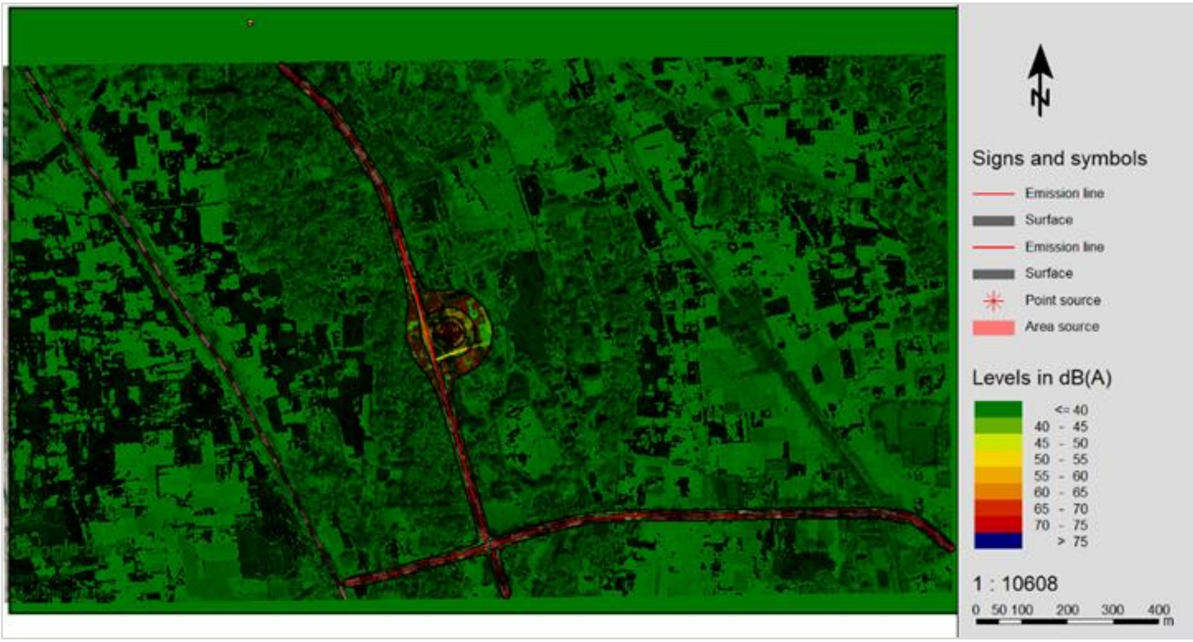


Figure 7.6: Predicted operation phase noise propagation during nighttime

During the baseline study of this EIA report, the ambient noise level at few sensitive receptors within the project site was recorded which are higher than the Bangladesh noise level standard. During operation of the proposed Power Plant, the ambient noise at some of the sensitive receptors would be equal to baseline condition as the generated noise would attenuate due to its distance or physical barriers but for other receptors it would be higher than the existing baseline condition. However, the resultant noise level of the sensitive receptors is presented in **Table 7.16** where cells highlighted with yellow color exceeds the Bangladesh standard.

Table 7.16: Predicted Noise Level at different sensitive noise receptors during the operation phase of the proposed Power Plant

Sample Code	Location Name	Location Type	Model Predicted Noise Level (dBA)		Baseline Noise Level (dBA)		Resultant Noise Level (dBA)		Standard*	
			Day Time	Night Time	Day Time	Night Time	Day Time	Night Time	Day Time	Night Time
NL1	Proposed Project site	Industrial Area	72	32.7	57.8	45	72	45	75	70
NL2	PDB School	Silent area	46	30.2	53.2	43	53.7	43	50	40
NL3	PDB Mosque	Silent area	43	32.7	50.4	41	50.9	41.5	50	40
NL4	Residential zone, PDB Colony	Residential area	62	60	45.5	45	62	60	55	45
NL5	Saidpur Bazar	Commercial Area	60	56	61	58	63	60	70	60
NL6	Saidpur Terminal	Commercial Area	67	60	60.3	62	60.8	62.8	70	60

*Note: *Bangladesh Noise Pollution Control Rules, 2006*

It is predicted that the resultant noise level would exceed the Bangladesh standard on around three locations at daytime and four locations at nighttime. It would be mentioned here that, most the sensitive receptors are within the Project boundary and very close to the Power Plant noise generating sources. Persistence exposure to the high level of noise can have adverse health impacts and can increase the level of stress to the susceptible individuals. It can also cause permanent damage to the hearing ability of the exposed persons.

7.5.3 Impacts on Land Resources

Agricultural Land use: Operation of Power Plant would lead to development of more industries and other infrastructures. It would create pressure on the existing agricultural land use of the study area. As a result, more agricultural land would be acquired in Power Plant adjacent areas. This impact is characterized as Major Adverse.

7.5.4 Impact on Water Resources

Drainage: Sufficient drainage facility would be provided within the power plant area in order to drain out the storm water. Moreover, the rainwater does not cause any sort of water logging situation in the study area. There would be no significant issue regarding drainage disturbance in the operational phase.

Ground water withdrawal: Referring to the **section 3.6.1** and **5.2.4** (ground water part) it is revealed that, potable water for drinking and other uses along with plant requirement a minimum ground water would be withdrawn which is negligible compared to the recharged amount of ground water of the studied area. Therefore, it will not hamper surrounding ground water uses including domestic use.

Water Quality: The Plant considered ETP and that is why the release of contaminated water will be remote. Moreover, the surface water bodies are far from the Plant site. On the other hand, Ground water contamination may occur in case of accidental event only. In normal case, there would be an oil sump for the collection of oil mixed water and leaked oil. Using oil separator technique oil will be separated from the oil mixed water and separated oil will be sold out to the vendor. Henceforth, the ground water contamination from the oil source will be remote.

7.5.5 Non-Hazardous Waste Generation

Waste Water

Generally, effluents from the proposed power plant would be HRSG blow down, cooling tower blow down, back flash from ion exchanger and iron filter of water treatment plant, floor and yard drains (cleaning), oily water from turbine hall and sub-station yard, etc. Generally this waste water is contaminated with Chlorine, Chromium, Copper, Iron, Zinc, and heavy metals.

The detail sources and quantity of the waste water is clearly described in Water Balance Diagram provided in section **3.6.1** of **Chapter 3**. From the water balance diagram it is estimated that the total quantity of the effluent from the power plant (excluding effluent from domestic water use) would be around 8 m^3/ day (**Figure 3.6**).

The proposed project considers a Water Treatment Plant (WTP) which to be constructed. Therefore, no waste water will be discharged to the river or canal without treatment and satisfying the MoEF's standard of effluent quality. Water can be reuse in the Plant or gardening or draining to natural drain.

Kitchen Waste

During commissioning phase, it is assumed that around 50- 75 officials including expatriate will be living at the site for about 3 months period. After commissioning in the operation phase, around 92 people will be living at site. The **Table 7.17** below shows the estimation of kitchen waste during operation.

Table 7.17: Estimation of Kitchen Waste during Operation Period

Sl No	Economic Classes of Employee	Project employee	Rate of kitchen waste generation (kg/day/capita)*	Total generated waste (kg/day)
1.	High Income Group (>20000 tk/month) for commissioning phase in three months period	75	0.44	**33.0**
			Total	**33.0**
1.	High Income Group (>20000 tk/month) for operation phase in 25 years period	92	0.44	40.48
			Total	**40.48**

**source: (JICA, Pacific Consultant Internationals, & Co, 2005)*

It is estimated that around 33 kg of kitchen waste will be generated each day from the residential area of the proposed unit in the commissioning phase and around 40.48 kg per day in the operation phase. Careless disposal of this waste would create pollution, odor problem, nuisance and aesthetic tiring.

However, the impact would be for long term but would be limited within the plant premises, reversible and may happen only in worst-case scenario (i.e. no management of kitchen waste). On the other hand, sensitivity of this impact to the residents of the Plant is High as presently there is no Kitchen Waste Management System at the power station. Thus, the significance of the impact would be **medium adverse** and needs to be minimized by EMP.

Sewerage

It is assumed that during commissioning phase, around 50-75 officials including 50 expatriates will be living at the Project site and about rest will be day labours. In the operation phase around 92 employees including staffs will be living at site for operation related activities. Therefore, it is estimated that maximum 2 m^3 [Considered as 0.29 wt.(kg)/ person/ day and 312 L/day per capita for Lower Income Group; and as 0.6 wt.(kg)/ person/ day and 264 L/day per capita for Higher Income Group] sewerage would be generated from temporary labor sheds and officers' residence in three months period at the commissioning phase. In the operation phase, around 280 m^3 sewerage would be generated from officers' residence for the 25 years period. A small portion of this sewerage may escape sewerage collection and disposal system. The fecal sludge would go to the existing septic tank.

This added sewerage would not have any significant impact on the existing sewerage system. The magnitude of the impact would be moderate and sensitivity would also be moderate. Thus significant of the impact would be **medium adverse** and needs to be controlled by adopting EMP.

7.5.6 Hazardous Waste Generation

During operation phase, liquid wastes may generate from cooling tower blow down, water from leaks and vents, waste water from turbine floor and workers' colony and offices and oily water separation unit. Besides, some HSD wastes will be collected in trays from different leaks of pipe joints and Burner area. It is important to dispose these wastes; otherwise it may contaminate nearby water resource and contaminate soil texture.

Oil and Oily Water

Lube oil is generally used in the power plant in different equipment like bearing, turbine hydraulic system, etc. Wash water or drained water from turbine hall, substation yard, etc may contain oil and oily water. However, the proposed plant considers to install an Oil Water Separation Unit integrated with a central water treatment plant. Therefore, the impact would **not be significant**. On the other hand, this proposed third unit would bring a means of treating oily water from existing unit.

Sludge from Water Treatment Plant (WTP) and Effluent Treatment Plant (ETP)

Concentrated sludge would be generated from water pre-treatment plant, demineralization plants, waste water treatment plants and oily water separation unit. This sludge would go to the sludge sump for dewatering and thickening. Disposal of the dry sludge might contaminate ground water of surface water if it is not properly managed. The magnitude of the impact major and sensitivity is also high. Therefore, significance of the impact is **major adverse** that calls for adoption of proper EMP.

7.5.7 Impact on Ecological Resources

Terrestrial Vegetation: As per project design, terrestrial vegetation include greenbelt will develop around the power plant site. The open space will be occupied with various native species. In addition, the height of a chimney is determined through modelling. Therefore, no adverse impact is anticipated because the contaminated flue gas does not come in contact to men or other living organisms till the contamination dilutes to permitted level.

Wildlife habitat: The greenbelt and other afforestation work will definitely be facilitated in creating wildlife habitats. On the other hand, establishment of greenbelt will protect existing wildlife habitat outside of the project site from pollution disturbance. The only negative impact can be identified as earth vibration during operation of the power plant.

7.5.8 *Impact on Social Environment*

Disturbance of Local Community: As it is currently found that the operation of the existing power plant generates noise, to which the exposed local people are feeling disturbed, particularly during the night time. This noise may also cause for brain hammering.

7.6 Summary of Assessed Impacts

The project's potential impacts and their significance have been assessed using the methodology described in the methodology part of **Chapter 1**. A summary of these impacts and their significance is presented in **Table 7.18**.

Table 7.18: Potential impacts, their significance and corresponding mitigation measures

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Pre-Construction Phase								
Physical Environment (Land Resources/ Hydrology/ Meteorology/ Air Quality/ Noise)								
Demolition of civil structures for site preparation	Soil quality	▪ Soil quality may be deteriorated due to unconsciously fallen of hazardous or non-hazardous waste generation during transport.	Waste management plan and precautionary measures have been taken in the demolition Plan.	**Low (1)** Sensitivity to the receptor is considered 'Low' as demolition-generated rubbles would mostly be sold to the vendor, the remainders may be dumped on an irregular vegetable fields for a time being.	**Minor (2)** Impact Duration: Minr (2) Spatial Extent: Minr (2) Reversibility: Minr (2) Legal Comp.: Minr (2) Likelihood: Minr (2) As such the resultant impact magnitude is (10/5= 2) 'Minor'. [Hazardous Waste and Ship Breaking Waste Management rules 2011]	**Minor Adverse (4)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Minor'. The resultant impact significance is 'Minor Adverse'.	• Demolition waste should be carried away by covered dump trucks. • Conduction of daily tool box meeting before starting work. • Water spraying for dust suppression during demolition and debris hauling.	**Minimal Adverse (1)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Low (1) and Magnitude: Minimal (1); the resultant significance is 'Minimal Adverse'.
Demolition of civil structures and Materials Handling, Clearing of vegetation and transportation activities	Dust Generation	• Concentration of $PM_{2.5}$, PM_{10}, and DSM will increase in air. • SPM of various size ranges can penetrate deeply into the lungs and cause a wide range of health problems including respiratory illness, asthma, bronchitis and even cancer. • DPM is generally consisted of soot, sulphates and silicates, all of which readily combine with other toxins in the atmosphere, increasing the health risks of particle inhalation	N/A	**Medium (2)** Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation	**Moderate (3)** Duration of potential impact: Moderate (2) Spatial extent of the potential impact: Moderate (3) Reversibility: Minor (2) Legal Comp.: Moderate (3) Likelihood: Moderate (3) == As such the resultant impact magnitude is (13/5= 2.6~3) 'Minor'.	**Moderate (6)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate (6)'.	• Follow national rules and regulations for waste management • Dust Suppression Mechanism like water spraying should be done at least two times in dry season to control generation of excessive SPM. • Screen the whole construction sites to stop dust spreading, or alternatively, place fine mesh screening close to the dust source • Properly cover piles of construction materials like cement, sand and other powders • Take care of green plantation in the study area especially on road side. • Proper and prior planning and appropriate sequencing and scheduling of all major demolition and site preparation activities • Regular inspection and maintenance of the Project vehicles should be carried out. • No unfit vehicle, vessels and machine should be allowed to move • Low sulphur diesel oil in all vehicle and equipment engines ▪ Regular monitoring of the concentration of air pollutants with highly sensitive equipment	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Medium (2) and Magnitude: 'Moderate-2.6'; the resultant significance is 'Minor (2.3~2).

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
	Exhaust Emissions	▪ Concentration of volatile chemicals including organic compounds, NO_x, SO_x, CO etc. will slightly increase from vehicular and equipment emissions. ▪ SPM of various size ranges can penetrate deeply into the lungs and cause a wide range of health problems including respiratory illness, asthma, bronchitis and even cancer. ▪ DPM is generally consisted of soot, sulphates and silicates, all of which readily combine with other toxins in the atmosphere, increasing the health risks of particle inhalation ▪ NO_x play a major role in the formation of acids in the atmosphere. NO_x also react with hydrocarbons in the presence of sun- light to produce photochemical smog. ▪ Global warming and related hazards	N/A	**Medium (2)** Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation	**Minor (2)** Duration of potential impact: Minor (2) (Short term) Spatial extent of the potential impact: Moderate (3) (Beyond immediate project components, site boundaries or local area); Reversibility: Minor (2) Legal Comp.: Moderate (3) Likelihood: Minor (2) == As such the resultant impact magnitude is (12/5= 2.4~2) 'Minor'.	**Minor (4)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Minor'. The resultant impact significance is 'Minor (4)'.	• Regular inspection and maintenance of the Project vehicles should be carried out. • No unfit vehicle, vessels and machine should be allowed to move • Low sulphur diesel oil in all vehicle and equipment engines • Regular monitoring of the concentration of air pollutants with highly sensitive equipment	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Medium (2) and Magnitude: 'Minor-2.4'; the resultant significance is 'Minor (2.2~2).
Demolition of civil structures and Materials Handling, Clearing of vegetation and transportation activities	Ambient Noise Level	▪ noise will be generated during demolition of the existing buildings and other structures and from the moving and idling vehicles and operation of heavy machineries. These activities may lead to lead to disturbances, increased stress level, increased blood pressure and other health complications to the staffs, workers, nearby communities and local people.	Boundary wall will be installed around the Project boundary.	**Medium (2)** Sensitivity to the receptor is considered 'Medium' as the vulnerable receptor has little capacity to absorb proposed changes.	**Moderate (3)** Impact Duration: Minr (2) Spatial Extent: Minr (2) Reversibility: Mod (3) Legal Comp.: Minr (2) Likelihood: Majr (4) As such the resultant impact magnitude is (13/5= 2.6~3) 'Moderate'	**Moderate Adverse (6)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate Adverse'.	• Limiting the project activity within daytime only • Workers should be provided with ear plug/ear muff headphone • Speed limit should be limited • Reduce unnecessary vehicle movement	**Minimal Adverse (4)** Changes magnitude with implementation of suggested mitigation measures. Sensitivity: Medium (2) and Magnitude: Minor (2); the resultant significance is 'Moderate Adverse'.
Water Resources	Drainage	▪ Drainage in the Project area may be affected due to stocking of demolished materials, sand dumping	Precautionary measures have to be taken in the Demolition Plan.	**Low (1)** The sensitivity is considered 'Minor" as vulnerable receptor	**Minimal (1)** Impact Duration: Minor (1) Spatial Extent: Minor (1) Reversibility: Minor (1)	**Minimal Adverse (1)** Sensitivity of receptor is found 'Minimal' while the magnitude is assessed	• Demolition waste should be carried away by covered dump trucks.	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		and malfunctioning of the drainage system.		(environmental elements) has good opportunities for mitigation.	Legal Comp.: Minor (1) [ECR, 1997] Likelihood: Minor (1) As such the resultant impact magnitude is (5/5= 1) 'Minimal'.	as 'Minor'. The resultant impact significance is 'Minor Adverse'.		suggested mitigation measures. Sensitivity: Low (1); Magnitude: Minimal (2); the resultant significance is 'Minimal Adverse'
Waste Generation	Non-Hazardous	▪ Solid and liquid waste would be generated due to demolition of existing structures and temporary settlement of labor shed.	A place within the project site should be selected for holding the non-hazardous materials temporarily.	**Medium (2)** Sensitivity to the receptor is considered 'Medium' as the vulnerable receptor has little capacity to absorb proposed changes.	**Moderate (3)** Impact Duration : Minr (2) Spatial Extent : Minr (2) Reversibility : Mod (3) Legal Comp. : Minr (2) Likelihood : Majr (4) As such the resultant impact magnitude is (13/5= 2.6~3) 'Moderate'	**Moderate Adverse (6)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate Adverse'.	• Non-hazardous waste should be placed in a specific location and carried away carefully by covered dump trucks	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Low (1); Magnitude: Minimal (2); the resultant significance is 'Minimal Adverse'
Biological Environment (Agriculture/ Fisheries/ Ecology)								
Site establishment	Terrestrial vegetation	A total of 94 trees include herbs, and shrubs need to be cut.	No plan has developed.	**Very High (4)** Sensitivity of receptors to be very high	**High (3)** Impact Duration : Majr (4) Spatial Extent : Minr (2) Reversibility : Majr(4) Legal Comp. : Minm (1) Likelihood : Majr (4) As such the resultant impact magnitude is (15/5= 3) 'Minor'.	**Major Adverse (12)** Sensitivity of receptor is found 'Very High' while the magnitude is assessed as 'High'. The resultant impact significance is 'Major Adverse'**.**	• Demark area to be cleared • Cut trees as low as possible • Keep felled trees within designated **area**	**Moderate Adverse (6)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: High (3) and Magnitude: Moderate (2); the resultant significance is '**Moderate Adverse'.**
Site establishment	Wildlife habitat	Demolition of perching trees	No plan has developed.	**Low (1)** Sensitivity of receptors will be low.	**Minor (2)** Impact Duration : Majr (4) Spatial Extent : Minm (1) Reversibility : Minr. (2) Legal Comp. : Minm (1) Likelihood : Majr (4) As such the resultant impact magnitude is (12/5= 2.4~2) 'Minor'.	**Minimal Adverse (3)** Sensitivity of receptor found 'Low' while the magnitude is assessed as 'Minor'. The resultant impact significance is 'Moderate Adverse'**.**	Plant trees outside of the project	**Minimal Adverse (3)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Low (1) and Magnitude: Minor (2); the resultant significance is '**Minimal Adverse'.**
Social Environment (Socio-Economic)								
Demolition of infrastructures and scraping	health and safety	▪ Labors using inadequate PPEs may fall under serious injury during occurrence of unexpected accidents.	Obligation to maintaining rules and regulations of BLA, 2006; ILO, 1998; EP-III and IFC PS-I, PS-II for the EPC contractor.	**High (3)** Sensitivity is considered 'High'; even if maintaining abatement measures, chance of accidental occurrence may also have during demolition activities.	**Minor (2)** Impact Duration : Minr (2) Spatial Extent : Minr (2) Reversibility : Mod (3) Legal Comp. : Minr (2) [Bangladesh Labour Act (BLA), 2006, ILO Declaration on	**Moderate Adverse (6)** Significance of impact assumed moderate adverse considering the sensitivity and intensity of impact	• Safety talk should be ensured through EPC contractor in each day, prior to starting the work • Awareness should be disseminated using local language and instruments.	**Minimal Adverse (3)** Suggested mitigation measures may decrease the magnitude of impact as 'Minor' (2) to 'Minimal' (1). Thus the resultant

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					Fundamental Rights and Principles (ILO, 1998), IFC PS-II, and Equator Principle-III] Likelihood : Minr (2) The resultant average impact magnitude is (11/5= 2.2~2) 'Minor'.		• Contractor should establish grievance mechanism for the labors with proper documentation. • Medical insurance of labors should be ensured.	significance is 'Minimal Adverse'.
	Disturbance of local community	▪ Noise of demolishing the structures will disturb the surrounding local community	No abatement is addressed	**Medium (2)** Sensitivity is considered 'Medium'; even if maintaining abatement measures as per the guideline of DoE.	**Minor (2)** Impact Duration : Minr (2) Spatial Extent : Mod (3) Reversibility : Minr (2) Legal Comp : Minr (2) [Bangladesh Labour Act (BLA), 2006, ILO Declaration on Fundamental Rights and Principles (ILO, 1998), IFC PS-II, and Equator Principle-III] Likelihood : Mod (2) As such the resultant impact magnitude is (11/5= 2.2) 'Minor'.	**Minor Adverse (4)** Significance of impact assumed moderate adverse considering the sensitivity and intensity of impact	• Restriction of DoE should be obeyed during implementing noise producing activity • Should used technology based equipment during demolishing • Should use noise absorbent panels so that dissemination of noise to the outside can be controlled.	**Minimal Adverse (2)** Suggested mitigation measures may decrease the magnitude of impact as 'Minor' (2) to 'Minimal' (1). Thus the resultant significance is 'Minimal Adverse'.
	Employment generation	▪ Around 100- 150 number of unskilled, semi-skilled and skilled labors will be engaged temporarily for the demolition works and around 10 supervisor will be engaged to monitor and supervise them.	The proponent has been suggested to deploy local labors during demolition of existing structures following the guideline of BLA, 2006; ILO, 1998.	**Medium (2)** The sensitivity assessed medium because temporary livelihood of some labors would be generated.	**Minor (2)** Impact Duration : Minr (2) Spatial Extent : Mod (3) Reversibility : Minr (2) Legal Comp. : Minr (2) [Bangladesh Labour Act (BLA), 2006, ILO Declaration on Fundamental Rights and Principles (ILO, 1998), IFC PS-II, and Equator Principle-III] Likelihood : Mod (3) As such the resultant impact magnitude is (12/5= 2.4~2) 'Minor'.	**Minor Benefit (4)** The Sensitivity is found 'Medium' while the magnitude is assessed as 'Minor'. Thus, the resultant impact significance is 'Minor Benefit'.	• The contractor should be bounded to engage at least by 50% of total labors from the locality through contract agreement.. • Labour wage should be fixed based on the current wage rate of the area. • Consider gender issues in employment opportunity. • EPC Contractor should oblige to obey the rules and regulations of BLA, 2006; and ILO, 1998.	**Moderate Benefit (6)** Suggested enhancement measures may increase the magnitude of impact from 'Minor' (2) to 'Moderate'(3). Thus the resultant significance is 'Moderate Benefit'.
Site preparation	Employment generation	▪ The site preparation activities will require around 75- 100 temporary unskilled, semi-skilled and skilled labors .	The proponent has been suggested to deploy local labors during site preparation following the guideline of BLA, 2006; ILO, 1998.	**Medium (2)** The sensitivity assessed medium because temporary livelihood of some labors would be generated.	**Minimal (1)** Impact Duration : Mini (1) Spatial Extent : Mini (1) Reversibility : Mini (1) Legal Comp. : Minr (2) [Bangladesh Labour Act (BLA), 2006, ILO Declaration on Fundamental Rights and Principles	**Minimal Benefit (2)** The Sensitivity is found 'Medium' while the magnitude is assessed as 'Minimal'. Thus, the resultant impact significance is 'Minimal Benefit'.	• Project surroundings unemployed potential people should get prioritized in recruitment. • Labour wage should be fixed based on the current wage rate of the project mouza. • Consideration on gender issues regarding employment. • EPC Contractor should oblige to obey the rules and regulations of	**Minor Benefit (4)** Suggested enhancement measures may increase the magnitude of impact from 'Minimal' (1) to 'Minor'(2). Thus the resultant significance is 'Minor Benefit'.

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					(ILO, 1998), IFC PS-II, and Equator Principle-III] Likelihood : Minr (2) As such the resultant impact magnitude is (7/5= 1.4) 'Minimal'.		BLA, 2006; ILO, 1998; EP-III and IFC PS-II.	
Transportation of equipment and materials to the project Site	health and safety	▪ Saidpur bypass –Some portion of Nilphamari road is using for road widening construction activity. Therefore the road becomes narrow and risky to move heavy vehicles. About 500m of these under construction road may need to be crossed for material carrying vehicles during construction phase.	The material carrying activities may start after finishing the road construction activity (which might be completed before monsoon of this year, 2019).	**Medium (2)** The sensitivity assessed medium because uncertain occurrences of road accident.	**Minor (2)** Impact Duration : Minr (2) Spatial Extent : Minr (2) Reversibility : Mod (3) Legal Comp. : Minr (2) [Bangladesh Labour Act (BLA), 2006, ILO Declaration on Fundamental Rights and Principles (ILO, 1998), IFC PS-II, and Equator Principle-III] Likelihood : Minr (2) The resultant average impact magnitude is (11/5= 2.2) 'Minor'.	**Minor Adverse (4)** Significance of impact assumed minor adverse considering the sensitivity and intensity of impact	• Should deploy traffic guards in the project site for maintaining road traffic during material heavy vehicles will be moved. • The authority should introduce some emergency medical facilities in their own compound to support in accidental occurrences. • EPC contractor should establish grievance mechanism for the labors with proper documentation	**Minimal Adverse (2)** Suggested mitigation measures may decrease the magnitude of impact as 'Minor' (2) to 'Minimal' (1). Thus the resultant significance is 'Minimal Adverse'.
Construction Phase								
Physical Environment (Land Resources/Hydrology/Meteorology/Air Quality/Noise)								
Disposal of construction waste during building, infrastructure, utility unit and power plant construction	Soil quality	Unplanned and indiscriminate disposal of solid and liquid waste may affect soil quality.	N/A	**Medium (2)** The sensitivity is considered 'Medium' as vulnerable receptor (environmental elements) has moderate opportunities for mitigation.	**Minor (2)** Impact Duration: Minr (2) Spatial Extent: Minr (2) Reversibility: Minr (2) Legal Comp.: Minr (2) [ECR, 1997] Likelihood: Minr (2) As such the resultant impact magnitude is (10/5= 2) 'Minor'.	**Minor adverse (4)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Minor'. The resultant impact significance is 'Minor Adverse'.	• Hazardous wastes should be disposed in a designated place with precautionary measures. • Good housekeeping will be adopted to reduce generation of construction wastes.	**Minimal Adverse (1)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Low (1); Magnitude: Minimal (1); the resultant significance is 'Minimal Adverse'.
Transportation activities including excavation of soil to create building and equipment foundations, dust generated from stockpiles of materials, waste, loose earth, handling and moving excavated material and transporting wastes on vehicles etc.	Dust Generation	▪ Concentration of $PM_{2.5}$, PM_{10}, and DSM will increase in air. ▪ SPM of various size ranges can penetrate deeply into the lungs and cause a wide range of health problems including respiratory illness, asthma, bronchitis and even cancer. ▪ DPM is generally consisted of soot, sulphates and silicates, all of which readily combine	N/A	**Medium (2)** Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation	**Moderate (3)** Duration of potential impact: Moderate (2) Spatial extent of the potential impact: Moderate (3) Reversibility: Minor (2) Legal Comp.: Moderate (3) Likelihood: Moderate (3) == As such the resultant impact magnitude is (13/5= 2.6~3) 'Minor'.	**Moderate (6)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate (6)'.	• Follow national rules and regulations for waste management • Dust Suppression Mechanism like water spraying should be done at least two times in dry season to control generation of excessive SPM. • Screen the whole construction sites to stop dust spreading, or alternatively, place fine mesh screening close to the dust source • Properly cover piles of construction materials like cement, sand and other powders	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Medium (2) and Magnitude: 'Moderate-2.6'; the resultant significance is 'Minor (2.3~2). So, no action is needed to start work.

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		with other toxins in the atmosphere, increasing the health risks of particle inhalation					• Take care of green plantation in the study area especially on road side. • Proper and prior planning and appropriate sequencing and scheduling of all major demolition and site preparation activities • Regular inspection and maintenance of the Project vehicles should be carried out. • No unfit vehicle, vessels and machine should be allowed to move • Low sulphur diesel oil in all vehicle and equipment engines • Regular monitoring of the concentration of air pollutants with highly sensitive equipment • the access road will be regularly maintained to keep it clean, free from mud and slurry • Road should be constructed by brick shoaling or bituminous before using it	
Exhaust emission from movement of heavy equipment by large vehicles which includes operation of diesel generators and other diesel based construction machineries	Exhaust Emissions	▪ SPM of various size ranges can penetrate deeply into the lungs and cause a wide range of health problems including respiratory illness, asthma, bronchitis and even cancer. ▪ DPM is generally consisted of soot, sulphates and silicates, all of which readily combine with other toxins in the atmosphere, increasing the health risks of particle inhalation ▪ NOx play a major role in the formation of acids in the atmosphere. NOX also react with hydrocarbons in the presence of sun- light to produce photochemical smog	N/A	**Medium (2)** Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation	**Moderate (3)** impact: Minor (2) (Short term); Spatial extent of the potential impact: Moderate (3) (Beyond immediate project components, site boundaries or local area); Reversibility: Minor (2) Legal Comp.: Moderate (3) Likelihood: Moderate (3) == As such the resultant impact magnitude is (13/5= 2.6~3) ‘Minor’.	**Moderate (6)** Sensitivity of receptor is found ‘Medium’ while the magnitude is assessed as ‘Moderate’. The resultant impact significance is ‘Moderate (6)’.	• A speed limit of 20 km/hr will be enforced on the construction site/access road; • Regularly maintain all diesel-powered equipment and reduce idling time to avoid emissions of NOx, PM10 • Use of high speed diesel (HSD) with sulphur content < 0.25% in HGVs and diesel powered equipment; • Vehicle / equipment exhausts observed to be emitting significant black smoke from their exhausts will be serviced/ replaced. • Use non-toxic paints, solvents and other hazardous materials for construction, wherever possible • No burning of materials on site	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Medium (2) and Magnitude: ‘Moderate-2.6’; the resultant significance is ‘Minor (2.3~2). So, no action is needed to start work.

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Noise would be generated from the moving and idling vehicles and heavy machineries used for Civil, mechanical, electrical and other construction activities, which may cause disturbance to the ambient environment	Ambient noise level	▪ These activities may lead to lead to disturbances, increased stress level, increased blood pressure and other health complications to the staffs, workers, nearby communities and local people.	Boundary wall will be installed around the Project boundary.	**Medium (2)** Sensitivity to the receptor is considered 'Medium' as the vulnerable receptor has little capacity to absorb proposed changes.	**Moderate (3)** Impact Duratio: Minr (2) Spatial Extent: Minr (2) Reversibility: Mod (3) Legal Comp.: Minr (2) Likelihood: Majr (4) As such the resultant impact magnitude is (13/5= 2.6~3) 'Moderate'	**Moderate Adverse (6)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate Adverse'.	• Limiting the arbitrary whistle or honking from the vehicles and vessels • Construction activities in the Project area should be limited only within daytime • Workers should be provided with ear plug/ear muff headphone • High noise generating machines and unfit vehicles should not be allowed in the project area. • Vehicles and machines that are not in use shall be switched off	**Minimal Adverse (4)** Changes magnitude with implementation of suggested mitigation measures. Sensitivity: Medium (2) and Magnitude: Minor (2); the resultant significance is 'Moderate Adverse'.
Water Resources	Drainage	• The Power Plant stations and control unit, storage sections, disposal zone etc. will be constructed at this stage. The drainage in the Project area may be affected due to construction materials, sand dumping and lack of management of the drainage system.	Regular inspection is to be made, particularly following heavy rainfall, to determine the effectiveness of the mitigation measure.	**Low (1)** The sensitivity is considered 'Minor" as vulnerable receptor (environmental elements) has good opportunities for mitigation.	**Minimal (1)** Impact Duration: Minor (1) Spatial Extent: Minor (1) Reversibility: Minor (1) Legal Comp.: Minor (1) [ECR, 1997] Likelihood: Minor (1) As such the resultant impact magnitude is (5/5= 1) 'Minimal'.	**Minimal Adverse (1)** Sensitivity of receptor is found 'Minimal' while the magnitude is assessed as 'Minor'. The resultant impact significance is 'Minor Adverse'.	• Construction waste should be carried away by covered dump trucks.	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Low (1); Magnitude: Minimal (2); the resultant significance is 'Minimal Adverse'
Waste Generation	Non-Hazardous	• Solid and liquid waste would be generated due to different phase of construction work.	A place within the project site should be selected for holding the non-hazardous materials temporarily.	**Medium (2)** Sensitivity to the receptor is considered 'Medium' as the vulnerable receptor has little capacity to absorb proposed changes.	**Moderate (3)** Impact Duratio: Minr (2) Spatial Extent: Minr (2) Reversibility: Mod (3) Legal Comp.: Minr (2) Likelihood: Majr (4) As such the resultant impact magnitude is (13/5= 2.6~3) 'Moderate'	**Moderate Adverse (6)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate Adverse'.	• Non-hazardous waste should be placed in a specific location and carried away carefully by covered dump trucks	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Low (1); Magnitude: Minimal (2); the resultant significance is 'Minimal Adverse'
Biological Environment (Agriculture/ Fisheries/ Ecology)								
Civil, mechanical, electrical and other constructions	Terrestrial vegetation	• Transportation of construction goods, dust particulates generated by construction machines.	No plan has been developed.	**Medium (2)** Sensitivity of receptors will be medium.	**Minor (2)** Impact Duration: Minr (2) Spatial Extent: Minr (2) Reversibility: Mod (3) Legal Comp.: Minr (2) [World Bank's Environmental and Social Framework 2017] Likelihood: Mod.(3) As such the resultant impact magnitude is (12/5= 2.4~2) 'Minor'.	**Minor Adverse (4)** Sensitivity of receptor found 'Medium' while the magnitude is assessed as 'Minor'. The resultant impact significance is 'Minor Adverse'.	• Spray water on construction sites to control dust particulates; • Use cover to the loaded truck to minimize dust particulates and accidental dropping of construction materials (e.g. brick, stone, etc.) during transporting	**Minimal Adverse (3)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Low (1) and Magnitude: Minor (2); the resultant significance is 'Minimal Adverse'.

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
	Wildlife habitat	Noise generation, construction site's lighting and vehicle and labor movements	No plan has been developed.	**Medium (2)** Sensitivity of receptors will be medium.	**Moderate (3)** Impact Duration: Minr (2) Spatial Extent: Mod. (3) Reversibility: Mod (3) Legal Comp.: Mod. (3) [World Bank's Environmental and Social Framework 2017] Likelihood: Mod.(3) As such the resultant impact magnitude is (14/5= 2.8~3) 'Moderate'.	**Moderate Adverse (6)** Sensitivity of receptor found 'Medium' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate Adverse'**.**	• Use low sound emission construction machines; • Keep lights downwardly at night; and • Labor and vehicle movement should wary to avoid disturbance to wildlife and their habitats.	**Minimal Adverse (1)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Low (1) and Magnitude: Minimal (1); the resultant significance is 'Minimal Adverse'
Social Environment (Socio-Economic)								
Civil, mechanical, electrical and other constructions	Disturbance of local community	• Noise of construction machineries/ equipment will disturb the surrounding local community	No abatement is addressed	**High (3)** Sensitivity is considered 'High'; even if maintaining abatement measures as per the guideline of DoE.	**Moderate (3)** Impact Duration : Mod (3) Spatial Extent : Mod (3) Reversibility : Minr(2) Legal Comp. : Minr (2) [Bangladesh Labour Act (BLA), 2006, ILO Declaration on Fundamental Rights and Principles (ILO, 1998), IFC PS-II, and Equator Principle-III] Likelihood : Mod (3) As such the resultant impact magnitude is (13/5= 2.6~3) 'Moderate'.	**Major Adverse (9)** Significance of impact assumed major adverse considering the sensitivity and intensity of impact	• Restriction of DoE should be obeyed during implementing noise producing activity • Should use modern technology based equipment during demolishing • Should use noise absorbent panels so that spreading of noise to the outside the construction area can be controlled.	**Moderate Adverse (6)** Suggested mitigation measures may decrease the magnitude of impact as 'Moderate' (3) to 'Minor' (2). Thus the resultant significance is 'Moderate Adverse'.
Civil, mechanical, electrical and other constructions	health and safety	• Labors using inadequate PPEs may fall under serious injury during occurrence of unexpected accidents.	Obligation to maintaining rules and regulations of BLA, 2006; ILO, 1998; EP-III and IFC PS-I, PS-II for the EPC contractor.	**High (3)** Sensitivity is considered 'High'; even if maintaining abatement measures, chance of accidental occurrence may also have during demolition activities.	**Moderate (3)** Impact Duration : Mod (3) Spatial Extent : Minr (2) Reversibility : Maj (4) Legal Comp. : Minr (2) [Bangladesh Labour Act (BLA), 2006, ILO Declaration on Fundamental Rights and Principles (ILO, 1998), IFC PS-II, and Equator Principle-III] Likelihood : Maj (4) The resultant average impact magnitude is (15/5= 3) 'Moderate'.	**Major Adverse (9)** Significance of impact assumed major adverse considering the sensitivity and intensity of impact	• Safety talk should be ensured through EPC contractor in each day prior to starting the work • Aware knowledge should be disseminated using local language and instruments. • EPC contractor should establish grievance mechanism for the labors with proper documentation. • Medical insurance of labors should be ensured.	**Moderate Adverse (6)** Suggested mitigation measures may decrease the magnitude of impact as 'Major' (3) to 'Minor' (2). Thus the resultant significance is 'Moderate Adverse'.
Civil, mechanical, electrical and other constructions	Employment generation	• Around 300- 500 number of unskilled, semi-skilled and skilled labors will be engaged temporarily for the construction activities	The proponent has been suggested to deploy local labors during	**High (3)** The sensitivity assessed 'High' because temporary livelihood of numbers labors would be generated.	**Moderate (3)** Impact Duration : Mod (3) Spatial Extent : Mod (3) Reversibility : Minr (2)	**Major Benefit (9)** The Sensitivity is found 'High' while the magnitude is assessed as 'Moderate'. Thus, the	• Project surroundings unemployed potential people should get prioritized in recruitment.	**Major Benefit (12)** Suggested enhancement measures may increase the magnitude of impact

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		that include civil works and plumbing and around 10 supervisor will be engaged to monitor and supervise them.	demolition of existing structures following the guideline of BLA, 2006; ILO, 1998.		Legal Comp. : Minr (2) [Bangladesh Labor Act (BLA), 2006, ILO Declaration on Fundamental Rights and Principles (ILO, 1998), IFC PS-II, and Equator Principle-III] Likelihood : Maj (4) As such the resultant impact magnitude is (14/5= 2.8~3) 'Moderate'.	resultant impact significance is 'Major Benefit'.	• Labour wage should be fixed based on the current wage rate of the project mouza. • Consideration on gender issues regarding employment. • EPC Contractor should oblige to obey the rules and regulations of BLA, 2006; and ILO, 1998.	from 'Moderate' (3) to 'Major'(4). Thus the resultant significance is 'Major Benefit'.
Operation Phase								
Physical Environment (Land Resources/ Hydrology/ Meteorology/ Air Quality/ Noise)								
Power Plant operation	Agriculture land use	Valuable agricultural land might be changed to industrial and others infrastructural development.	N/A	**High (3)** The sensitivity is considered 'High' as vulnerable receptor has moderate opportunities for mitigation.	**Moderate (3)** Impact Duration: Majr (4) Spatial Extent: Mod (3) Reversibility: Majr (4) Legal Comp.: Minr (2) Likelihood: Majr (4) As such the resultant impact magnitude is (17/5= 3.4~3) 'Moderate'	**Major (9)** Sensitivity of receptor is found 'High' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Major Adverse'.	• A local/ regional plan should be prepared by the concerned Government Authority to guide the plan induced development and conserve agricultural land from the invasion. • The fallow/infertile lands should be brought under cultivation. • There should be concerned to infertile lands brought under infrastructural development. • Compensate the landowner based on the prevailing Government Rule for acquisition of any agricultural land in future.	**Minor Adverse (2)** Changes in magnitude with implementation of suggested mitigation measures. Sensitivity: Medium (2); Magnitude: Minr (2); the resultant significance is 'Minor Adverse'.
• Little amount of particulate emissions (<1 μm diameter) in the form of un-burnt hydrocarbons and Volatile Organic Chemicals (VOCs) such as benzene and formaldehyde, may be released due to the incomplete combustion of diesel based fuel source.	Dust Generation	• Small amount of particulate emissions (<1 μm diameter) in the form of un-burnt hydrocarbons and Volatile Organic Chemicals (VOCs) such as benzene and formaldehyde, may also be released because of the incomplete combustion of the fuel source.	N/A	**Medium (2)** Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation	**Minimal (2)** Duration of potential impact: Major (4) Spatial extent of the potential impact: Moderate (3) Reversibility: Minimal (1) Legal Comp.: Minor (2) Likelihood: Minimal (1) == As such the resultant impact magnitude is (11/5= 2.2~2) 'Minor'.	**Minor (4)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Minor'. The resultant impact significance is 'Minor (4)'.	• PM2.5 and VOCs will be monitored periodically, to ensure that these emissions are not occurring as a result of the incomplete burning of the diesel fuel	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Medium (2) and Magnitude: 'Minor - 2'; the resultant significance is 'Minor (2). So, no action is needed to start work.
• Operation of Gas Turbine running with HSD of 150 MW will emit SO_2,	Exhaust Emissions	• The operation of the plant with Diesel as fuel may generate little amount of	N/A	**Medium (2)** Vulnerable receptor with some capacity to absorb proposed changes or	**Minimal (2)** Duration of potential impact: Major (4)	**Minimal (4)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed	• To ensure compliance with the air emission criteria for flue gas stacks, the following measures are	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
NO_x and CO continuously at 50m stacks		flue gas emissions containing NOx. • Emissions of SO2 are expected to be very much insignificant. Particulate emissions are also likely to be negligible. A very little amount of particulate emissions (<1 µm diameter) in the form of un-burnt hydrocarbons and Volatile Organic Chemicals (VOCs) such as benzene		moderate opportunities for mitigation	Spatial extent of the potential impact: Moderate (3) Reversibility: Minimal (1) Legal Comp.: Minor (2) Likelihood: Minor (1) == As such the resultant impact magnitude is (11/5= 2.2~2) 'Minimal'.	as 'Minimal'. The resultant impact significance is 'Minimal (4)'.	suggested to be implemented during the operation phase: • The use of continuous emission monitoring (CEM) equipment for the measurement of air emission levels in the exhaust stack • CEM should be undertaken for SO2, and NOx • PM2.5 and VOCs will be monitored periodically, to ensure that these emissions are not occurring as a result of the incomplete burning of the fuel • The stack will be provided with safe access to sampling points for CEM. • Also follow national rules and regulations for waste management	suggested mitigation measures. Sensitivity: Medium (2) and Magnitude: 'Minimal ~1'; the resultant significance is 'Minimal (1.5). So, no action is needed to start work.
The ambient noise level would increase due noise generation during operation of the plant.	Ambient Noise	Persistence exposure to the high level of noise can have adverse health impacts and can increase the level of stress to the susceptible individuals.	Boundary wall will be installed around the Project boundary. Proper insulation of noise generating machineries.	**High (3)** Sensitivity to the receptor is considered 'Medium' as the vulnerable receptor has little capacity to absorb proposed changes.	**Moderate (3)** Impact Duratio: Minr (2) Spatial Extent: Minr (2) Reversibility: Mod (3) Legal Comp.: Minr (2) Likelihood: Majr (4) As such the resultant impact magnitude is (13/5= 2.6~3) 'Moderate'	**Major (9)** Sensitivity of receptor is found 'High" while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate Adverse'.	• Modern low noise generating machines should be used • All major rotating will be covered by noise proof hoods • Doors and windows of control room will be provided with noise proof seals • Workers should be provided with ear plug/ear muffler headphone • Green belt should be developed around the proposed Power Plant area	**Moderate Adverse (6)** Suggested mitigation measures may decrease the magnitude of impact as 'Major' (3) to 'Minor' (2). Thus the resultant significance is 'Moderate Adverse'
Waste Generation	Non-Hazardous	• Solid and liquid waste would be generated due to increased number of household in the project area.	A place within the project site should be selected for holding the non-hazardous wastes and it should be removed as early as possible.	**Medium (2)** The sensitivity is considered 'Medium' as vulnerable receptor has moderate opportunities for mitigation.	**Moderate (3)** Impact Duration: Majr (4) Spatial Extent: Mod (3) Reversibility: Majr (4) Legal Comp.: Minr (2) Likelihood: Majr (4) As such the resultant impact magnitude is (17/5= 3.4~3) 'Moderate'	**Moderate (6)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate Adverse'.	• Household wastes should be cleaned at a regular basis by the local authority.	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Medium (2) and Magnitude: 'Minimal ~1'; the resultant significance is 'Minimal (1.5). So, no action is needed to start work.
	Hazardous waste	• Liquid wastes/ may generate from cooling tower blow down, water from leaks and vents, waste water from turbine floor and workers' colony	Liquid hazardous wastes generated from the plant activity should be passed through the Effluent Treatment Plant (ETP) and may	**Medium (2)** The sensitivity is considered 'Medium' as vulnerable receptor has moderate opportunities for mitigation.	**Moderate (3)** Impact Duration: Majr (4) Spatial Extent: Mod (3) Reversibility: Majr (4) Legal Comp.: Minr (2) Likelihood: Majr (4)	**Moderate (6)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate Adverse'.	• Liquid wastes should be quickly eradicated from the storage tank by liquid hazard carrying trucks. • Sludge generated from the ETP or WTP should be managed environmentally following the guideline of DoE.	**Minimal Adverse (2)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Medium (2) and Magnitude: 'Minimal

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		and offices and oily water separation unit.	use the treated water for further use.		As such the resultant impact magnitude is (17/5= 3.4~3) 'Moderate'			~1'; the resultant significance is 'Minimal (1.5). So, no action is needed to start work.
Biological Environment (Agriculture/ Fisheries/ Ecology)								
Induced development in the study area due to Power Plant operation	Agriculture crop production	• The crop production might be loss due to invasion of agricultural land. • Establishment of transmission tower would affect the agricultural production.	N/A	**Medium (2)** The sensitivity is considered 'Medium' as vulnerable receptor has moderate opportunities for mitigation.	**Moderate (3)** Impact Duration: Majr (4) Spatial Extent: Mod (3) Reversibility: Majr (4) Legal Comp.: Minr (2) Likelihood: Majr (4) As such the resultant impact magnitude is (17/5= 3.4~3) 'Moderate'	**Moderate (6)** Sensitivity of receptor is found 'Medium' while the magnitude is assessed as 'Moderate'. The resultant impact significance is 'Moderate Adverse'.	• Food security should be assured by increasing crop production and cropping intensity. It should be done through the use of modern technology in the crop production. • Farmers should be properly trained about the system and management of GAP (Good Agricultural Practices)/ ICM/ IPM (Integrated Crop Management/ Integrated Pest Management)	**Minor Adverse (2)** Changes in magnitude with implementation of suggested mitigation measures. Sensitivity: Low (1); Magnitude: Minr (2); the resultant significance is 'Minimal Adverse'.
Fisheries Resources	Fish habitat area and habitat quality.	No loss	NA	**Low (1)** The sensitivity is considered 'Minor" as vulnerable receptor (environmental elements) has good opportunities for mitigation.	**Minimal (1)** Impact Duration: Minor (1) Spatial Extent: Minor (1) Reversibility: Minor (1) Legal Comp.: Minor (1) [ECR, 1997] Likelihood: Minor (1) As such the resultant impact magnitude is (5/5=1) 'Minimal'.	**Minor (1)** Sensitivity of receptor is found 'Minimal' while the magnitude is assessed as 'Minor'. The resultant impact significance is 'Minor Adverse'.	Waste product should be dump in protected and save place. And ground water should be used in optimal level.	**Minimal Adverse (1)** Magnitude: Minimal (1); the resultant significance is 'Minimal Adverse'.
	Fish species composition	No loss						
	Fish production	No loss						
Implementation of EMP	Terrestrial vegetation	Greenbelt and associated plantation	A large-scale afforestation and green belt development activities shall be undertaken in all available spaces except the switchyard site within the proposed Project area.	**Minimal (1)** Sensitivity of receptors will be minimal.	**Minor (2)** Impact Duration: Majr (4) Spatial Extent: Minr. (2) Reversibility: MInm. (1) Legal Comp.: MInm. (1) [World Bank's Environmental and Social Framework 2017] Likelihood: Majr.(4) As such the resultant impact magnitude is (12/5= 2.4~2) 'Minor'.	**Minimal Beneficial (2)** Sensitivity of receptor found 'Minimal' while the magnitude is assessed as 'Minor'. The resultant impact significance is 'Minimal Beneficial'.	• **Develop a** greenbelt with all strata and all-season fruiting plants; and • Plant rough bark broadleaved trees plants.	**Moderate Beneficial (6)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Minor (2) and Magnitude: Moderate (3); the resultant significance is 'Moderate Beneficial'.
	Wildlife habitat	New habitat creation; earth vibration during power generation	No plan has developed.	**High (3)** Sensitivity of receptors will be high.	**Minor (2)** Impact Duration: Majr (4) Spatial Extent : Mod. (3) Reversibility : Minr.. (2) Legal Comp. : Mod.. (3) [World Bank's Environmental and Social Framework 2017] Likelihood : Majr.(4) **As such the resultant impact magnitude is (16/5= 3.2~3) 'Minor'.**	**Moderate Adverse (6)** Sensitivity of receptor found 'High' while the magnitude is assessed as 'Minor'. The resultant impact significance is 'Moderate Adverse'.	Take necessary measure on reducing vibration on earth during operation.	**Minimal Adverse (3)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Minimal (1) and Magnitude: Moderate (3); the resultant significance is '**Minimal Adverse'.**

Activities	IESCs	Impact and Risk from various activities	Abatement Measures	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Social Environment (Socio-Economic)								
Operation of the Plant	Disturbance of local community	• Noise of the plant will disturb the surrounding local community	No measures are addressed yet	**Medium (2)** Sensitivity is considered 'Medium'; even if maintaining abatement measures as per the guideline of DoE.	**Minor (2)** Impact Duration : High (4) Spatial Extent : Mod (3) Reversibility : Minr (1) Legal Comp. : Minr (2) Likelihood : Mod (2) As such the resultant impact magnitude is (12/5= 2.4~2) 'Minor'.	**Minor Adverse (4)** Significance of impact assumed moderate adverse considering the sensitivity and intensity of impact	• Should use modern technology producing less noise during operation the plant • Should use noise absorbent panels so that diffusion of noise to the outside of the plant can be protected.	**Minimal Adverse (2)** Suggested mitigation measures may decrease the magnitude of impact as 'Minor' (2) to 'Minimal' (1). Thus the resultant significance is 'Minimal Adverse'.
	health and safety	• Workers of the plant may fall in injuries even casualty or life loss in case of occurring accidents during operation of the plant. In addition, accidental occurrences during plant operation may affect life and assets in the surrounding community.	Currently not addressed.	**High (3)** Sensitivity is considered 'High'; even if maintaining abatement measures, chance of accidental occurrence may also have during demolition activities.	**Moderate (3)** Impact Duration : Mod (3) Spatial Extent : Minr (2) Reversibility : Maj (4) Legal Comp. : Minr (3) [Bangladesh Labour Act (BLA), 2006, ILO Declaration on Fundamental Rights and Principles (ILO, 1998), IFC PS-II, and Equator Principle-III] Likelihood : Minr (2) The resultant average impact magnitude is (14/5= 2.8~3) 'Moderate'.	**Major Adverse (9)** Significance of impact assumed major adverse considering the sensitivity and intensity of impact	• Awareness scheme should be disseminated using local language and instruments. • Authority should establish medical center in their own premises. • Medical/life insurance of employees should be ensured.	**Minimal Adverse (3)** Suggested mitigation measures may decrease the magnitude of impact as 'Major' (3) to 'Minimal' (1). Thus the resultant significance is 'Minimal Adverse'.
	Employment generation	• Around 50- 75 people will be engaged in different levels such as Plant Engineer, officials for operation and maintenance activities, accountants, Guards, labors etc.	Not addressed	**Medium (2)** Sensitivity is considered 'Medium'	**Moderate (3)** Impact Duration : Maj (4) Spatial Extent : Minr (2) Reversibility : Min (1) Legal Comp. : Maj (4) Likelihood : Maj (4) The resultant average impact magnitude is (15/5= 3) 'Moderate'.	**Moderate Beneficial (6)** Significance of impact assumed moderate beneficial considering the sensitivity and intensity of impact	• Priority should be given to the local people if they are qualified, experienced and skilled in respective specialized position.	**Moderate Beneficial (9)** Changes in sensitivity and magnitude with implementation of suggested mitigation measures. Sensitivity: Moderate (3) and Magnitude: High (3); the resultant significance is 'Moderate Beneficial'.

8. Hazard and Risk Assessment

8.1 Introduction

Hazard is any substance, phenomenon or situation, which has the potential to cause disruption or damage to people, their property, their services and their environment. Whereas, risk is the probability that negative consequences may arise when hazards interact with vulnerable areas, people, property and environment. From this 150 MW ±10% (Net output 161.603 MW) Simple Cycle HSD-based (Gas Turbine) Power Plant, probable hazards like fires or explosions through gas, catastrophic rupture of high speed machinery etc. could occur mostly in construction and operation phase. Such events have the potential to cause multiple major injuries or fatalities on-site or off-site, in addition to serious damage to equipment and extended loss of production. Mismanagement of one particular hazard can have consequences that simultaneously impact to a varying degree on several risk types. Thus, for this 150 MW ±10% (Net output 161.603 MW) Simple Cycle HSD-based (Gas Turbine) Power Plant risk assessment was conducted carefully to examine the potential hazards, how they may occur and the measures to prevent such hazards.

8.2 Frequency Analysis

Failure frequencies need to be calculated in order to determine a probabilistic risk assessment. Generally, a number of techniques can be made available to determine such frequencies. This study does not account the frequency of failure from different data sources. This study only assessed the potential zones under risk of chemical explosion e.g. risk zoning of the hazardous substances.

8.3 Consequence Analysis

Consequence analysis is that part of risk analysis which considers individual failure cases and extent of damages. To predict the hazardous outcome of accidents and their possible effects, consequence analysis is generally employed. The analysis is carried out on a variety of preconceived scenarios. The purpose and benefits that are likely to be derived by carrying out consequence analysis include: Explosion, Fireball, BLEVE, Flash Fire, Jet Fire, Pool Fire.

The particular outcomes modeled depend on source terms (conditions like fluid, temperature, pressure etc.) and release phenomenology. The current understanding of the mechanisms occurring during and after the release is included in our consequence analysis models and tools.

8.3.1 Consequence Modeling Tools

This study includes the use of ALOHA for consequence modeling. ALOHA is one of the tools developed by EPA's Office of Emergency Management (OEM) and the National Oceanic and Atmospheric Administration Office of Response and Restoration (NOAA), to assist front-line chemical emergency planners and responders.

ALOHA is an atmospheric dispersion model used for evaluating releases of hazardous chemical vapors. ALOHA allows the user to estimate the downwind dispersion of a chemical cloud based on the toxicological/physical characteristics of the released chemical, atmospheric conditions, and specific circumstances of the release. ALOHA can estimate threat zones associated with several types of hazardous chemical releases, including toxic gas clouds, fires, and explosions ALOHA software is used for consequence modeling, where the consequence is displayed according to the type of release. The ALOHA output is a graph showing the release effect at the specified standard radiation levels or overpressure according to the type of release. The graphs from ALOHA are then turned into a digital format in the form of a table showing the distances in all directions at each radiation level.

For the proposed power plant, HSD is a compound, flammable hydrocarbons which consist of a number of organic hydrocarbons like N-hexane, Xylene, Toluene etc. However, the tank of storage HSD burst and leakage are subjected to consequence analysis. The outcome of this analysis provides information about possible hazards due to accidents or tank failures.

8.3.2 Assumption and considering factors

Fuel oil is a combustible liquid, which will burn if the temperature of the liquid exceeds the flash point and the vapor generated at the liquid surface is ignited. The resultant incident is a pool fire that radiates heat to the surrounding area resulting in potential equipment damage and or injury/fatality.

Fuel oil is also a contaminant to the biophysical environment and its release can damage sensitive environmental areas surrounding the storage area in the event a leak occurs and escapes to the environment. Fuel will also float on water and be carried a significant distance from a leak point by a water course.

The ALOHA model has been running for identifying the potential zone of threat during pool fire. The High Speed Diesel composes of a number of chemical hydrocarbons. This study considers only the N-hexane which presence significantly in HSD. Pool formation occurs through HSD storage tank release causing different levels of thermal radiation incident. However, the pool fire will remain confined within dyke provided around storage tanks.

Site data:

Location: SAIDPUR, BANGLADESH

Building Air Exchanges Per Hour: 0.68 (unsheltered single storied)

Chemical data:

Chemical Name: N-HEXANE

Molecular Weight: 86.18 g/mol

AEGL-1 (60 min): N/A

AEGL-2 (60 min): 2900 ppm

AEGL-3 (60 min): 8600 ppm

IDLH: 1100 ppm

LEL: 12000 ppm   UEL: 72000 ppm

Ambient Boiling Point: 68.6° C

Vapor Pressure at Ambient Temperature: 0.23 atm

Ambient Saturation Concentration: 228,672 ppm or 22.9%

Atmospheric data: (manual input of data)
Wind: 3 meters/second from SE at 3 meters
Ground Roughness: open country
Cloud Cover: 3 tenths
Air Temperature: 28° C
Stability Class: E
No Inversion Height
Relative Humidity: 50%

Source strength:
Leak from hole in vertical cylindrical tank
Flammable chemical is burning as it escapes from tank
Tank Diameter: 20.4 meters
Tank Length: 15.289 meters
Tank Volume: 5000000 liters
Tank contains liquid
Internal Temperature: 28° C
Chemical Mass in Tank: 2,124,642 kilograms
Tank is 65% full
Circular Opening Diameter: 3 inches
Opening is 8.41 meters from tank bottom
Max Flame Length: 16 meters
Burn Duration: ALOHA limited the duration to 1 hour
Max Burn Rate: 192 kilograms/min
Total Amount Burned: 11,455 kilograms
Note: The chemical escaped as a liquid and formed a burning puddle.
The puddle spread to a diameter of 6.2 meters.

Threat zone:
Threat Modeled: Thermal radiation from pool fire
Red: 21 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: 29 meters --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: 42 meters --- (2.0 kW/(sq m) = pain within 60 sec)

8.3.3 Results of HSD Tank failure

Consequence analysis was carried out for identified selected failure cases. Consequence analysis quantifies vulnerable zones. For the selected accidental scenarios, after vulnerable zone is defined, measures can be proposed to minimize the damages.

HSD tank at the plant site is located in the plant area. The fire scenario of 2X50,00,000-liter tank and 2x1000000 liter tank are presented on the above. The distance of occurrence of 2 kW/m^2 radiation intensity for both the storage types has been calculated at 42 m (sufficient to cause first degree burn). Plant personnel or other sensitive point should be avoided or protected within this range (**Figure 8.1**).

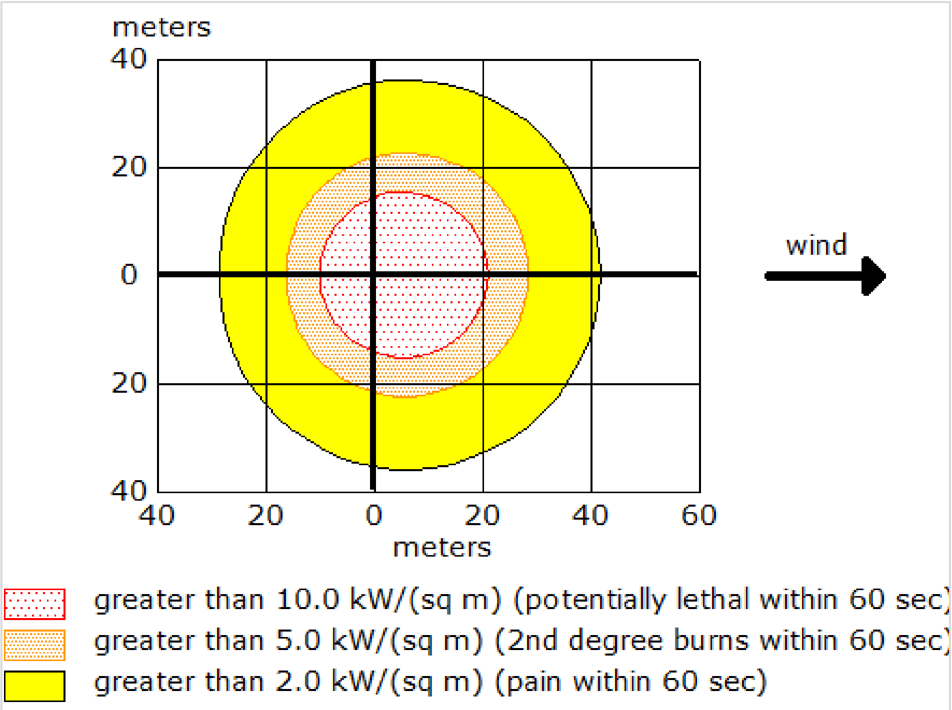


Figure 8.1: Threat zone assessment

Damage Criteria

In case of accidental release of HSD, it will normally spread out and form a pool. If its pool finds ignition source, a fire is likely to occur. Any person caught in the fire is likely to suffer severe burn injuries. Therefore, in the consequence analysis, the distance to which Lower Flammable Limit (LFL) value persists is taken to indicate the area which may be affected by fire. Any other combustible materials within fire zone are also likely to catch fire and secondary fire may occur. Hence due to HSD spillages pool fire may result if there is an immediate ignition source.

Thermal radiation due to fire may cause various degrees of burns on human bodies. Moreover, their effects on inanimate objects like equipment, piping or vegetation also need to be evaluated to assess the impact. The effects due to thermal radiation intensity and escape time respectively are presented in the following tables. Finally, **Table 8.1, 8.2 and 8.3** lists out tolerable intensities of various objects as given in "Guidelines for Chemical Process Quantitative Risk Analysis".

Table 8.1: Damage due to incident radiation intensity

Incident Radiation Intensity (kW/m2)	Types of Damages
62.0	Spontaneous ignition of wood
37.5	Sufficient to cause process equipment damage
25	Minimum energy required to ignite wood at infinitely long exposure
12.5	Minimum energy required for piloted ignition of wood, melting plastic tubing etc.
4.5	Sufficient to cause pain to personnel unable to reach over within 20 sec;
1.6	Will cause no discomfort during long exposure

Table 8.2: Heat radiation and escape time

Radiation Intensity (kW/m^2)	Time to pain Threshold (Seconds)
1.39	60
1.74	40
2.33	30
2.9	16
4.7	9
6.93	6
9.5	5
11.66	4
19.9	2

Table 8.3: Tolerable intensities for various objects

Object	Tolerable Intensity (kW/m^2)
Drenched Tank	38
Special Buildings (No Windows, fire proof doors)	25
Normal Buildings	14
Vegetation	10-12
Escape Route	6 (up to 30 seconds)
Personnel in Emergencies	3 (up to 30 seconds)
Plastic cables	2
Stationary Personnel	1.5

8.4 Hazard, Magnitude and Frequency Analysis

The potential impacts of the project and the likelihood of frequencies have been scaled and ranked in order to identify and prioritize the hazard and the associated consequences. The magnitude of the said impacts are classified and listed in the following **Table 8.4**.

Table 8.4: Hazard Magnitude Scale

Parameters	1 (Insignificant)	2 (Minor)	3 (Moderate)	4 (Major)	5 (Catastrophic)
Duration of potential impact	Temporary with no detectable potential impact	Limited to construction period	Medium Term (1 to 2 years)	Long term (more than 2 years)	Permanent Damage
Spatial extent of the potential impact	Specific locations within site boundaries with no detectable potential impact	Within project boundary	Beyond immediate project components, site boundaries or local area	Widespread far beyond project boundaries with some community and probable wildlife habitat coverage (if any)	Beyond project boundaries extending to widespread communities and wildlife habitat
Reversibility of potential impacts	Baseline remains almost constant	Baseline returns naturally or with limited intervention and within a few months	Requires a year or so for recovering with some interventions to return to baseline	long-term, requires considerable intervention to return to baseline	Effectively permanent, with little or no chance of returning to baseline
Compliance to Legal Standards	Complies with all minimum requirements	Meets minimum national	Complies with limits given in national	Complies partially with limits given in	Completely cross national standards and or

Parameters	1 (Insignificant)	2 (Minor)	3 (Moderate)	4 (Major)	5 (Catastrophic)
before Mitigation Measures	only some improvement opportunities to strengthen good practices	standard limits or international guidelines	standards but breaches international lender guidelines in one or more parameters	national standards but breaches international lender guidelines	international guidelines/ obligations
Extent of health injuries	Minor pain, scratch, discomfort requiring no medical attention	Health injuries can be cured with first aid and/or some medical attention	requires hospitalization; may require long term recuperation; may lead to long term absence from work	may lead to permanent disability; few fatalities of workers and or community people	more than five(5) and or community people more than two (2)
Impact on wildlife	Minimal disturbance within compliance	Disturbing habitat of wildlife causing discomfort	Disturbing habitat of wildlife causing decrease of preys and forcing them to relocate	Impact leading to deaths of any endangered species and decrease of their food source	Impact may lead to deaths of two (2) or more endangered marine mammals and-or five(5) of other endangered species

Criteria for determining the frequency of the potential hazard being occurred are outlined in **Table 8.5**.

Table 8.5: Criteria for Determining Frequency of the Potential Hazard

Frequency Scale	Definition
1 (Rare)	Rare chance of occurrence, if not at all
2 (Low)	Very minimal chance of occurring
3 (Medium)	May occur considering if the conditions are abnormal or exceptional
4 (High)	Occurs more frequently without prior warnings
5 (Almost Certain)	Occurs under typical conditions

8.4.1 Risk Matrix Development

Following the magnitude and frequency scales, a risk matrix can be developed considering the probable potential hazards associated with project activities i.e. pre-construction, construction and operation of the Project. The table below (**Table 8.6**) shows the risk matrix for the potential hazards and how frequently they may occur. Similarly, in **Table 8.7**, the risk evaluation based on the type of activities and potential hazards are shown.

Table 8.6: Risk Matrix of Potential Hazards/Impacts

Frequency (F) of Hazards ↓	Hazard Magnitude (M) →				
	1(Insignificant)	2 (Minor)	3 (Moderate)	4 (Major)	5 (Severe)
1 (Rare)	1	2	3	4	5
2 (Low)	2	4	6	8	10
3 (Medium)	3	6	9	12	15
4 (High)	4	8	12	16	20
5 (Almost Certain)	5	10	15	20	25

Color Legend:

Red (15-25)	≡ Top Priority	:Action with follow-up Verification & Validation by Authority needed before allowing work
Orange (10-14)	≡ High Priority	:Action needed under follow-up Supervision before allowing work
Yellow (5-9)	≡ Medium Priority	:Need maintaining with routine monitoring & reporting
Green (1-4)	≡ Low Priority	:Only for awareness; no Intervention Action needed to start work

In order to calculate the potential risk, the frequency of impact is multiplied with consequences. e.g. Level 1 of frequency of a hazard (Rare) is multiplied with Level 1 of hazard consequence (insignificant) to give a total score of 1 (1X1=1) and so on.

In that regards,

- a score between 1 to 4 has considered as low priority;
- a score between 5 to 9 is considered as medium priority and;
- a score between 10 to 14 is considered as high priority and;
- a score between 15 to 25 is considered as the top priority

Table 8.7: Identification of Existing Safeguards

Hazard points	Project Activities	Potential hazard	Root causes	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
Construction and Erection Phase										
Machinery and equipment	Mobilizing in machines, equipment and vehicles for site clearance activities	• Trips and falls • Cuts and bruises	• Fatigue or prior sickness • Mechanical failure • Lack of safety training • Not abiding to general health and safety and traffic rules	3	3	9	• Arranging toolbox meeting before going out for work • Regular inspection and maintenance of equipment • Training of rules and regulation, • Regular health and safety training to all construction workers and lorry drivers, including the proper use of PPEs.	2	1	2
Construction site	Construction of building, steel structure and its foundation, stacking of components, cutting, welding, painting works, drilling work, etc., Use of machineries and equipment for dismantling of structures	• Accidents (burns, electric shocks etc.) • Injuries from falls and slips • Injuries from falling of heavy objects/machineries • Inhalation of dust • Cuts and bruises	• Fatigue or prior sickness • Electric failure • Equipment failure • Lack of safety protocols (e.g. not putting up warning signs or enclosing the area to prevent entry of outside people) • Not abiding to health and safety rules (e.g. not wearing appropriate PPEs during work, being careless at handling heavy equipment etc.) • Not maintaining a designated place for backfilling storage • Not maintaining enough lighting during the night (for those working overtime)	3	2	6	• Arranging toolbox meeting before going out for work (during each construction activities.). • Provide each worker with a safety checklist and safety permit (based on their work) before starting work. • Regular inspection and maintenance of equipment, machineries and especially, safety harness. • Maintain a registry for any faulty equipment found; inform site contractors and have them replace those immediately. No work should be done until the faulty machineries are replaced and tested. • Regular health and safety training and firefighting drills to all construction workers, including the proper use of PPEs during work. • Spraying water on dust to minimize its spread via wind; put stockpile at a designated place and cover them with GI sheet; put up GI sheet fencing around the construction site. • Equipment, machineries and electric wires should be checked for current and voltage ratings. When using an extension cable, its wire rating should match with the equipment wire rating. • Recording of any unusual activities and issuance of fines or suspensions if any rules are broken • Maintenance of an accident registry book	2	2	4
	Work at heights Lifting of machineries and equipment from tall heights	• Accidents • Injuries from falls and slips (e.g. broken bones, fractures, traumas, etc.) • Fatalities	• Fatigue or prior sickness • Lack of safety protocols (e.g. not putting up warning signs or enclosing the area to prevent entry of outside people) • Not abiding to health and safety rules (e.g. not wearing appropriate PPEs and safety harness during work, being careless at handling heavy equipment, not wearing safety harness	4	3	12	• Regular inspection and maintenance of equipment, machineries and especially, safety harness. • Maintain a registry for any faulty equipment found; inform site contractors and have those replaced immediately. No work should be done until the faulty machineries are replaced and tested. • Recording of any unusual activities and issuance of fines or suspensions if any rules are broken • Maintenance of an accident registry book. • Not allowing workers working in dimly lit areas. Appropriate warning signs must be placed in hazard prone working areas with the hazard signs being fluorescent and perfectly readable from 3-4-meter distance. • Restricting workers from working without appropriate safety measurements in place during night times (e.g. wearing appropriate PPEs and safety harness etc.).	2	2	4

Hazard points	Project Activities	Potential hazard	Root causes	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
			when working at heights etc.) • Not maintaining enough lighting during the night				• Maintaining a registry on who is working night shifts and where. • Overtime hours should be restricted to no more than two hours per day as per Bangladesh Labor Rules, GoB			
	Vehicles and vessels movement	• Noise generation • Accident (e.g. vessel capsize) • Emission from vehicles • Spread of dust and minute particles due to vehicle movement.	• Running engine, hydraulic horns, sirens etc. • Mechanical failure • Old engine or engine parts/lack of maintenance	3	3	9	• Regular inspection and maintenance of equipment, machineries and vehicles. • Training of traffic rules, including maintaining vehicle speed limit for different categories of roads. • Spraying water on dust at plant site to minimize its spread via wind or vehicle movement. • Regulate the use of hydraulic horns during construction. Set a limit on the amount of noise generated as stipulated in schedule III of ECR, 1997. • Switch off engines/generators/equipment when not in use. • Monthly health checkup of workers for any illness. Provide treatment accordingly	2	1	2
	Possible fire and Explosion hazard from machineries, equipment, oxyacetylene cylinders (used for welding purposes), generators and vehicles	• Explosion caused due to poor maintenance of oxyacetylene cylinders or due to using faulty cylinders • Fire caused by mechanical/electrical failure of generators • Fire caused by mechanical/electrical failure of vehicle	• Lack of proper maintenance of machineries, equipment and vehicles	4	3	12	• Regular inspection and maintenance of equipment, machineries, vehicles and acetylene cylinders. • Check for leaks or faults in acetylene cylinders before. Make sure proper labeling signs are marked on the cylinders • Training on how to use/handle acetylene welding machines. Ensure proper usage of PPEs (gloves, safety mask etc.) before commencement of welding works. • Ensure firefighting equipment such as fire extinguishers are at hands reach in case of a minor fire breakout. In case of severe fire break out, raise alarm and notify appropriate authorities and nearby firefighting departments.	3	2	6
	Working in a confined space	• Suffocation • Falling of debris	• Lack of protective measures • Faulty/Damaged pipelines • Negligence towards work	4	3	12	• Ensure regular communications with outside when entering underground. • Use proper safety precautions (e.g. PPEs, oxygen masks etc.) when working at confined spaces	3	2	6
	Occupational Hazard	• Cuts, bruises and burns • Falls, slips and trips • Health injuries • Sickness and illness	• Lack of safety awareness • Carelessness in maintaining safety protocols • Use of faulty machineries and equipment • Improper hygiene • Prior sickness or illness • Heavy workload	3	3	9	• Regular inspection and maintenance of equipment, machineries and vehicles. • Raising awareness on occupational hazards. • Arrange monthly health and safety training, electrical safety training and firefighting drills to all construction workers, including the proper use of PPEs during work. • Training of traffic rules and regulation, including maintaining vehicle speed limit for different categories of road. • Maintenance of hygiene at construction site and providing appropriate training to workers in hygiene maintenance • Supplying workers with safe drinking water • Monthly health checkup of workers for any sickness or illness. Provide treatment/consultation accordingly. In serious cases of injuries or sickness, an ambulance should be on standby for transporting them to nearby hospital.	2	1	2

Hazard points	Project Activities	Potential hazard	Root causes	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
							• Work load should be managed effectively. Workers working every 2 hours should be given a mandatory 30 minutes break as stipulated in chapter 9 of Bangladesh Labor Rules of GoB. • Employment of child labor (children below the age of 18), pregnant women and elder citizens in hard labor and dangerous activities must be prohibited. • All other facilities (toilet, canteen, overtime hours, leaves etc.) should be followed as stipulated in Labor Rules of GoB .			
Chemical Storage Area	• Storage of chemicals	• Release of toxic fumes • Fire/explosion • Falls and slips	• Lack of proper ventilation in chemical storage area • Storing flammable and volatile chemicals in the same area. • Faulty electric connections • No bounding around chemical storage areas • Not ensuring proper labelling/MSDS • Lack of training of chemical handlers/workers	3	3	9	• Safe storage of chemicals should be ensured with adequate ventilation • Flammable chemicals should be stored separately and away from any ignition source • No smoking inside the chemical storage area • Storage should be done in an organized way. No empty boxes or containers should be kept haphazardly in the floor • A record should be kept on the type of chemicals being stored along their expiry date and date of manufacture. Maintain MSDS. • The storage area should be fitted with adequate fire alarms, automatic fire defusing hydrants and fire extinguishers in case of a fire breakout • Regular inspection of storage area for any abnormalities • Training workers on how to handle and store certain chemicals	2	2	4
Operation Phase										
Generators and its ancillary components	Power system backup in case of failure	• Mechanical hazard • Fire hazard/explosion • Electrical hazard • Noise generation	• Mechanical failure • Lack of sound buffers	4	3	12	• Installing machines with computerized control and monitoring system for detecting any faults in the machines. • Installing machines with environment friendly and safe design (e.g. with noise buffers, energy efficiency, manual override, automated kill switch etc.) • Test running the machines and its safety systems before going into final operation, monthly inspection and maintenance • Install automated fire alarms and fire hydrant system in turbine and generator room.	3	2	6
Cable gallery Switchyard	• Transmitting electricity from generator • Controlling and monitoring the power switching system	• Fire due to resulting arc flash/arc blast • Other electric hazard due to unprotected cables • Slips and trips from unorganized/loose cables lying in the floor	• Short circuit in control • Faulty cables and wires • No safe connection to earth • Using cables with different voltage and current ratings • Unorganized cables	3	3	9	• Monitoring. Installation of fire defense and fighting systems. • Checking the insulation of the wire, along with the wire's voltage and electric ratings. • Change wires if ratings do not match with the power supply or if the insulation is damaged • Proper earthlings should be made to avoid electric shocks. • Switch off power before doing any electrical work. Inform supervisor and respected machine operator before starting any electrical work. Inform them again after the electrical works are done. • Switchyards should be fitted with circuit breaker in case of short circuit or during an unusual surge of electrical current. • When working with exposed live wire/machines, the maintenance worker should maintain distance of 6 meters	2	2	4

Hazard points	Project Activities	Potential hazard	Root causes	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
							• Maintain a safe distance from the rights-of-way (RoW). Don't raise any construction under the RoW. • Place "electrical hazard" or "high voltage" signs on all switchboards.			
Water treatment and waste water treatment plant	• Produce clarified, dematerialized water for steam generation and treat effluent water before discharge	• Chemical hazard	• Spillage/accidental release • Mishandling and misuse	3	3	9	• Safe use of chemical. Using appropriate MSDS to aware people of chemical properties, storage and handling procedures. • Limited entry except authorized personnel • Training and use of appropriate PPE • Make spill kits available in case of accident. • Install safety shower, eye wash and first aid facilities	2	2	4
Chemical storage	• Use for chemicals for manufacture in different phases • water and potable water.	• Toxic accidental release due to multifunction of equipment & insensitivity of operator.	• Chemical spillage • Chemical fires • Mishandling and misuse	3	3	9	• Putting up "chemical hazard" warning sign in the entry of chemical storage or Ammonia storage areas. • Set up awareness programs on how to handle/store chemicals • Check containers for leaks, faults and cracks. Change them immediately if found. • Labeling chemical storage containers for easy recognition. Put up MSDS in chemical containers along with appropriate warning labels (e.g. corrosive, toxic, flammable etc.) • Storing different types of chemical separately. All flammable or corrosive chemicals should be stored separately and should have proper bounding • A fire extinguisher/ fire hydrant should be installed nearby in case of any fire breakout. Emergency contact details for fire fighters and ambulance service should also be placed there. • In case of a spillage, keep flammable substance away from the spillage area and inform the appropriate authority immediately. • Recording of any unusual activities and issuance of fines or suspensions if any rules are broken.	2	1	2
Plant site	Daily plant activities	• Cuts, bruises and burns • Falls, slips and trips • Health injuries • Sickness and illness	• Lack of safety awareness • Carelessness in maintaining safety protocols • Use of faulty machineries and equipment • Prior sickness or illness • Heavy workload • Unsafe working environment.	3	3	9	• Regular inspection and maintenance of equipment, machineries and vehicles. • Raising awareness on occupational hazards. • Arrange monthly health and safety training, electrical safety training and firefighting drills to all officers and plant workers, including the proper use of PPEs during work • Monthly health checkup of officers and workers for any sickness or illness. Provide treatment/consultation accordingly. In serious cases of injuries or sickness, an ambulance should be on standby for transporting them to nearby hospital • Keeping all safety & precaution measure in order such as, maintaining first aid & well equipped primary health center on plant site.	2	2	4

8.4.2 OHS Training

The (EHS Manager) will be responsible for ensuring that the appropriate employees receive training required under the plan. The company's human resources representative will be responsible for ensuring that all employees receive introductory training on the EHS Management System.

Training Procedure

<u>*Task-Specific Training*</u>

A training program will need to be developed to ensure that employees are capable of accomplishing the tasks required to meet OHSE objectives and targets. The program will identify training topics, who should receive the training, when training should be given, and the training method. The program will also distinguish between training conducted to comply with OHS regulations and other training.

A training needs assessment for the employees needs to be made. The EHS Manager will review past training and the nature of the employee's work. Based on this review, specific training requirements for each employee or type of employee will need to be documented. The EHS Manager shall document the OHSE Training Program. The training plan shall be implemented by the EHS Manager. Upon completion of training by employees, the EHS Manager shall make the superiors aware of the training completed. The (EHS Manager) shall document the training completed form and Training Log. Specific documentation pertaining to training received shall need to be maintained by the operational work areas for a minimum of two years, or as required by regulation. Training effectiveness will need to be evaluated to ensure that the OHS Management System is being implemented effectively when changes are made to significant risks, objectives, targets or operational controls. Improvements to the training plan will need to be made accordingly.

<u>*General EMS Training*</u>

All employees shall receive introductory training to make them aware of the OHS Management System. The human resources representative shall be responsible for coordinating the effort to assure that all new and existing employees have received suitable training. Type of trainings and training actions need to be adopted has been listed below in **Table 8.8**.

Table 8.8: Type of training and training actions

Sl	Type of Training	Training Actions
1	Actions to be taken in the event of a fire	• Use fire exit and educating workers and staffs of the nearest emergency evacuation zone. • Proper evacuation procedure in the event of a fire. • Training on locating emergency equipment and use of portable fire extinguishers to extinguish fires. • Training on whom to contact in case of an emergency.
2	Handling of flammable liquids	• Training on the safe handling and storage of volatile/flammable chemicals/oils. • Training on waste classification system and use of various color-coded bins for various waste disposals. • Training on the use of PPEs.
3	Emergency Drills	• Regular monthly training on mock fire drills.

Sl	Type of Training	Training Actions
		• Regular monthly workshop on emergency response and preparedness plan.
4	First-aid and medical assistance	• Training on first-aid treatment for broken bones/fractures, burns, cuts/wounds, unconsciousness, breathlessness.

In case of an emergency fire breakout, the EHS Manager should be notified immediately who will delineate the information and responsibilities to other staff member. An emergency contact list should be prepared by the EPC contractor consisting of Manager's contact details, Hospitals, Police, Ambulance services and other relevant contact details.

Training Schedule

In order to reduce the risks associated with accidents, internal and external threats, and natural disaster a safety training program is essential for workers in plant operation. There should be regular training programs on safety for the workers to increase their awareness and also to reduce the risks. Provision of yearly professional training for health and safety, would enhance the effectiveness of safety. Safety training should be planned for the local people living around the project area so that they can be aware about the risk and can take appropriate preparedness (**Table 8.9**).

Table 8.9: Training schedule that may be adopted for safety

Target trainee	Training schedule
Worker	Two trainings per year
Professional	Two trainings per year
Local people	Two trainings per year
Drivers	Four trainings per year
Safety professional	Three trainings per year

In addition, there must be a discussion and awareness session for increasing awareness on safety in each and every kind of meeting. Tool box meeting and job safety analysis should be regularly practiced by the employee. Further details on the type of trainings to be provided will be discussed in the separate Emergency Response report.

8.5 Emergency Response Plan

The primary objective of the plan is to provide clear lines of authority and communication during incident and crisis events.

- Providing means by which trained people and resources are available to those managing the incident or crisis event
- Keeping the workplace safe and to achieve minimal or zero incidents for health hazard; as well as keeping the impacts on the environment, materials, machineries and equipment from these unplanned events to a minimum.
- This ERP is intended to provide information, strategies and procedures relating to all aspects of emergency management which comprise of-
- Prevention of emergencies;
- Preparation for emergencies;
- Response to an emergency;
- Recovery following an emergency and
- Documenting and Reporting

8.5.1 Emergency Preparedness

Preparedness includes emergencies from fire related disasters and the necessary steps required to prepare for such emergencies. For this, it is required to design, manufacture, deliver to the site, install, test and commission the fire-fighting and fire detection equipment to protect the steam & turbine, generating units and all associated equipment. The following **Table 8.10** includes the list of preparedness measures to be included.

Table 8.10: List of preparedness measures

Sl	Area of Requirement	Preparedness Actions
1	Design Requirement	• Design should take into account basic operating policy • All automatic systems must have a manual initiation facility • All fire protection installations should comply with the requirements of the codes of practice of the National Fire Protection Association, Boston, Massachusetts, U.S.A., as appropriate for the respective systems, to the approval of the Engineer.
2	CO_2 Fire Protection System	• An automatic Carbon Dioxide (CO2) fire protection system should be provided in all machinery enclosures. • The Protection System should consist of a fire detectors and an automated fire extinguishing mechanism once fire/smoke is detected. • Facilities for alternative manual actuation of the fire protection system should also be provided such that, when the manual mode has been selected the protection sequence will not proceed beyond the alarm stage without manual action by an operator. • High risk areas should be marked as “fire protection zones” and should have a separate fire protection system independent of others. • The protection system should be checked on a monthly basis to test their functionality. Any defect should be reported to the manger and should be replaced immediately.
3	Hydrant System	• Water hydrants should be provided in the plant in such places that are susceptible to fire, such as Chemical Plant, electrical building, Outdoor electrical etc. • Firefighting water pool/ storage tank should have a capacity of minimum 4 hours of supply in case of worst case scenario. • Regular inspection of the hydrant system should be made to see if they are functioning properly or not. Any defect should be reported to the manger and should be replaced immediately.
4	Piping	• The fire-fighting water mains should consist of buried piping of at least 150 mm diameter. • The underground pipe-work should be provided with an approved protective coating unless the pipe is manufactured from an approved non-corrosive material.
5	Portable Equipment	• Portable equipment such as, CO2 extinguishers and dry chemical extinguishers of various weights and sizes should be provided at various locations of the plant • Regular inspection of portable extinguishers should be made and noted. Expired extinguishers should be replaced immediately.

8.5.2 Emergency Evacuation Plan

The EPC contractor will formulate a plan for evacuation in the event of an emergency. It includes a layout plan delineating all the possible emergency fire exits and evacuation zone. An emergency contact list should also be prepared by the EPC contractor consisting of EHS Manager's contact details, Hospitals, Police, Ambulance services and other relevant contact details.

8.5.3 Emergency Response

Emergency events are broken down to three level tiers; tier 1, 2 and 3. Tier 1 having the lowest threat level and Tier 3 having the highest threat level. In the case of an emergency event, the Incident Response Team (IRT) at plant site would be mobilized with the Emergency Response Group (ERG) (Chaired by the Chief Engineer) coordinating and overseeing arrangements to ensure that the IRT meets its emergency management obligations. In the case of Tier 1 emergencies, the cases are escalated primarily to site specific IRTs only. Tier 2 involves ERG providing tactical response, support, assistance and advice to all incident and emergency situations at site/location and for providing operational response to any emergency situation which may occur in the affected (such as, fire, explosion and various social crisis). The Incident Management Team (IMT) is activated in the case of Tier 3 incidents and responsible to define and control strategy for those incidents. The following table (**Table 8.11**) shows the emergency response escalation protocol for different levels of emergencies.

Table 8.11: Emergency Response Escalation Protocol

Impact/ Consequence	Health & Safety	Natural Environment	Reputation Government Community Media	Civil Unrest protests / Hartals		Definition	Country Threat Level	Escalation				Site specific IRT Members
Tier 1	Minor injury	Negligible impact on fauna/flora, habitat, aquatic ecosystem or water resources. Incident reporting according to routine protocols.	Minimal impact to reputation.	Situation generally stable with some protests / Hartals against government		Incidents that are containable by the Operations' Site Incident Response Team (IRT)	Insignificant Low	Operation Sites	Plant Manager	IRT	ERG Leader	Plant Manager other IRT members ERG - as required
Tier 2	Moderate injury- Medical Treatment , Lost Time injury	Impact on fauna, flora and/or habitat but no negative effects on ecosystem, may require immediate regulator notification.	Moderate to small impact on business reputation.	Security unrest appears to escalate to regular outburst - but authorities appear to be capable of maintaining control		Incidents that require ERG of governmental and regulatory support	Medium High	ERG	ERG Leader	Chief Engineer activate Central ERG	Inform Member	ERG Leader – Chief Engineer other ERG members ERG - activated for EHS / Security issues
Tier 3	Permanent disabling injury and or long term off work and fatality, Lost Time injury.	Long term impact of regional significance on sensitive environmental features, likely to result in regulatory intervention/action	Significant impact on business reputation/ or international media exposure.	Confirmed direct threat to foreign business interest or against expatriates Situation certain to escalate further beyond Government control		Incidents when there are multiple injuries or fatalities requiring IMT support and also international support, regulatory and public relations assistance.	High Extreme	IMT	IMT Leader Activate IMT	Director Technical	Managing Director- IMT	IMT other IMT members IMT - activated

8.5.4 The Incident Response Team (IRT)

The Incident Response Team (IRT), based at plant location, is trained and responsible for dealing with all envisaged incidents and emergency situations which may occur at the location. Where additional support in the way of resources and advice may be required by the IRT at a remote location this will be requested through and provided by the Emergency Response Group (ERG) of head Office. On all occasions when an IRT is mobilized due to an incident or emergency situation, the ERG Manager must be notified immediately.

8.5.5 The Emergency Response Group (ERG)

The Emergency Response Group (ERG) is based in the company's Head Office and responsible to coordinate with representatives from various agencies and also senior staff from HR, Finance, HSE, Logistic, Security, IT, and public affairs department. ERG will be responsible for providing tactical response, support, assistance and advice to all incident and emergency situations at site/location and will provide operational response to any emergency situation that may occur. The function of the ERG is to coordinate and oversee arrangements to ensure that the IRT meets its emergency management obligations. ERG should develop a plan, in consultation with the appointed EHS Manager where it should describe how to handle both the "technical" crises e.g. fire, explosion, and "social" crises e.g. illness, injury, kidnap, civil unrest. On all occasions that the ERG is mobilized due to an incident or emergency situation the Managing Director must be notified immediately.

8.5.6 The Incident Management Team (IMT)

The Incident Management Team (IMT) is the corporate body located in the headquarters with the responsibility to define and control strategy for major incidents. The IMT may however also be called upon to address some of the tactical roles that would normally be the responsibility of the ERG. The IMT is chaired by a Managing Director and includes high level representation from the Ministry of Power, Energy and Mineral Resources, Army, Police Department, Fire Department, District Commissioner's Office and the Disaster Management Bureau (DMB) of the Bangladesh Government.

8.5.7 Emergency Recovery

After the emergency situation had passed, the ERG would assess and categorize the damage and would provide for compensations for the injured; provide provisions for temporary services; reinstate normal environmental and working standards; initiating investigation process for the cause of disaster; evaluating response procedure and providing a recommendation to mitigate future emergencies.

8.5.8 Documenting and Reporting

Implementation status of the safety plans should be monitored and documented regularly. Monthly monitoring report should be prepared based on regular inspection and should be submitted to the Superintending Engineer. Any kind of incidents or even near misses should be documented and reported to the Superintending Engineer.

8.5.9 Emergency Recovery

After the emergency situation had passed, the ERG would assess and categorize the damage and would provide for compensations for the injured; provide provisions for temporary services; reinstate normal environmental and working standards; initiating investigation process for the cause of disaster; evaluating response procedure and providing a recommendation to mitigate future emergencies.

8.5.10 Emergency Evacuation Plan

The EPC contractor will formulate a plan for evacuation in the event of an emergency. He/she will make a layout plan, showing all the possible emergency fire exits and the location of the evacuation zone. An emergency contact list should also be prepared by the EPC contractor consisting of EHS Manager's contact details, Hospitals, Police, Ambulance services and other relevant contact details.

9. Environmental Management Plan

9.1 Introduction

The Environmental Management Plan (EMP) includes several plans for implementing mitigation and enhancement measures, disaster management, spill response, hazardous materials management, emergency response, dust management, occupational health and safety, and Environmental Code of Practices. Generally, the impacts, which are minor or moderate, are to be mitigated by adopting Environmental Code of Practices (ECPs) and Contractor’s good practices during project implementation. On the other hand, impacts and risks which are critical or major will be mitigated or prevented by adopting mitigation measures discussed in **Chapter 7** along with specific plans discussed in this Chapter.

9.2 Objective of EMP

The basic objective of the EMP is to manage adverse impacts of project constructions and operation in a way, which minimizes the natural environment and people of the study area including water resources, fisheries resources, agricultural resources, ecological resources and finally socio-economic environment. The specific objectives of the EMP are to:

- Facilitate the implementation of the mitigation and enhancement measures identified during the present EIA to comply with regulatory requirements discussed earlier in the document;
- Maximize potential project benefits and control negative impacts;
- Draw responsibilities for project proponent, contractors, machinery suppliers’ consultants, and other members of the Project team for the environmental management of the Project;
- Maintain essential ecological process, preserving biodiversity and wildlife, where possible restoring and compensating degraded or fragmented natural resources;
- Make stakeholders aware about implications of the project activities, satiate their concerns and roles and responsibilities of respective quarters;
- Foster and facilitate informed decision making process; and
- Ensure sustainable development.

The EMP will be managed through a number of tasks and activities. One purpose of the EMP is to record the methodology for management of mitigation and enhancement measures identified for each negative and positive impacts of the Project respectively. The management will clearly delineate the responsibility of various participants and stakeholders involved in planning, implementation and operation of the Project.

9.3 Project Components and Various Categories of Mitigation Measures

9.3.1 Project Components

The proposed Power Plant includes two components and these are: (i) Power Generation; and (ii) Power Evacuation. Details of the project components are given in Chapter 3. Necessary impacts of various environmental sectors i.e Physical environment, Biological environment and Social environment; were identified on selected IESCs according to the components of the proposed Power Plant.

9.3.2 Various Categories of Mitigation Measures

The EMP includes various categories of mitigation measures and plans: (i) general and non-site-specific measures in the form of environmental codes of practices (ECPs) presented in **Annex 6** to address general construction and operation matters identified as moderate and minor in significance prior to mitigation; (ii) project specific and site-specific mitigation measures discussed in **Chapter 7** and summarized in **Table 7.18**; (iii) Hazardous Materials Management and Response Plan, and (iv) Construction Environmental Action Plan (CEAP) with site-specific and contract-specific management plans to be prepared by the contractor, which include pollution prevention, occupational health, safety and environment, and emergency response.

9.4 Inclusion of EMP in Contract Documents

In order to make the Contractors fully aware of the implications of the EMP and responsible for ensuring compliance, technical specifications in the tender documents will include compliance with mitigation measures proposed in the EIA as well as the World Bank Guideline's (WBG's) General Environmental Health and Safety Guidelines. The Contractor must be made accountable through contract documents for the obligations regarding the environmental and social components of the project.

9.5 Environmental Code of Practices

A set of environmental code of practices (ECPs) has been prepared for various environmental and social management aspects: ECP 1: Waste Management; ECP 2: Fuels and Hazardous Goods Management; ECP 3: Water Resources Management; ECP 4: Drainage Management; ECP 5: Soil Quality Management; ECP 6: Protection of Flora; ECP 7: Protection of Fauna; ECP 8: Protection of Fisheries; ECP 9: Road Transport and Road Traffic Management; ECP 10: Construction Camp Management; ECP 11: Cultural and Religious Issues; ECP 12: Workers Health and Safety, ECP 13: Construction and Operation Phase Security, ECP 14: Topography and Landscaping, ECP 15: Air Quality Management and ECP 16: Noise and Vibration Management. The Contractors will be contractually obligated to comply with these ECPs, presented in **Annex 6**.

9.6 Environmental Management Plan during Pre-Construction Phase

9.6.1 Dismantling Components

Demolition of Existing Infrastructures

The existing infrastructures, which fall under the proposed project site, will be dismantled. The type of infrastructures and the area belonged to those structures, are as follows: buildings of an area of about 38,771 sqft (3,602 sqm), sludge pond of an area of about 10,450 sqft (971 sqm) (**Table 9.1**), two HSD oil tanks of an area of about 2,119 sqft (197 sqm), two lube oil tanks of an area of about 706 sqft (65 sqm), and scrap yard of an area of about 1,614 sqft (150 sqm) (**Table 9.2**). Approximately 37,065 tons of debris may be generated due to demolition of civil structures and 140 tons of steel from oil tanks. Pictures of some buildings are to be demolished are given in the **Figure 9.1**.

Table 9.1: List of infrastructures and debris quantity from the demolitions site of SPS

Building and structures to be Demolished												
Sl. No.	**Name of Buildings**	**Number**	**Storey**	**Length (ft)**	**Width (ft)**	**Area (sq ft)**	**Area (sq. m)**	**Height (ft)**	**Factor**	**Total Debris in cubic ft**	**Total Debris in cubic m**	**Total Debris in Ton**
1	Administration Building (components)	1	2	24	20	468	44	20		3,092	88	211
		1	2	18	9	168	16	20		1,112	31	76
		1	2	11	10	104	10	10		345	10	24
		1	2	41	40	1,646	153	20		10,866	308	742
2	Oil diesel Power Plant House (Basement)	1	2	200	140	28,000	2,601	20		184,800	5,233	12,611
3	Oil diesel Power Plant House (on ground)	1	3	200	140	28,000	2,601	30		277,200	7,849	18,917
4	C Type Quarter	1	1			1,000	93	10	0.33	3,300	93	225
5	C type Quarter	1	2			1,250	116	20		8,250	234	563
6	Kitchen and Washroom	1	1	20	18	360	33	10		1,188	34	81
7	Old Office	1	2	50	26	1,300	121	20		8,580	243	586
8	New Office	1	1	50	23	1,170	109	10		3,860	109	263
9	XEN Dak Bungalow	1	1	42	14	592	55	10		1,954	55	133
10	XEN Dak Bungalow	1	2	89	31	2,712	252	20		17,897	507	1,221
11	Sludge Pond	1	6 ft depth	110	95	10,450	971	6		20,691	586	1,412
					Total=	**66,771**	**6,203**				**14,794**	**37,065**
					Except Basement (Ref. Sl. No. 2) of Old Power Plant Total=	**38,771**	**3,602**					

Source: CEGIS estimation, 2019

For storing the debris generated from dismantling of structures will require an estimated area of about one (01) acre and spacious scrap site will be required temporarily or sold out to the relevant vendors.

Table 9.2: List of oil tanks and quantity of steel from the demolitions site of SPS

Oil Tanks to be Demolished					
Sl. No.	Oil Tanks	Oil Tank Capacity (Lit)	Estimated Area of Occupancy (sqft)	Area (sq. m)	Qunatity of Steel (Ton)
1	HSD Oil Tank-1	9,00,000	2,119	98.5	48.3
2	HSD Oil Tank-2	9,00,000	2,119	98.5	48.3
3	HSD Oil Tank-3 (Day Tank)	5,00,000	802	75	30.8
4	Lube Oil Tank-1	1,00,000	353	33	6.2
5	Lube Oil Tank -2	1,00,000	353	33	6.2

Source: CEGIS estimation, 2019

Old Power House

XEN Building

Old Administration Building

Sludge Pond

Figure 9.1: Some Pictures of the Structures to be Demolished

The project site is largely covered by grasses and having different species of trees, shrubs and climbers. Among the trees, the major ones are timber trees followed by fruit and other trees. Among the timber trees mahogany, rain tree are dominant. The fruit trees are: mango, litchi, bael, papaya, coconut, jack fruit, lemon, etc. Trees fall in other category include Jhau, Kamini, Debdaru, Neem, Krishnochura, Bot, etc. Based on the field study, it is counted that about 94 small to big trees (sapling mostly, juvenile and adult) will be cut down during site preparation. The trees found in the site were planted by Saidpur Power Station as a part of a greenery program from the date of commissioning of the Plant.

The hazardous waste like oil, sludge, etc. generated from demolition of civil structures, sludge pond and oil tanks will be treated as per the WBG's General EHS Guidelines, 2007 and WBG's Good Practice.

Building Infrastructures: The off-sites include the buildings for different uses of the SPS. The total number of new buildings and sheds to be constructed are seven (07). In these buildings, the number of Plant Buildings are five (05) and Non-Plant Buildings are two (02). Among the Plant buildings three (03) nos. are four storied and the rests are two (02) storied buildings. Details about non-Plant buildings are yet to finalize.

Decommissioning

Decommissioning a power plant and repurposing the site for future use is often a lengthy and complex process. Economic, environmental and corporate social responsibility concerns justify decommissioning and demolition of the obsolete power plant.

Integrating environment friendly remediation and sustainable practices can assuage local community concerns regarding the remnants of old power plant having pollution potentials and speed up site cleanups, and play a part in meeting ambient state.

<u>Potential Sources of Impact</u>

The Saidpur Power Station (SPS) has an abandoned oil-based Power Plant and associated facilities like HSD oil tanks, lube oil tanks, sludge pond, civil buildings, etc. Construction of new plant will require the demolition of old power plant and ancillaries. The likely air quality impacts arising from the demolition of the old plant and oil tanks is related to dust nuisance and gaseous emissions from demolition plant and vehicles.

Major dust generating activities associated with the demolition works are:

- mechanical demolition of building structures and oil tanks;

- debris storage;
- material transferal on to dump trucks; and
- filling of puddles and pools.

The demolition of old power plant at Saidpur Power Station is expected to take about 6 months, with work commencing in early 2020 and completed around the end of 2020.

The debris storage will be temporarily and waste materials would be taken offsite as soon as possible. The mechanical demolition will be carried out at the beginning of the demolition period, while filling of puddles and pools would be undertaken at a later stage. These two activities will not, therefore, be carried out concurrently.

The means of transport and the number of dump trucks required for removal of materials from the site depend on the choice of the demolition contractor and the quantity of materials arising from the demolition works. It is expected that there will be approximately 37,065 tons of concrete waste and 140 tons of steel arising from the demolition, i.e., about 2,480 dump trucks trips will be generated over the demolition period (about 6 months). It is expected that there will be 30 dump trucks movements per day and the existing paved road of the power station will be used.

It should be pointed out that the above activities would not be carried out simultaneously at the same location, but spread out through the whole site.

Exhaust gas comprising $S0_2$ and $N0_2$ will be emitted from the diesel-powered mechanical equipment used. However, since the number of such plant required on-site will be limited, gaseous emissions will be minor. It is not, therefore, expected that construction works will cause an exceedance of the air quality for these gases.

Assessment Methodology

The fugitive dust emissions at demolition sites are associated with land clearing, ground excavation, vehicle movement, cutting and filling operations. These sources involve earth-moving activities and general disturbance of ground. A significant portion of the dust associated with the demolition are falling walls.

Demolition works and truck movements are the two major dust generation activities for the demolition. The demolition comprises land clearance, excavation, vehicle movement and cutting and filling which are assumed to be occurring simultaneously.

The demolition works will be carried out at different elevations and, therefore, the height of emissions for the dusty activities will be varied. The emission height of the dust sources are considered 1 m for demolition and 0.5 m for haul road [Compilation of Air Pollutant Emission Factors, 5th Edition, USEPA (AP-42)]. Dust generating activities of demolition works will be carried out during normal working hours.

As per USEPA, the shortest, horizontal, distance between the source and receivers is assumed the worst case dust concentrations at ground level (1.5 m above ground) at the Air Sensitive Receivers (ASRs), A1, A2 and A3 depending on the wind direction. Domestic premises, commercial buildings, factory and active recreation areas are classified as ASRs. **Table 9.3** lists the identified ASRs and their horizontal distances from the site boundary. Locations of ASRs are shown in **Figure 9.2**.

Table 9.3: Locations of Air Sensitive Receivers

ASR	Location	Distance from Site Boundary (m)
A1	Administration building	90
A2	PDB School	633
A3	Nearest settlement (West Side of the Power Plant)	38

Source: GIS data

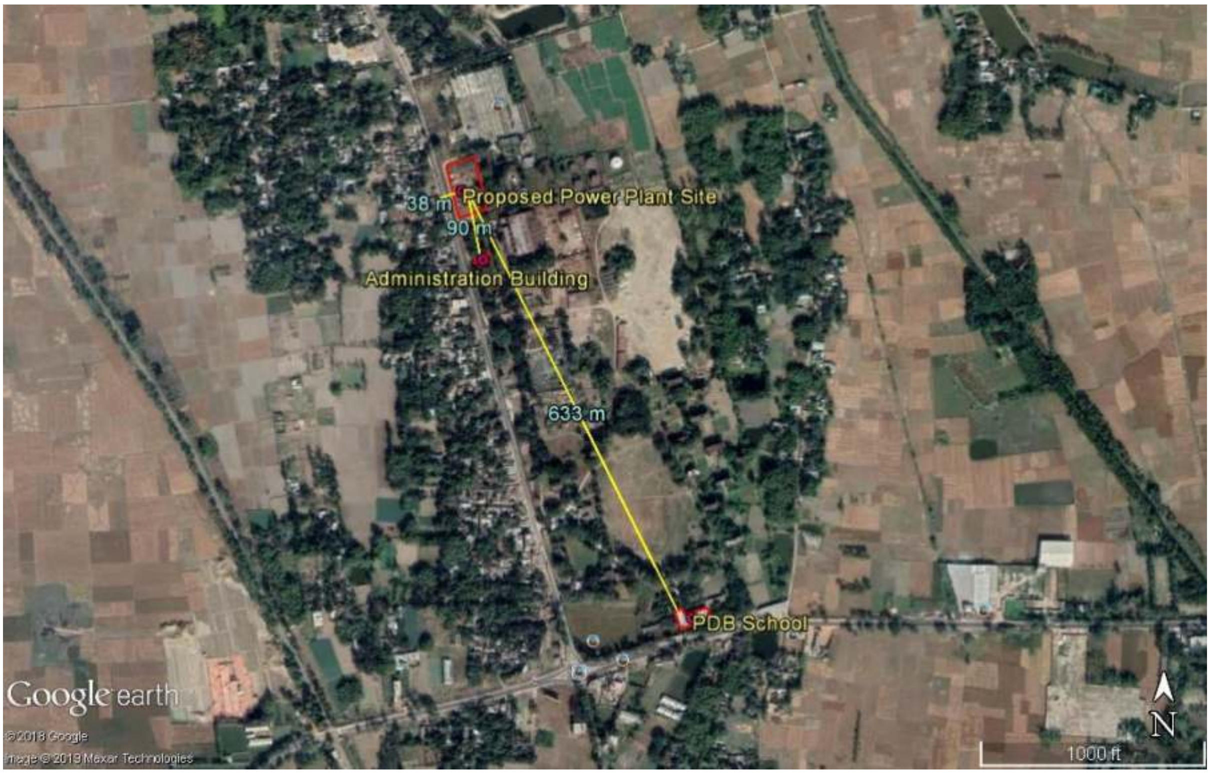


Figure 9.2: Distances of Air Sensitive Receivers from the Plant Site

Oil storage tanks are located between the dust sources and receivers on the west side village. It is expected that these tanks will restrict the dust movements, lowering concentrations at the ASRs.

Mitigation measures to suppress the dust emissions from the site are therefore recommended as good site practice.

Mitigation Measures

As presented above, the demolition works are likely to cause high dust impacts at some ASRs. The following dust control measures should be implemented and incorporated in the Contract Specification to minimize dust nuisance to within acceptable levels arising from the works:

- the heights from which excavated materials are dropped should be controlled to a practical height to minimize the fugitive dust arising from unloading;
- dusty materials should not be loaded to a level higher than the side and tail boards, and should be covered before transport;
- effective water sprays should be used on the site at potential dust emission sources such as active demolition areas;

- haul roads should be regularly watered; and
- wheel washing facilities should be provided at the exit of the site.

With the above measures, it is expected that the dust emissions from the site could be reduced by 50% and mitigated Total Suspended Particles (TSP) levels at the ASRs. Environmental monitoring and audit (EM&A) for dust generated during the demolition is also recommended at the site boundary to ensure that the dust criteria will not be exceeded.

Water Quality

Key issues addressed in this section are the generation of demolition run-off and wastewater which may cause adverse water quality impacts on water sensitive receivers if not properly controlled. Where appropriate, mitigation measures have been proposed to control potential water quality impacts. The parameters of most concern during the demolition will be suspended solids (55) and dissolved oxygen (DO) levels, the standards of which are given in **Table 5.6**. The measured baseline data for the same parameters are provided in **Table 5.7** (in-situ test result) and **Table 5.8** (Laboratory test result).

All discharges during the demolition of SPS are required to comply with the standard of the DoE, which defines acceptable discharge limits to different types of receiving waters.

In order to evaluate the water quality impacts resulting from the demolition of SPS, the Water Sensitive Receivers (WSRs) have been identified, based on the engineering requirements, methodology, mechanical equipment and spoil excavation and disposal methodology expected for the demolition works.

The water monitoring locations in the vicinity of the site are Proposed Power Plant site (sample of ground water) and Kharkharia River as shown in **Figure 5.13**).

Potential Sources of Impacts

Potential sources of impacts upon water quality from the demolition of SPS could include the following activities:

- site run-off and surface water drainage containing elevated levels of suspended solids after rainfall;
- run-off from general demolition activities; and
- Sewage effluents generated from the workforce.

Evaluation of Impacts

Demolition Site Run-off and Surface Water Drainage Run-off and drainage from the site may contain increased loads of SS and contaminants. Potential sources of water pollution from site run-off include:

- run-off and erosion from site surfaces, drainage channels, earth working area and demolition stockpiles;
- wash water from dust suppression sprays and wheel washing facilities; and
- Fuel, oil and lubricants from maintenance of on-site vehicles and equipment.

Demolition run-off and drainage may cause physical, chemical and biological effects on the downstream water quality in the natural drainage canal. Water quality impacts will become significant if the run-off and drainage are allowed to discharge directly into the receiving water body without treatment.

General Demolition Activities

General demolition activities have the potential to cause water pollution as a result of debris and rubbish, concrete dust and demolished materials, entering the water column and resulting in floating refuse in the vicinity of the site that reduces the aesthetic quality of any receiving water body. Spillages of liquids, such as oil and diesel for demolition equipment, could also result in water quality impacts if they enter the soil or nearby water bodies.

Mitigation Measures

It is important that appropriate measures should be implemented to control run-off and drainage and, thereby, prevent high loadings of SS from entering the local waterbodies causing impacts on the identified WSRs. Proper site management is essential to minimize surface water run-off, soil erosion and the impacts of sewage effluents.

Site run-off and drainage should be prevented or minimized in accordance with the DoE guidelines.

Demolition Site Run-off and Surface Water Drainage

Exposed soil areas should be minimized to reduce the potential for siltation, contamination of run-off, and erosion. Run-off related impacts associated with demolition work and other general activities can be all readily controlled through the use of appropriate mitigation measures which include:

- the use of sediment traps, where appropriate; and
- the adequate maintenance of drainage systems to prevent flooding and overflow.

The boundaries of critical site areas should be marked and provided with protective measures to control site run-off. Temporary channels should be provided to facilitate run-off discharge into the appropriate watercourses, via a silt retention pond.

Oil interception facilities should be provided in appropriate areas in the drainage system, where oil spills may occur, and regularly emptied to prevent the release of oil and grease into the storm water drainage system after accidental spillages.

Provided the surface run-off and drainage are effectively managed and controlled over the site, adverse water quality impacts can be avoided.

General Demolition Activities

Debris and rubbish on site should be collected, handled and. disposed of properly to prevent such material from entering the water column and causing water quality impacts.

All fuel storage areas will be provided with locks and be sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest container to control spilt fuel oils.

Impacts of Wastes Generated from Demolition

Potential Sources of Impact

General

Demolition activities will result in the generation of a variety of wastes which can be divided into distinct categories based on their constituents, as follows:

- demolition waste;
- chemical waste; and
- general refuse.

The volumes and nature of each of these waste types arising from the demolition of SPS are identified below:

Demolition Waste

Demolition waste comprises materials torn down during demolition, including concrete and structural steels, materials which have been over ordered or are surplus to requirements for the demolition process and materials which have been used and discarded. The bulk of the wastes

generated in the demolition process will come from the buildings and other related structures (e.g., chimney) which are to be torn down. Demolition waste may comprise different types of materials, and the list is given in **Table 9.4**.

Table 9.4: Type of Waste Materials from Demolition Activities

Sl. No.	Waste Materials	Sl. No.	Waste Materials	Sl. No.	Waste Materials
1	Concrete*	8	ceramic/ ceiling tiles*	15	trimmings from bamboo scaffolding
2	Dirt/soil/mud	9	steel (girders, steel mesh, reinforcement bar, joists, trusses, window frames, railings, bannisters)	16	wiring
3	reinforced concrete	10	other metal (e.g., aluminum frame)	17	white goods (appliances)
4	asphalt (from roads, parking lots)	11	sheet plastics (e.g., protective covers)	18	fixtures (various material types)
5	bricks/masonry	12	other plastics (e.g., pipes, stair handles, scaffolding ties)	19	fibre (from insulation) and
6	mortar*	13	glass (e.g., window, doors)	20	contaminants (e.g., lead based paints).
7	plaster (from drywall)	14	wood (e.g., door frame, doors, office partitioning)		

Those items marked with an asterisk are inert materials, which are considered suitable for public dumping.

Demolition wastes are typically generated simultaneously in mixed form and the individual waste materials may be altered (e.g., painted). The volume and composition of waste requiring disposal to landfill by the demolition of SPS will be dependent on the demolition procedure and material recovery practices. At this stage, it is not possible to predict accurately the amount of demolition waste that will be disposed. However, it is anticipated that the total demolition waste arising will be about 37,205 tons.

Chemical Waste

Chemical Waste, as defined under the Waste Disposal (Chemical Waste) (General) Regulation, includes any substance being scrap material, or unwanted substances. There is no Asbestos Containing Material (ACM) in the old Power Plant as it was a Gas Turbine Power Plant running with HSD. Some minor quantities of residual lubricating oils will be generated during demolition.

General Refuse

The presence of a demolition site with large numbers of workers will result in the generation of a variety of general refuse materials requiring disposal. General refuse may include food wastes and packaging, together with waste paper.

The SPS demolition site will employ around 125 workers. Estimates of waste arising based on the numbers of workers suggest that the general refuse produced at the SPS will be about 38 kg day.

Sewage Effluent

Demolition workforce sewage discharges on site should be connected to the existing sewer or sewage treatment facilities where possible. If the demolition works result in the loss of connection to the sewerage system, adequate portable chemical toilets will need to be provided by a licensed contractor who will be responsible for the proper maintenance of these facilities.

Assuming that either the foul sewer or portable toilets are utilized throughout the demolition works no adverse water quality impacts should arise from the demolition workforce sewage.

9.6.2 *Demolition Plan*

Demolition Procedures

a) Demolition will be carried out by hand operated pneumatic jack hammer. Oxy-acetylene torch may be used to cut the reinforcement. Mobile air compressor will be placed on the ground floor.

b) Demolition should be started on the roof and proceed down floor by floor to the ground floor. The concrete of each structural element should be broken down gradually. The reinforcement should be left in place until the concrete is broken away and when its support is no longer needed.

c) The demolition of other structural element under the building should be executed according to the following:

   i. Cantilevered slabs will be demolished by hand held jack or pneumatic hammer; prior to such demolition, the cantilevered slab should be supported and the area underneath it be protected according to the precautionary measures.

ii. The cantilevered beams will be demolished by hand held jack or pneumatic hammer; the cantilevered beam will not be demolished prior to demolition of slabs and walls which are supported by the cantilevered beams.

iii. Demolition of other slabs should be done sequentially and then interior beams and columns would be demolished.

Precautionary Measures during Demolition

a) There should be a provision of covered walk way along the entire length of each property boundary.

b) The catch platform on top of the covered walkway should be placed underneath the balconies to support the cantilevered structures. Steel propping should be installed on all floors underneath the cantilevered slabs and beams. Steel propping will have a bearing capacity of 25kN[1], spaced at 1.2 m on center.

c) Double row scaffold with nets and tarpaulin will be installed and will cover the external face of the building.

d) Bamboo catch fans will be provided at vertical intervals of no more than 10 m.

e) All existing utilities should be terminated. Sewer services and drainage connections will be disconnected and sealed off at the last manhole.

f) Field Safety Gears for Personal Safety of the labors should be in place.

g) Appropriate cloths (long pants, high visibility jacket), footwear, and gloves should be in place and used as required:

   i. Eye and ear protection;

   ii. Hardhat;

   iii. Respiratory protection;

   iv. Personal meds & Rx drugs;

   v. Bottled water;

   vi. Maps/ GPS device;

   vii. Cell Phone;

   viii. Sunscreen, insect repellant; and

   ix. First aid kit

Demolition Waste Management Plan

Debris handling

i. Existing furniture, door frames, windows, piping and other building services will be removed before demolition. Any salvageable material will be sorted and removed separately.

[1] kN stands for Prop Load

ii. Building debris will be conveyed through a 800 mm x 800 mm opening on the floor slabs. Openings shall not cut through structural support elements. Plastic chute will be initiated through the openings to convey the debris to the ground floor.
iii. Demolition debris should be picked up on ground floor with bulldozer and carried away by dump trucks. Debris clearing and transportation should be scheduled to maintain the following conditions:
    - Debris accumulation on the first floor or above will not be higher than 100mm.
    - Debris accumulation on the ground floor will not exceed 1m.
    - No debris will be allowed to accumulate on the cantilevered structures.
iv. Debris waste and other materials should not be thrown, tipped or shot down from a height where these are liable to cause injury to any person.
v. All the glass windows in the light well should be taken out or protected before using the light well for conveyance of debris in order to minimize any dangerous situation.

Special site safety

- The existing staircase will be used as emergency route. The emergency route will be maintained throughout the demolition process. The route will be clear of obstruction at all time. Signs or markings will be installed to clearly identify the route.
- Fire extinguisher or firefighting equipment will be placed in a visible location, adjacent to the staircase, on each floor.
- All flammable materials will be stored in a safe location.

Dust and Noise

- Water spraying will be applied to suppress the dust generated during the demolition operation and debris hauling.
- Super silenced type air compressor will be used during demolition. Demolition works will not be performed within the restricted hours and day.

Training

- All site personnel will go through a training program to understand the project and site safety requirements. The training program will be conducted by a competent trainer. The training program will include the following:
- An induction course at the beginning of the job to circulate information on the proposed method and required safety measures to perform the work,
- Daily safety meetings to maintain and reinforce the safety concept.

Typhoon (Emergency Bell)

- In the case when Typhoon signal is hoisted, the contractor will inspect all scaffolding, protective screen, and externally exposed temporary work and strengthen any loose connections. After the typhoon, all scaffoldings, protective screens and externally exposed temporary works will be inspected and confirmed to be safe by the competent and experienced person.

Maintenance and inspection

- All the precautionary measures, covered walkway, catch platforms, catch fans and temporary supports will be checked by the representatives of Project Director (PD) of the Project, BPDB on a weekly basis and the contractor on a daily basis any accumulation of building debris on the catch fans and catch platforms should be removed. Any deficiency will be repaired when found necessary. The inspection and repair report records will be provided to the PD of the Project.
- The contractor will identify and rectify any unsafe conditions such as partially demolished structural elements and damaged temporary supports before leaving the job site each day.

Emergency Plan

- Emergency telephone numbers will be clearly displayed in a selected locations. In the event of any emergency or accident, the contractor will notify the Police and Fire services Department for assistance. The Contractor will also notify the BPDB.
- At the initial warning of the typhoon or a major storm event, the following will be performed:
- Contractor will secure all scaffold, screen, temporary supports and loose elements on site. The scaffold will be taken down to the prevailing top level of the building.
- All flammable materials will be removed or secured in a safe location.
- No unstable and/or partially demolished structural elements will be left on site. If this is unavoidable, the unstable structure will be braced and secured.

Environmental Precautions

The general requirements to minimize environmental impacts from construction sites should also be applied to demolition processes. The following sections contain some of the measures to be adopted:

Air Pollution

Concrete breaking, handling of debris and hauling process are main sources of dust from building demolition. Dust mitigation measures complying with the Air Pollution Control Regulations should be adopted to minimize dust emissions. Burning of waste shall not be allowed. Diesel fumes generated by equipment during demolition works should be subject to the control of the Air Pollution Regulations.

Noise

Noise pollution arising from the demolition works including, but not limited to, the use of specified powered mechanical equipment (SPME), powered mechanical equipment (PME), such as pneumatic breakers, excavators and generators, etc. scaffolding, erection of temporary works, loading and transportation of debris, etc. affects the site. Silent type PME should be used to reduce noise impact as much as practicable. Demolition activity should not be performed within the restricted hours as established by EPC Contractor and approved by PD, BPDB.

Water

The discharge of wastewater from demolition should be treated to the standards as stipulated in the Draft Environmental Conservation Rules 2017 before discharge. EPC contractor should maintain proper control of temporary water supply and an effective temporary drainage system.

Hazardous Material

Other materials such as LPG cylinders in domestic flats. Toxic and corrosive chemicals and any other hazardous materials have to be identified and properly handled and removed prior to the commencement of the demolition of the buildings. The Environmental Protection Department should be consulted if in case of doubt about the waste classification.

Post Demolition

The site should be reestablished to eliminate any potential hazard to the public. The following measures should be considered:

- The site will be levelled and cleared of debris after completion of the demolition. Adequate drainage (temporary) should be provided before implementation of construction works.
- In the case of no immediate redevelopment, the site boundary will be completely enclosed to prevent public access.
- For storing the dismantled infrastructure components, spacious scrap site will be required of temporarily stack or sold out to the relevant vendors.

Damage to pavement, footpath and other elements within the right of way will be repaired to its original condition prior to the completion of the demolition project.

Oil Tank Management

Safety Requirements

- Provide appropriate protective equipment for all personnel working in direct contact with vapours, liquids or sludge removed from the tanks. All personnel shall be trained in the proper use and maintenance of the appropriate protective equipment used on this project. Smoking will not be allowed in the work area or loading area during the course of the work.
- Personnel working inside and in the general vicinity of the tanks shall be trained and thoroughly familiar with the safety precautions, procedures, and equipment required for controlling the potential hazards associated with this work, including training for confined space entry. Personnel shall use proper protection and safety equipment during work in and around the tanks, including instruments to monitor air quality, explosive atmospheres and oxygen content.
- All provisions of the site Health and Safety Plan included shall be in force during tank removal activities, unless modified in writing by the Contractor's Site Safety Officer.
- Warning signs and devices shall be placed at regular intervals along the work area perimeter, and establish restricted work zones, support areas and decontamination

areas as needed. Contractor shall furnish, install and maintain fencing or other appropriate barricades at open excavations, including illumination if left over night.

- Prior to ending operations on any working day or at any time the Contractor is not on site, the Contractor shall secure all areas of work by erecting temporary safety fencing.
- Cutting of steel or other metals by thermal methods shall, at all times, occur in a non-explosive environment. During such work, percent of lower explosive limit in the tanks, piping of the surrounding atmosphere shall be continuously monitored. The Contractor shall note that residual pockets of oils or residues may exist in some of the pipelines and the Contractor shall exercise care to prevent release to the environment and harm to workers, facility staff or the public resulting from potential explosive nature of the contained materials.
- The Contractor shall provide and maintain an adequate supply of fire extinguishers and other required safety equipment in close proximity to all tank cleaning and removal activities.
- Provide suitable personnel, material and equipment to clean and remove the fuel piping and tanks and all sludge and liquids that may be in the piping and tanks prior to removal. Take all necessary precautions during removal of the tanks to prevent damage to utilities adjacent to the area. All fuel fill, and other fuel lines and vents shall be removed.

Tank Cleaning

a) The Contractor shall perform the following activities prior to closure of the tank:
    - Notify the local fire department.
    - Obtain all necessary permits, as previously detailed within this Section.

b) Inspect the work area prior to excavation, decontamination and removal activities to the extent required to safely perform the work.

c) The Contractor shall protect existing site surfaces, materials, and structures from inadvertent Contamination from cleaning operations.

d) Assure that any electrical power connected to the tanks or its ancillary equipment (pumps) has been deactivated and the actual wiring properly dismantled at the circuit breaker(s).
    - Collect, containerize and dispose of all residual oils, other product, and sludge remaining in the tanks and piping prior to tank cleaning and removal.
    - Tanks shall have interiors steam cleaned followed by three (3) rinses. The steam discharge nozzle and all conductive insulated objects subject to impingement or condensation should be bonded to the tank or be grounded. Surfaces shall be steam cleaned using a commercial-scale steam cleaner. The Contractor shall be required to use a detergent and provide a steam generator. Liquid waste generated as a result of steam cleaning and rinsing operations shall be collected and removed by the Contractor. The Contractor shall dispose of the liquids as per the method specified for the tank sludge and residues or consultation with the DoE.
    - After the above operations, all flammable vapors shall be removed from the tanks by displacement with inert gas. The vapors shall be made inert by adding solid carbon dioxide, (dry ice), in the amount of 1.5 pounds per 100 gallons of tank capacity. The dry ice shall be crushed and distributed evenly over the greatest possible area to

ensure rapid sublimation. All available tank openings shall be open to the atmosphere during this procedure to ensure rapid dissipation of the dry ice.
- To evaluate the effectiveness of the dry ice procedure, the Contractor shall use a suitably calibrated instrument to determine if the resultant vapor mixture within the tanks exceeds ten percent of the Lower Explosive Limit (LEL). Readings shall be taken throughout the tanks depth wherever access is possible. If the vapors within the tanks exceed ten percent of the LEL, the displacement procedure shall be repeated followed by a recheck of the LEL until the vapors are less than 10 percent of the LEL.
- After acceptable LEL levels have been reached, excavation of tanks may begin after approval of the Engineer.

Tank Disposal

- The Contractor shall dispose of all demolition related wastes as designated herein, in accordance with all applicable regulations.
- The Contractor shall characterize, containerize, transport, and dispose of all residue, sludge, cleaning materials, and fluids from the tanks at an approved and permitted disposal/recycling facility.
- If evidence of soil or groundwater contamination is identified by the Engineer during the tank closure, then disposal of pumped groundwater shall be performed by the Contractor only as approved by the Engineer.
- Tanks and piping shall be delivered for disposal in an acceptable manner to an approved disposal or recycling facility following decontamination.
- All concrete associated with existing buried tanks shall be broken up and re-used/disposed in the designated site or landfill area.

9.6.3 Site Preparation

Proposed Project site is mostly fallow land and rests includes some trees, herbs and some civil structures which are to be demolished. The site is under the process of site preparation for Power Plant construction. The EPC contractor shall have detail site preparation plan ensuring safeguarding of Occupation Health, Safety and Environment (OHSE). The plan should be reviewed and approved by the proponent.

9.6.4 Kitchen Waste

Kitchen waste collection and disposal system should be implemented to manage the kitchen waste generated from the labor shed during the pre-construction phase of the Project. All the generated waste should be collected and sorted considering type of materials including degradable, recyclable, reusable and disposable waste and managed separately. Temporary bins with different color indicating disposal of degradable and non-degradable wastes should be installed at waste generation sources. Collected waste should be disposed of at the designated place in consultation with local Authority. The waste will be disposed of onsite maintaining DoE's standard.

9.6.5 Ecosystem Management Plan

It is necessary to follow ADB Safeguard Policy Statements (SPSs), IFC's Guidance note 6 with a consistent biodiversity monitoring action plan. The management must closely work with local institutions like Department of Environment (DoE), Bangladesh Forest Department (BFD), Bangladesh Water Development Board (BWDB), and local communities also be involved in the implementation of the EMP that has been prescribed in the EIA report. Similarly, the authority should safeguard environmental standards while ensuring its updates to any changes and development in cleaner environmental technologies. The suggested environmental management plan must be taken into consideration to ensure the protection, conservation, and sustainable use of the ecological resources. Ideally, the EMP outlines the details of project activities, impacts, and proposed measures, schedules and responsibilities to maintain for the betterment of the existing ecosystem for a sustainability manner.

9.6.6 Drinking Water Supply and Water Quality Management

The local people prefer groundwater for drinking. This is because depth of the water bodies within the study area is not sufficient. Almost every household near the Project area and within the study area uses groundwater to fulfill their drinking requirement as well as household activities.

In order to minimize the surface water contamination, the disposal of industrial wastes into the river should be restricted to a minimum level. In addition, dumping of household wastes near the river should be strictly prohibited and monitored.

9.6.7 Groundwater Level Management Plan

The annual recharge of groundwater within the Project area is high compared to the withdrawal for Power Plant in the demolition period. However, program for monitoring of groundwater level during and after the construction period should be done to avoid mining of groundwater.

9.6.8 Management of surface water availability

The rivers within the study area are not perennial and become almost dry in summer. Therefore, the navigation completely stops during pre-monsoon.

The surface water is used for irrigation purpose during pre-monsoon where farmers have sufficient amount of water for extraction. People in this region generally use Tube well for drinking purpose and household activity.

9.6.9 Stakeholder engagement plan

Stakeholders should engage from the planning, design, implementation and operation phase as well. As the proposed project will be implemented to the BPDB own land therefore no other except BPDB is the primary stakeholder for this project. However, for mitigating the probable impacts due to the proposed project the local secondary stakeholders will need to be engaged in all the phases of the proposed project.

9.7 EMP during Construction Phase

9.7.1 Acoustic Management Plan

Noise to be generated from different mechanical equipment machineries and vehicle used in construction activities shall have to be managed following the applicable national and international standards. Construction activities should be limited during daytime only. Also, reduce noise generation through unnecessary honking from machineries, vehicles and construction activities.

9.7.2 *Kitchen Waste*

Kitchen waste collection and disposal system should be implemented to manage the kitchen waste generated from the labor shed during the construction phase of the Project. All the generated waste should be collected and sorted considering type of materials including degradable, recyclable, reusable and disposable waste and managed separately. Temporary bins with different color indicating disposal of degradable and non-degradable wastes should be installed at waste generation sources. Collected waste should be disposed of at the designated place as similar to the pre-construction phase.

9.7.3 *Construction waste management plan*

The common construction solid wastes are cut pieces of rod, cement bags, wooden boxes etc. The EPC Contractor will be required to prepare a construction waste management plan to ensure that waste generated during construction phase are collected, transported, and disposed of properly. Measures such as planned/scheduled stocking-up and delivery of materials for construction, covering of equipment; fencing around the construction site, and proper housekeeping at the construction site should be implemented. The EPC Contractor should ensure that no waste should be dumped or discharged in to the nearby agricultural lands. Hazardous material from construction site including fuel and other combustible materials should be stored properly at a designated place.

9.7.4 *Waste Disposal and Effluent Management Plan*

Authority should develop a waste prevention strategy, which will significantly reduce the total amount of waste. The strategy should focus on recycling and the facility wise implementation of recycling plans as per following items (as per Financer/IFC Guidelines):

- Evaluation of waste production processes and identification of potentially recyclable materials;
- Identification and recycling of products that can be reintroduced into the operation of the Plant;
- Investigation of external markets for recycling by other Power Plant operations located in the neighbourhood or region of the facility (e.g., waste exchange);
- Establishing recycling objectives and formal tracking of waste generation and recycling rates;
- Providing training and incentives to employees in order to meet these objectives.

9.7.5 *Fuel and Hazardous substances Management Plan*

EPC contractor should prepare a fuel and hazardous substances (Mostly chemicals needed for water treatment) management plan considering the proposed EMP, environmental code of practices and applicable guidelines. The plan should be approved by the proponent.

9.7.6 *Ecosystem Management Plan*

Ecosystem management plan is an integral part of the EMP. Implementation of such management plan is essential for safeguarding the ecosystem. Vegetation clearance should be limited within the project boundary. Implementation of plantation at the plant site is suggested where possible during construction works. In addition, plantation of 1:5 ratio (replant 5 for cut 1) also suggested to mitigate loss of the existing vegetation. The project proponent shall maintain minimization of noise levels within standard for abating wildlife disturbance. Fencing around the proposed project site shall be kept so that the wildlife become safe in terms of construction related mortality.

9.7.7 Labor Recruitment Plan

Labors should be recruited following rules and regulation of Bangladesh Government as well as international standard of International Finance Corporation (IFC). In this regard, Bangladesh Labour Act (BLA), 2006, ILO Declaration on Fundamental Rights and Principles (ILO, 1998) and IFC PS-II and Equator Principle – III will need to apply during preparation of the Labor Recruitment Plan.

9.7.8 Management of surface water availability

In monsoon, the usual depth ranges from 5-7 ft and small boats are observed in the river. The depth varies in different locations within the river for which no motorized boats are used for navigation.

The surface water is used for irrigation purpose during monsoon. People in this region generally use Tube well for drinking purpose and household activity.

9.7.9 Drinking Water Supply and Sanitation Plan

A plan for separate water supply and sanitation provisions might be needed as temporary facilities for labors at labor camp and workshops. The facility will be stopped and scrapped after completion of the Project construction. The Plan will be submitted to the authority for review and approval before contractor mobilization.

9.7.10 Traffic Management Plan

During construction, a number of vehicles will be running from/to the construction site. Besides, project site is connected with Saidpur- Nilphamari regional road and Saidpur Bypass road. The ongoing four lane construction of the regional road may also cause traffic congestion. In order to avoid the impacts of this additional traffic there must be a management plan for traffic operation. A detailed mitigation plan should be prepared by the Contractor in consultation with the local people and authorities responsible for roads and traffic.

9.8 EMP during Operation Phase

9.8.1 Air Pollution Management Plan

To ensure compliance with the air emission criteria for flue gas stacks, a number of mitigation measures will be adopted by the proponent. Use of continuous emission monitoring (CEM) equipment for the measurement of air emission levels in the exhaust stack. CEM will monitor the NO_x, and PM with respect to standard limit. Ambient NO_x, SO_x and PM will also be monitored though passive sampler for three months at the mostly affected areas around the stacks. Necessary steps like maintenance of pollution generating or controlling sources should be taken urgently because of breaching the air pollution standard. Green belt in and around the Plant will reduce the generated CO_2 in addition to other pollutants in a large extent. EHS department will regularly look after the air quality issues.

9.8.2 Acoustic Management Plan

All the equipment and machineries should be maintained in good working order. Noise level should be monitored at different selected location within Power Plant and nearest community. The greenbelt shall be developed with the aim of lowering the noise level. Mechanical parts with high noise potential shall be provided with acoustic hood. Noise generated from other sources like vehicle must be controlled adopting mitigation measures. An Environment Manager shall be given responsibility of monitoring the efficiency of the management plan and regular monitoring of noise level. This monitoring may be done quarterly in a year and report to be submitted to project authority.

9.8.3 Solid waste management

Waste to be generated from different point sources like office, household, workshops, construction yards, etc. shall be efficiently collected, disposed and managed. Waste shall be collected and managed separately as per type. Hazardous waste should be managed separately. Initiatives might be taken for recycling and re-use of waste. On site, waste disposal system should be constructed.

9.8.4 Waste Water Management Plan

The waste water generated from the household and office buildings should be released in the specified sewage line so that it would not contaminate any nearby water body. Distilled water will be used in the plant section for power generation which will go through a continuous recycling process. As the water will not be released, waste water will not be generated.

9.8.5 Sewerage Management Plan

Proper management of sewerage is essential for good living. A good drainage system to be developed for continuous drainage of all sewerage to the local municipality sewerage system. Otherwise, the sewerage should be collected through pipes in pits of proper size which will be periodically cleaned by the professional cleaner.

9.8.6 Water resources management

Proper water drainage should be ensured in every phase of the project. Although the water logging scenario is not a common factor within the project area, but workers have to be careful regarding the placement of different construction materials. These necessary materials should not place in such places where it may block the drainage. Waste water management should also be monitored strictly. Although, waste water will not be produced during power generation, but household and office buildings will eventually release such water which should be drained properly into a specific zone where it will have the least effect on surrounding environment and ecosystem. Groundwater will be used in all phases of the plant. Therefore, the consumption should be kept at minimum level to ensure proper water recharge.

9.8.7 Hazardous Material Management

Liquid wastes may generate from cooling tower blow down, water from leaks and vents, waste water from turbine floor and workers' colony and offices and oily water separation unit. Besides, some HSD wastes will be collected in trays from different leaks of pipe joints and Burner area. It is important to dispose these wastes; otherwise it may contaminate nearby water resource and contaminate soil texture. The authority should be aware of handling the hazardous materials with proper safety.

9.8.8 Agricultural Land Management Plan

Agricultural crop land might reduce for the infrastructural and industrial development in the study area. So, food security should be assured by increasing crop production. It should be done through the use of modern varieties and technology in the crop production and the fallow lands should be brought under cultivation. Single, double and triple cropped area should be increased based on land types. There should be concerned to avoid agricultural land for infrastructural development. Infertile lands should be brought under infrastructural development. Moreover; insect infestation might increase in the surrounding agricultural land due to lighting of the plant site. So, farmers should be properly trained Good Agricultural Practices (GAP) and Integrated Crop Management/Integrated Pest Management (ICM) introduction.

9.8.9 Ecosystem Protection Plan

The plan for ecosystem protection is environment friendly approach to power plant to show results in conservation of natural resources such as water and fuel as well as control of environmental pollution. In the project design, a set of well-defined activities that are envisaged right from the project conceptualization stage so that during the entire life cycle of the power plant, it will fully compliant with various environment regulations and a pristine environment and ecological balance which will be maintained in and around its power station and township. Performance enhancement and up-gradation measures are suggested to undertake by the agencies (BPDB and DoE) during the operational stage of the station. These activities will have greatly help to minimize the impact on environment and preserve the ecology in and around the power project. A broad-based Environment Monitoring Plan (EMP) has formulated for execution. With better awareness and appreciation towards ecology and environment, the above-mentioned agencies are set to continue looking for innovative and cost-effective solutions to conserve natural resources and reduce wastes.

9.8.10 Greenbelt Development

Introduction

A greenbelt program at the open spaces in and around the proposed Project site has been considered for attenuating noise, sinking CO_2 and arresting dust particles that may be produced due to operation of the power plant and vehicular movement. The plantation for proposed greenbelt should be started in the monsoon season.

Objectives

The objective of Greenbelt development is to reduce soil erosion by controlling rainwater runoff, facilitate sustenance of ground water table, controlling environmental pollution; assisting and enriching biodiversity index etc.

Guidelines for Greenbelt Development

Design and development of greenbelt should follow the guidelines of the Forest Department. The Proponent should follow a minimum of five-year comprehensive greenbelt development program and accordingly should follow the prevailing practices of the greenbelt management.

Management Plan (Year 1)

- Capital provision for watering to the plants through water pipelines & taps/valves, flexible pipes and should be considered under project capital cost;
- The proponent may start activities of greenbelt development program at the end of construction phase of the project in the exposed area;
- The proponent should collect saplings/seedlings of native and exotic species adapted locally from local nursery ; and
- Plantation and maintenance of trees and shrubs should be undertaken as suggested in the Guidelines for greenbelt development

Management Plan (Year 2-5)

- The proponent should maintain all necessary facilities for watering planted trees in operating condition ;
- The proponent should conduct regular monitoring for checking the survivability of the plants and re-plantation should be undertaken if required; and
- The proponent should execute manuring by maintaining proper schedule for ensuring good health of the planted trees.

9.8.11 Greenbelt Development Plan

A total number of 498 trees are composed of six species have been planned to plant for the development of greenbelt. The greenbelt development Plan is shown in the **Figure 9.3**. The selected Species are:

Nageswar (*Messua ferra*): The dense canopy with long height species

Weeping Debdaru (*Polyalthia sp*): The narrow height column canopy act as green wall beside the service roads

Kathbadam (*Terminalia catapa*): The broad leaves tree with wide canopy coverage has been considered because of its shade facilities along with edibility of fruits to small wildlife and birds.

Mango (*Mangifera indica*): The most prominent fruit-yielding tree can meet-up fruit demand

Litchi (*Litchi cinensis*): This fruit-yielding tree is considered in this area for its nativity.

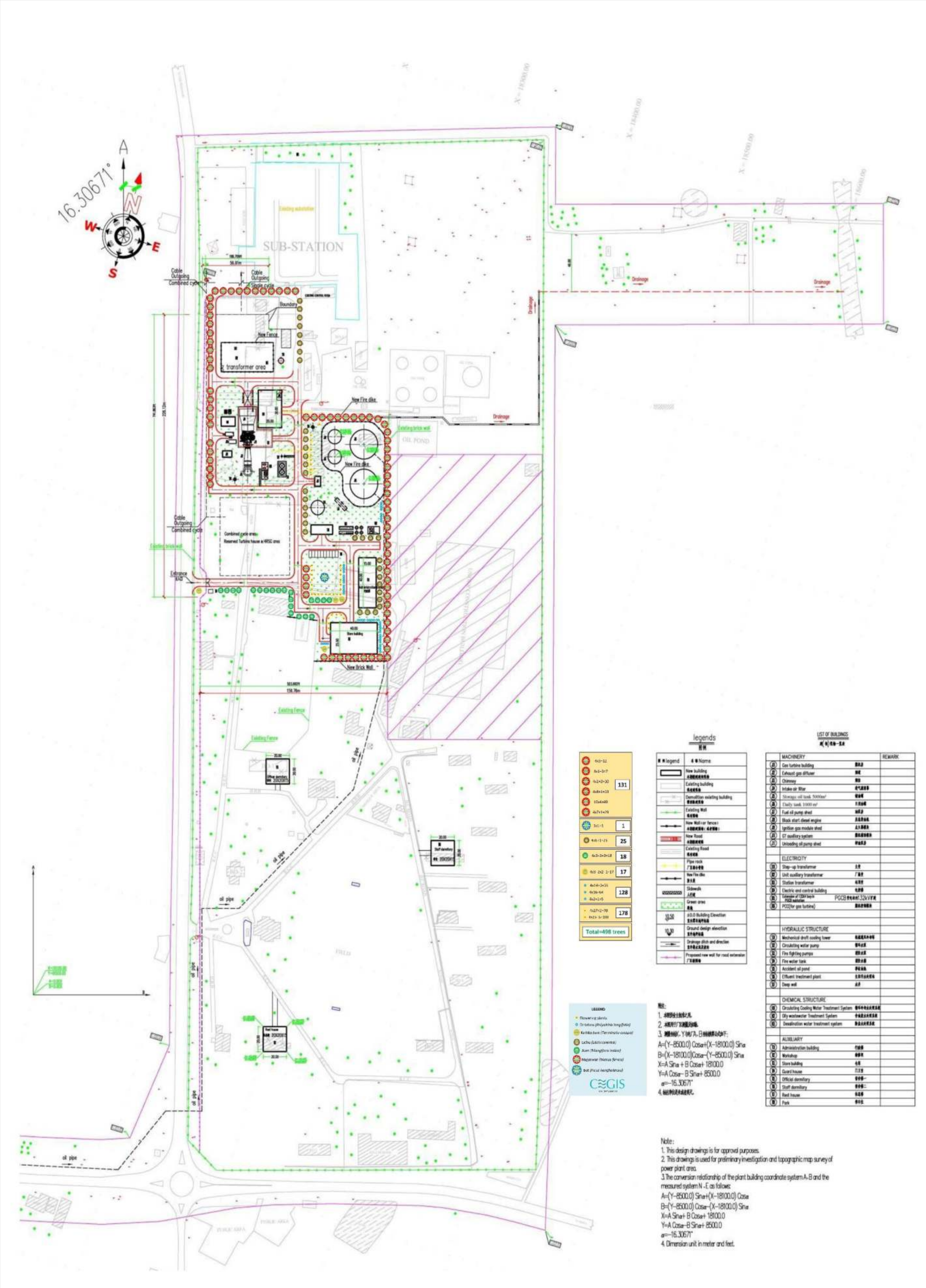


Figure 9.3: Greenbelt Development Plan

Banyan (*Ficus benghalensis*): This tree provide the widest shade which is appropriate to plant at the Parkside. It also gives enormous support to local avifauna.

Flowering herbs and shrubs: These species have high aesthetic values, hence these species are also suggested to plant.

The abovementioned species have been selected considering following criteria:

- Native species;
- Exotic species which are adapted locally;
- Canopy coverage, width and density to create barriers against noise and dust absorption and avoiding Collisions with overhead cables;
- Having more CO_2 sinking capacity;
- Support local avifauna and other small wildlife;
- Having ecosystem goods and services potential; and
- Aesthetic values.

9.8.12 Occupational Health Safety and Environment

A detailed Occupational Health, Safety and Environment (OHSE) Plan should be prepared by the Project authority considering the following:

- Occupational Hazard Identification and Control Plan
- Inspection and Auditing Plan
- Leadership and Administration Plan
- HSE Communication Plan
- Required PPEs
- Site Security Plan
- OHSE Program for the Contractors/Sub-Contractors
- Preventative Maintenance Plan
- Incident Investigation Mechanism

9.8.13 Grievance Redress Mechanism

There may have different types of disputed issues during implementation of the proposed project. Therefore, it is essential to prepare grievance mechanism to solve all types of disputed issues. In this project, only a local level Grievance Redress Committee is needed to form.

Procedures

The local level GRC will be constituted with representation of the local UP Chairman for the union or Ward Councilor for the Paurashava area and affected people ensuring women's representation, if available. The following composition is proposed for the local level GRC (LGRC) with representations from Project Proponent, Implementing Agency (IA), local elected officials and representatives of affected people including women in the Project area to ensure a participatory process and to allow voices of the affected communities in the grievance procedures.

Local Grievance Redress Committee

1.	Executive Engineer, BPDB	: Convener
2.	Representative of IA (Non-voting)	: Member-Secretary
3.	UP Chairman or Puarashava Councilor	: Member
4.	Female member of ward of the Paurashava/union	: Member
5.	Retired teacher from the Paurashava/union	: Member
6.	Representative of PAPs	: Member

One (1) representative of the Project Affected Persons (PAPs) of the project surrounding community, based on the recommendation of IA and approval by the convener will be a member of the LGRC. The Member-Secretary of LGRC will be available and accessible to APs to address concerns and grievances. It is assumed that GRCs will work well and successfully resolve disputes in a participatory manner ensuring fairness in the decision making process. The LGRC is empowered to take a decision, but it requires the approval of the Project Director for implementation of the decisions.

9.9 Mitigation Plan

The mitigation plan presented in **Table 9.5** which includes various actions, defines responsibilities for implementation, supervision and timing of each actions.

Table 9.5: Mitigation plan

IECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Mitigation Plan for Pre-Construction Phase				
Physical Environment				
Environmental Quality				
Ambient air quality	Increase dust particles due to land development works	• National rules and regulations for waste management should be followed. • Dust Suppression Mechanism like water spraying should be done at least twice in dry season and windy months to control generation of excessive SPM. • Screen the whole construction sites to stop dust spreading, or alternatively, place fine mesh screening close to the dust source • Properly cover piles of construction materials like cement, sand and other powders • Proper and prior planning and appropriate sequencing and scheduling of all major demolition and site preparation activities.	Appointed Contractor/ BPDB	BPDB
Ambient noise	Noise would be generated during site establishment work (land filling)	• Construction of boundary wall around the Project site • Workers should be provided with ear plug/ ear muff headphone	Contractor/ BPDB	BPDB
Construction Waste	• Foul odor, visual pollution, chances of water pollution from the unmanaged solid waste from construction activities and labor shed	• Dust suppression system like water sprinkler should be adopted control dust emission from the site development areas • Unpaved land should be water sprinkled two times in a day except the rainy days • Practice 3R • Stockpiled materials should be covered and be secured from leaching contamination, risk of runoff etc. • Fencing the proposed project.	Contractor	OE/ESH Unit

IECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Kitchen Waste	• Foul odor, visual pollution and risk of polluting the surrounding environment if not managed properly	• Onsite waste disposal system must be adopted • Sanitation system must be developed substantially • Colored bins for degradable and non-degradable waste • Protected from scavenging by birds and animals and from contamination through leaching	Contractor	OE/ESH Unit
Water Resources				
Drainage	• Demolition of substation may temporarily disturb the drainage.	• The demolition equipment should be placed in a certain place where drainage will not be disturbed.	EHSU	Independent Monitor/ BPDB
Biological Environment / Condition				
Ecological Resources				
Terrestrial vegetation	A large number (n=94) of fruits, timber and medicinal plants needs to be cut within the project boundary	• Demark area to be cleared • Cut trees as low as possible • Keep felled trees within designated area	Contractor	BPDP and DoE
Wildlife habitat	Wildlife habitats and their movement will fall disturbances	Plant trees outside of the project.	Contractor	BPDP and DoE
Socio-Economic Environment / Condition				
Disturbance of Local community	Noise of dismantling the existing structures will disturb the resident of the surrounding community.	▪ Noise absorbent panels should be used to protect the diffusion of noise to the outside of the plant. ▪ In this regard, modern technology should be introduced that produce low noise for conducting dismantling activity. ▪ Moreover, this dismantling work should be prohibited at quiet time from 8pm to 7am so that the community can get proper sleep at night.	Contractor	EHSU-BPDB

IECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Health and Safety	Injuries leading to casualty or death may be caused from the demolition activities. Besides, unconscious movement of material carrying vehicles may cause road accidents.	• Working labors must use all the Personal Protective Equipment (PPEs) those required for conducting respective activities. • Safety and awareness talk should mandatory in everyday before starting the works. • A temporarily medical camp should set up in the project site and transport facilities should be available in emergency movement of the critical patients. • Medical insurance should be ensured for the workers involve in risky activities. • The entire project site should be fenced and prohibited for outsider access. • The traffic guards will need to be deployed to maintain the road traffic during the movement of material/equipment carrying heavy vehicles. • Use of necessary traffic management tools along the road as per requirements.	Contractor	EHSU-BPDB
Mitigation Plan for Construction Phase				
Physical Environment				
Environmental Quality				
Ambient air quality	The emitted dust (SPM, PM) from the construction areas will disperse to the ambient environment. The repairable particulate matters may be inhaled by the human being causes respiratory problem. Moreover, the fugitive dust will fall over the plant leaves and household structures.	• National rules and regulations for waste management should be followed. • Dust Suppression Mechanism like water spraying should be done at least twice in dry season and windy months to control generation of excessive SPM. • Screen the whole construction sites to stop dust spreading, or alternatively, place fine mesh screening close to the dust source • Properly cover piles of construction materials like cement, sand and other powders	Appointed Contractor/ BPDB	BPDB

IECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
		• Proper and prior planning and appropriate sequencing and scheduling of all major demolition and site preparation activities. • Use of high speed diesel (HSD) with sulphur content < 0.25% in HGVs and diesel powered equipment; • Road should be constructed by brick shoaling or bituminous before using it • Use non-toxic paints, solvents and other hazardous materials for construction, wherever possible • No burning of materials on site		
Ambient noise	Noise would be generated from the moving and idling vehicles and heavy machineries used for Civil, mechanical, electrical and other construction activities, which may cause disturbance to the ambient environment	• Construction of boundary wall around the Project site • Limiting the arbitrary whistle or honking from the vehicles and vessels • Construction activities in the Project area should be limited only within daytime • Workers should be provided with ear plug/ear muff headphone • High noise generating machines and unfit vehicles should not be allowed in the Project area. • Vehicles and machines that are not in use shall be switched off	Contractor/ BPDB	BPDB
Waste Generation	• Perishable solid wastes from kitchen and Sanitary waste from labor shed may spread odors and create hygienic problems • Liquid waste may contaminate soil texture	• All solid wastes, should be stored in designated sites covered with tarpaulin prior to final disposal • Perishables solid wastes should be stacked in specific one place which will be periodically taken to their pre-selected municipal disposal area • Kitchen wastes should be dumped in a specific place and covered for avoiding unwanted odor • Sanitary latrines will be refilled after construction phase • Waste water should be collected in ditches and finally reuse after proper treatment	Contractor	OE/ ESHSU

IECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Biological Environment				
Ecological Resources				
Terrestrial vegetation	Transportation of construction material and labor movement will deteriorate the status of the terrestrial vegetation along the roads.	• Spray water on construction sites to control dust particulates; • Use cover to the loaded truck to minimize dust particulates and accidental dropping of construction materials (e.g. brick, stone, etc.) during transporting.	Contractor	BPDP and DoE
Wildlife habitat	Sound emission from construction machines, lighting at night, and labor and vehicle movement will deteriorate wildlife habitat.	• Use low sound emission construction machines; • Keep lights downwardly at night; and • Labor and vehicle movement should wary to avoid disturbance to wildlife and their habitats	Contractor	BPDP and DoE
Socio-Economic Environment / Condition				
Disturbance of Local community	Noise of construction machineries/ equipment will disturb the resident of surrounding local community. Also, unauthorized movement of labors may disturb the resident and CPRs users of BPDB compound area.	• Noise absorbent panels should be used to protect the diffusion of noise to the outside of the plant. • Modern technology should be introduced that produce low noise for conducting construction activity. • The construction activity should be prohibited at quiet time from 8pm to 7am so that the community can get proper sleep at night. • Labors movement should be prohibited near to the BPDB colony and School.	Contractor	EHSU-BPDB
Health and Safety	Labors using inadequate PPEs may fall under serious injury during occurrence of unexpected accidents which may tends to casualties in some extent. Beside, From accommodation to work site in every stage gender issues are sensitive, as female wage earners are available in Saidpur Upazila.	• Use of Personal Protection Equipment (PPE); • Awareness of workers • Arrangement of firefighting equipment with training to its usage; • Staff should be trained on handling emergency situation; • Safe handling and storage of flammable chemicals and fuels; • Regular inspection and monitoring of pressure parts and units;	Contractor	EHSU-BPDB

IECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
		• Compliance with the national Noise Control Rules and Regulations and IFC Occupational Health and Safety Standards; • Equipment to be used by competent operators; • Provision of equipment with low noise and vibration outputs where possible and • Provision of addressing gender concern issues from accommodation to work site;		
Mitigation Plan for Operation Phase				
Physical Environment				
Ambient air quality	A little amount of Air pollution may occur due to emission of pollutants like SO_x, NO_x, $PM_{2.5}$ and PM_{10} from stack of Power Plant. Moreover, formaldehyde, may be released if poor air/fuel mixing and the incomplete combustion of the fuel source occurs.	• The use of continuous emission monitoring (CEM) equipment for the measurement of air emission levels in the exhaust stack • $PM_{2.5}$ and VOCs will be monitored periodically, to ensure that these emissions are not occurring as a result of the incomplete burning of the diesel fuel • At last but not least national rules and regulations should be followed for waste management.	BPDB	EHSU
Ambient noise level in the control room, turbine hall	Noise will be generated from the rotating machines like diesel generating set, pumps, fans etc. Thus, hearing complexity and loss along with increased blood pressure, disturbances and discomfort to the technicians and workers and surrounding communities.	• Build a brick boundary walls at least 3 m of height and thick plantation to attenuate noise in the sensitive receptors. • The machines/ equipment/ vehicles should be turned off when not in use. • Workers should use appropriate PPEs (soundproof earpiece, earmuffs etc.) while working close to noise equipment • Modern low noise generating machines should be used • All major rotating machines like diesel generating set, turbines, fans, pumps etc. will be covered by noise proof hoods	Contractor	EHSU

IECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
		• Doors and windows of control room will be provided with noise proof seals • A green belt should be developed around the proposed Power Plant area to limit the spread of noise to the nearby community		
Waste Generation	• Perishable and non-perishable solid wastes from kitchen may spread odors and create hygienic problems.	• Household waste and chemical wastes from Power Plant and the vicinity should be managed separately • Kitchen wastes should be dumped in colored bins in specified place and finally to the authorized waste disposal area	BPDB	OE/ EHSU
Ground water withdrawal	• The proposed Power Plant will require a minimum amount of ground water for its cooling and other services. However, the site is under the Barind Tract and already have scarcity of ground water there; this may cause adverse cumulative impact on ground water system.	• This can be mitigated by reducing the water withdrawal, which can be compensated by creating reservoirs so that water can reserve during wet period. • Rainwater harvesting facilities should be created by following the BNBC.	BPDB	BPDB
Land Resources				
Agriculture land use	Agricultural land might be changed to industrial and others infrastructural development.	• A local/regional plan should be prepared by the concerned Government Authority to guide the plan induced development and conserve agricultural land from the invasion. • The fallow/infertile lands should be brought under cultivation. • There should be concerned to infertile lands brought under infrastructural development. • Compensate the landowner based on the prevailing Government Rule for acquisition of any agricultural land in future.	Contractor	BPDB

IECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Biological Environment				
Agricultural Resources				
Crop production	The crop production might be impacted due to industrial development in the study area	• Food security should be assured by increasing crop production and cropping intensity. It should be done through the use of modern technology in the crop production. • Farmers should be properly trained about the system and management of GAP (Good Agricultural Practices)/ICM/IPM (Integrated Crop Management/Integrated Pest Management).	Contractor	BPDB
Ecological Resources				
Terrestrial vegetation	Terrestrial vegetation include greenbelt will develop around the power plant site	• Develop a greenbelt with all strata and all-season fruiting plants; and • Plant rough bark broadleaved trees plants.	BPDP	DoE
Wildlife habitat	• Creation of wildlife habitats; • Earth vibration during operation of the power plant	Take necessary measure on reducing vibration on earth during operation.	BPDP	DoE
Socio Economic Environment / condition				
Health and Safety	Accommodation facilities become dilapidated/unhygienic to reside and no medical facilities are observed in the BPDB compound. Beside these the working labors will engage is different risky activity which may be life threatening as well.	• Workers should have safe accommodation facilities; • Medical center is needed to set up in the project compound which will be operated through a MBBS doctor and associated with relevant equipment; • Use of Personal Protective Equipment (PPE) for all; • Monthly/quarterly awareness campaign for the workers; • Arrangement of firefighting equipment with training to its usage; • Staffs should be trained on handling emergency situation; • Safe handling and storage of flammable chemicals and fuels;	Hired Consultant	EHSU-BPDB

IECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
		• Compliance with the national Noise Control Rules and Regulations and IFC Occupational Health and Safety Standards; • Equipment to be used by competent operators; • Provision of equipment with low noise and vibration outputs where possible;		
Disturbance of Local People due to Noise	From previous experience of the existing power plant it is found that a sound is generated which transfuse to the adjacent surrounding area. Adjacent people are disturbed due to this noise generated from existing power plant. Local people are disturbed for this sound, especially at night time. However they are expecting the same scenario for this new power plant.	• Using modern machineries so that quantity of sound generation is reduced. • Using noise Absorptive Panels so that reduces noise levels in buildings and enclosed spaces. Typically applied to interior or exterior walls to reduce sound reflected from noisy equipment. • Using Sound Barrier Walls, Open top enclosures used to effectively block noise by surrounding noisy equipment while not restricting airflow.	Hired Consultant	EHSU-BPDB

Note: These mentioned costs are tentative and might be changed during detail design of the project that shall be carried out by the EMP contractor. The EPC contractor shall be appointed after obtaining of Environmental Clearance Certificate from DoE.

9.10 Administrative Setup and Organogram

9.10.1 Bangladesh Power Development Board

In 1972, after the emergence of Bangladesh as an independent country through a bloody War of Liberation, Bangladesh Power Development Board (BPDB) was created as a statutory body to boost the power sector. BPDB was established on May 1, 1972 by the Presidential Order No. 59 bifurcating erstwhile Bangladesh Water and Power Development Authority. BPDB was formed as an integrated utility with responsibility of power generation, transmission and distribution. It started operation with only 500 MW installed capacity.

The organogram of the BPDB is presented in **Figure 9.4**.

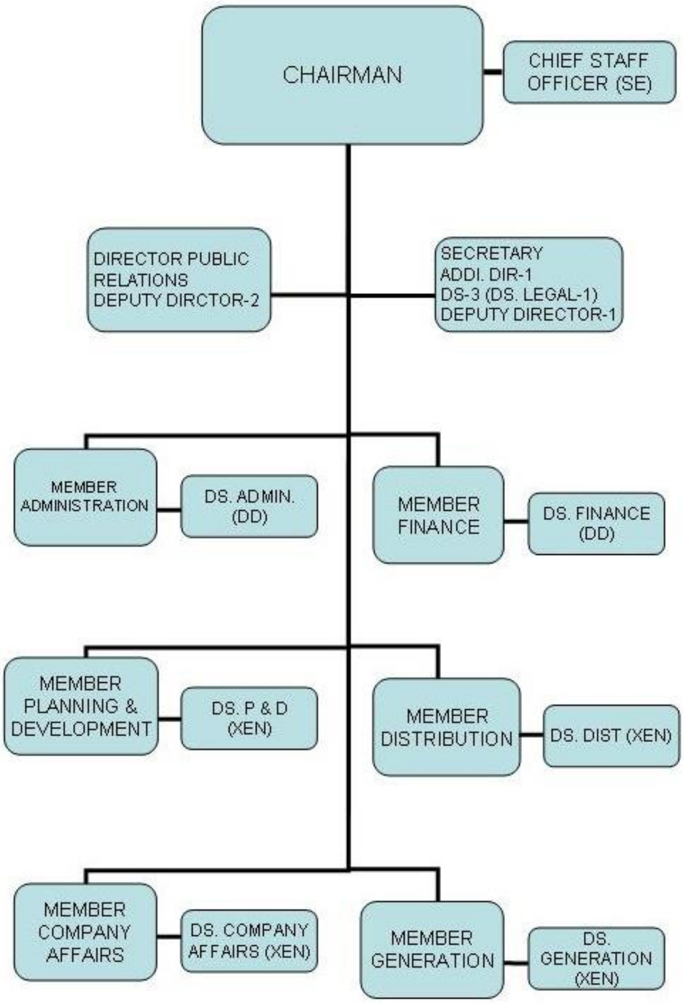


Figure 9.4: Organogram of BPDB

9.10.2 Proposed Saidpur 150 MW ±10% HSD Based Simple Cycle Power Plant

In the Project period, about 19 number of people (according to the information given by BPDB) will be engaged for the Project. Additionally, for the pre-construction and the construction phase approximately 100 people would be involved for the land development as well as the construction of the proposed Power Plant. The organogram for the 150 MW ±10% HSD Based Simple Cycle Power Plant Project, is presented in **Figure 9.5** and **Figure 9.6**.

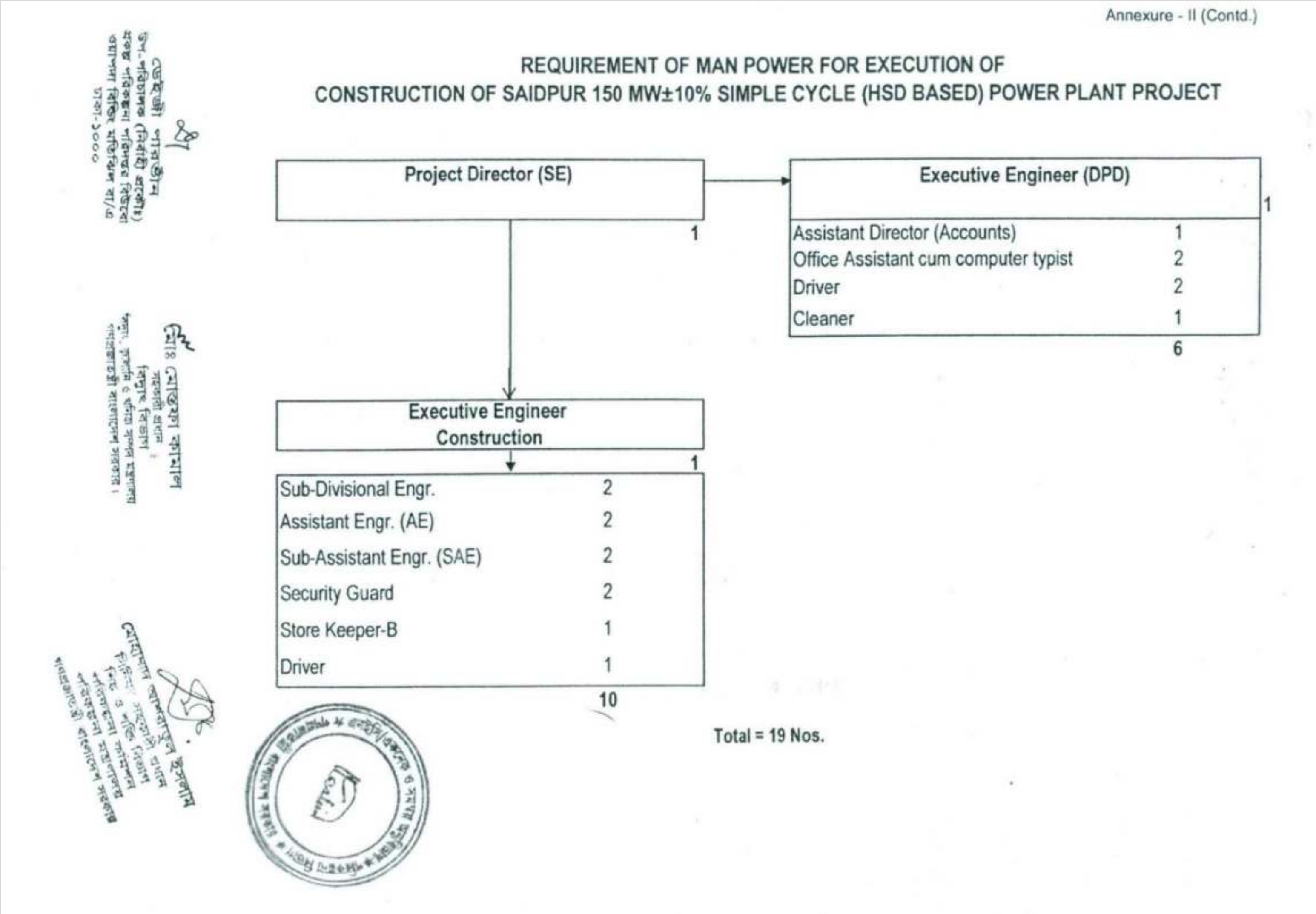


Figure 9.5: Proposed Manpower Structure for Saidpur 150 MW ±10% HSD Based Simple Cycle Power Plant Project

-52-

Annexure-7

OPERATION AND MAINTENANCE SETUP FOR CONSTRUCTION OF SAIDPUR 150 MW±10% SIMPLE CYCLE (HSD BASED) POWER PLANT PROJECT

In Lakh Taka

Sl.No.	Type of Personnel (Pay Scale)	No. of persones	Annual Remuneration per Person	Total Annual Remuneration
I.	**Managerial :**			
1	Manager (SE) (50000-71200)	1	16.27	16.27
2	Executive Engr. (43000-69850)	3	15.18	45.55
3	Sub-Divisional Engr. (35500-67010)	8	14.14	113.14
4	Asstt. Engr. (22000-53060)	8	10.48	83.82
5	Asstt. Director (Admn.) (22000-53060)	1	10.48	10.48
6	Asstt. Director (Acc.) (22000-53060)	1	10.48	10.48
7	Store Officer (22000-53060)	1	10.48	10.48
8	Sub-Asstt. Engineer (SAE) (16000-38640)	16	7.92	126.65
	Sub-Total of I (1 to 8)	**39**		**416.88**
II.	**Staff & Others**			
1	Foreman-C (16,000-38,640)	2	[illegible].92	15.83
2	Electrician-B (9,700-23,490)	1	3.90	3.90
3	Electrician-A (9,300-22,490)	1	3.85	3.85
4	Instrument Mechanic-A (9,000-21,800)	1	3.65	3.65
5	Instrument Mechanic-B (9,700-23,490)	1	3.90	3.90
6	Computer Operator (11,000-26,550)	2	5.59	11.18
7	Driver (9,300-22,490)	5	3.85	[illegible]
8	Attendant-B (9,700-23,490)	8	3.90	31.2[illegible]
9	Attendant A (9,000-21,800)	8	3.65	29.22
10	Fitter-C (10,200-24,680)	2	5.22	10.44
11	Welder-D (9,000-21,800)	1	3.65	3.65
12	Machinist-B (11,000-26,590)	1	5.59	5.59

-53-

Annexure-7 (Contd.)

OPERATION AND MAINTENANCE SETUP FOR CONSTRUCTION OF SAIDPUR 150 MW±10% SIMPLE CYCLE (HSD BASED) POWER PLANT PROJECT

In Lakh Taka

Sl.No.	Type of Personnel (Pay Scale)	No. of persones	Annual Remuneration per Person	Total Annual Remuneration
13	Laboratory Assistant (9700-23490)	1	3.90	3.90
14	UDA (11,000-26,590)	1	5.59	5.59
15	Store Keeper-B (10,200-24,680)	1	5.22	5.22
16	Store Helper (8,250-20,010)	1	3.47	3.47
17	SAA (Cashier) (11000-26590)	1	5.59	5.59
18	Security Supervisor (9700-23490)	1	3.90	3.90
19	Security Guard (8500-20570)	8	3.56	28.49
20	Cleaner (8500-20570)	2	3.56	7.12
21	MLSS Cum Guard (8250-20010)	4	3.47	13.90
	Sub-Total of II (1 to 21)	**53**		**218.86**
	Grand Total	**92**		**635.74**

Figure 9.6: Proposed Manpower Structure for Operation and Maintenance Set up

9.11 Environmental Monitoring Plan

Successful and effective implementation of EMP depends on regular and systematic monitoring, documentation and reporting. The Project authority must have a provision of Environmental quality and safety department for monitoring the EMP implementation during construction and operation phase of the Project. A three-tier monitoring program has been proposed comprising of compliance monitoring, impact monitoring, and external or independent monitoring, as one of the key elements of the EIA study. The main purpose of this monitoring program is to ensure that the various tasks those detailed out in the environmental management plan, particularly the mitigation measures which are to be implemented efficiently and effectively, and also to evaluate Project's impacts on the key environment and social components.

The aim of this environmental assessment is to depict the right measures to enhance the environmental sustainability of the proposed Project through providing suggestion on design considerations, implementation, management and operation as suggested in the EMP. Regular monitoring is required for the effective implementation and operation of EMP. The Project authority should establish an Environmental cell headed by Deputy General Manager-Environment Health and safety, Environmental, Health and Safety Manager and Environmental Officers. Chief Engineer, BPDB is the responsible authority for administering and implementing the Project and the Project Director will implement environmental monitoring program during construction and the Plant Manager will implement the monitoring plan during operation stage. During construction stage, the Environmental Compliance Monitoring will be conducted by the Contractor(s) supervised by the Owner's Engineer (OE) and Environmental Impact Monitoring will be carried out by the Owner's Engineer (OE) with the support of the Contractor(s). The organogram, officer's duties and responsibilities have been presented in the **Section 9.10**. Moreover, third party monitoring is necessary as due diligence to this power Project. Necessary works should be implemented and monitored by proper authority as mentioned in **Table 9.1**.

9.11.1 Compliance Monitoring

Compliance monitoring is a very important tool/ aspect of environmental management to safeguard the environment. The monitoring will comprise surveillance to check whether the contractor is meeting the compliance provisions of the contract during pre-construction, construction and operation of the Project including the responsible agencies for implementation and supervision.

For monitoring of physico-chemical parameters, locations near the baseline sampling points are suggested. Actual monitoring time and location will be decided by the Owner's Engineer (OE) and the proponent (BPDB). The Contractor will be responsible for carrying out, or contracting an approved third party for environmental and social monitoring of all the parameters as required with frequency. This monitoring will be carried out by its own cost during the construction phase. The observed outcomes are to be compared with the IFC's General EHS Guidelines (where relevant standards are specified), or the national standards (Environmental Conservation Rules, 1997 and amended in 2005). **Table 9.5** shows the monitoring plan for pre-construction phase of the proposed Power Plant Project.

9.11.2 Impacts Monitoring during Construction

The purpose of the impact monitoring is to ensure the efficient, effective and timely implementation of the mitigation measures given in the EMP. This monitoring will generally be carried out by the Owner's Engineer (OE)/ Contractor with the help of checklists prepared on the basis of the impact monitoring. **Table 9.5** shows the monitoring plan for construction phase of the proposed Power Plant Project.

9.11.3 Independent/ External Monitoring

The proponent (BPDB) will engage an independent organization for monitoring the implementation of EMP. The environmental and social data has to be monitored during construction and operation of the Power Plants. The Project monitoring process has been suggested to follow IFC performance standard. For specifications the proponent is to collect the catalogues of major components like Power Inverter, Photovoltaic cells or Solar cells, Transformers, Lightning arrester etc. of the manufacturer/ supplier from the EPC contractor. **Table 9.6** shows the monitoring plan for operation phase of the proposed Power Plant Project.

The suggested locations of environmental monitoring during construction and operation phase has been specified with temporal (time, date, seasons, weather, etc.) and spatial references (GPS reference). Hence, the monitoring data would be comparable with the standard limit. Recorded data will be analyzed for preparing report and finally submitted to the clients or suggested authorities.

The environmental monitoring cell of the proponent or third party independent monitoring team will check the EMP implementation and submit a quarterly report to the concerned department.

Additionally, yearly monitoring report with quarterly monitoring data should be submitted to the DoE for renewals of the Environmental Clearance Certificate as required. Furthermore, the client will request to BPDB for the formation and sponsor of another auditing team comprising representatives from DoE, concerned Ministry, representative from local University etc. to monitor environmental and social compliance, monitoring reports, due diligences etc. throughout the Project life.

Table 9.6: Environmental Monitoring Plan

Sl. no	Components of EHS Monitoring	Monitoring Indicators	Locations	Frequency	Type/ Duration of Sampling	Implemented by	
						Monitoring	Supervision
1	**Environmental Monitoring during Pre-construction and Construction Phase**						
1.1	Dust generation	SPM and PM_{10}	Identified ASRs within 200 m from the construction site (3 locations)	Bi-monthly	24-hour	Appointed Contractor/ 3rd Party Environmental Consultant	BPDB
1.2	Exhaust emission	$PM_{2.5}$, NO_2, SO_2, CO	Identified ASRs within 100 m from the activity areas (2 locations)	Bi-monthly	24-hourly monitoring of $PM_{2.5}$ and SO_2 and 1-hourly monitoring of NO_2 and CO	Appointed Contractor/ 3rd Party Environmental Consultant	BPDB
1.3	Ambient Noise Daytime (6:00 – 18:59) and Night time (19:00 – 6:00), Leq values in dBA.	Noise levels in Leq, Leq day, Leq night and hourly Leq during the demolition and construction works	Identified Noise sensitive receptors (4 locations including nearest Industrial zone, School, Residential area, labor shade, workplace, representative Project Site etc.) within 2 Km from the Project site (as per **Figure 9.7**)	Monthly	At least 15 min per sample (both day and night time)	EPC/Third Party	OE/BPDB
1.4	Water Resources	Inspection to be made particularly following heavy rainfall, to determine the effectiveness of the mitigation measure.	Project area	Monsoon period	24 hour basis	EPC Contractor	DoE

Sl. no	Components of EHS Monitoring	Monitoring Indicators	Locations	Frequency	Type/ Duration of Sampling	Implemented by	
						Monitoring	Supervision
		Connectivity between water body and river should be kept at its original condition.	Study Area	Monsoon period	6 Months interval	EPC Contractor	DoE, BPDB
		Components of ground water should be testified before the beginning of construction	Project area	Once	According to DoE standard	BPDB	DoE
1.5	Terrestrial Vegetation	Canopy Coverage	Within the project area	Monthly for a 3-year monitoring plan in the project and adjacent area	Open-eyed observation	BPDB	BPDB
1.6	Terrestrial floral health and diversity	Plant Growth, Diseases etc.	Within the project area	Monthly for a 3-year monitoring plan in the project and adjacent area	Quadrat Sampling	BPDP	BPDB
1.7	Wild life abundance	Wildlife coverage	Within the project area	Monthly for a 3-year monitoring plan in the project and adjacent area	Open-eyed observation	BPDP	BPDB
1.8	Social Environment	Labor Engagement for project activity	Project Area	Quarterly	labor engagement procedures, and Child labour are involved or not, wage rate etc	Third party Monitoring and submit to project authority.	BPDB
		Health and Safety	Construction site and local community at close vicinity	Quarterly	Record of accident, Labors safety and working condition, additional support after occurrences etc.	Third party Monitoring.	BPDB

Sl. no	Components of EHS Monitoring	Monitoring Indicators	Locations	Frequency	Type/ Duration of Sampling	Implemented by	
						Monitoring	Supervision
		Disturbance of local people due to Noise	Project area and adjacent project area (within 0.5 km)	Quarterly	Noise data will be cross checked and to comply this with tolerate level.	Third party Monitoring.	BPDB
2	**Environmental Monitoring During Operation**						
2.1	Stack emissions	NO_x, CO, $PM_{2.5}$ and O_2	Main stack and bypass stack	Continuous	CEM	Appointed Contractor/ 3rd Party Environmental Consultant	BPDB
2.2	Ambient air quality	NO_x, CO, PM_{10}, $PM_{2.5}$, SO_2	5 locations within 2 km from the Project boundary (same as baseline monitoring locations)	Per 3 months	CEM	Appointed Contractor/ 3rd Party Environmental Consultant	BPDB
2.3	GHG Emissions	GHG production	Plant control room	Per 3 months	CEM	Appointed Contractor/ 3rd Party Environmental Consultant	BPDB
2.4	Ambient Noise	Day time (6:00 – 18:59) and Night time (19:00 – 6:00) LAeq, L10, L90	Power Plant site and identified nearby noise sensitive receptors (4 locations including nearest Industrial zone, School, Residential area, labor shade, workplace, representative Project Site etc.) within 2 Km from the Project site (as per **Figure 9.7**)	Quarterly	At least 15 min per sample (both day and night time).	EHSU/ KPS	Independent Monitor/ BPDB

Sl. no	Components of EHS Monitoring	Monitoring Indicators	Locations	Frequency	Type/ Duration of Sampling	Implemented by	
						Monitoring	Supervision
2.5	Water Resources	Storage tanks which preserve groundwater should be cleaned properly and stored water should be used regularly	Storage tanks, Project area	Continuous	Every 2 weeks interval	BPDB	BPDB
		The water should not be allowed to be stored for a longer period to avoid bacterial impurities.	Storage tanks, Project area	Continuous	Every 2 weeks interval	BPDB	BPDB
2.6	Drainage network	Blockage of drainage path due to sludge and plastic materials	Within project boundary and surrounding area	Pre-monsoon, Monsoon and Post-monsoon	6 Months interval	EPC Contractor	OE/ BPDB
2.7	Ecological Resources	vegetation coverage (Greenbelt)	Within the project area	Quarterly for a 2-year monitoring plan	Once in a year for next 10 years from plant installation	IMA	Independent Monitor/ BPDB
		Terrestrial floral health and diversity	Within the project area	Quarterly for a 2-year monitoring plan	Quadrat Sampling	IMA	Independent Monitor/ BPDB
		Wildlife abundance	Within the project area	Quarterly for a 2-year monitoring plan	Open-eyed observation	IMA	Independent Monitor/ BPDB
		Wildlife occurrence	Within and close surround to the project area	Yearly	Once in a year for next 10 years from plant installation	Appointed Contractor/ 3rd Party Environmental Consultant	Independent Monitor/ BPDB

Sl. no	Components of EHS Monitoring	Monitoring Indicators	Locations	Frequency	Type/ Duration of Sampling	Implemented by	
						Monitoring	Supervision
	Generation of Non Hazardous Solid Waste (Domestic waste, Office Waste,)	Collection system, Odor, waste sprawling	Designated Sites	Monthly	Visual Inspection, waste classification	EHSU	BPDB
2.8	Worker's Health and Sanitation	General Health Condition, accident, fatalities, injuries Complain, fitness, etc.	Workers involved in the Plant operation and maintenance	Quarterly	Health Checkup, Grievance register	EHSU	BPDB
		Available quantity and quality of potable water	Work place, residence	Monthly	Sampling, Checking		
		Hospital, Hygienic Toilet, Gym	Work place, Residence, common places	Monthly	Observation, KII		
2.9	Occupational Noise	LAeq, noise exposure	Inside Plant Area (Turbine hall, RMS, etc.), Control room, Administrative building, residential buildings, health unit (as per **Figure 9.7**)	Quarterly	Continuous sampling for at least 15/20 min both during day and night (as USEPA) by using: ANSI Type II Noise Meter Inspection of record of shifting hour, workers' roster	EHSU	BPDB

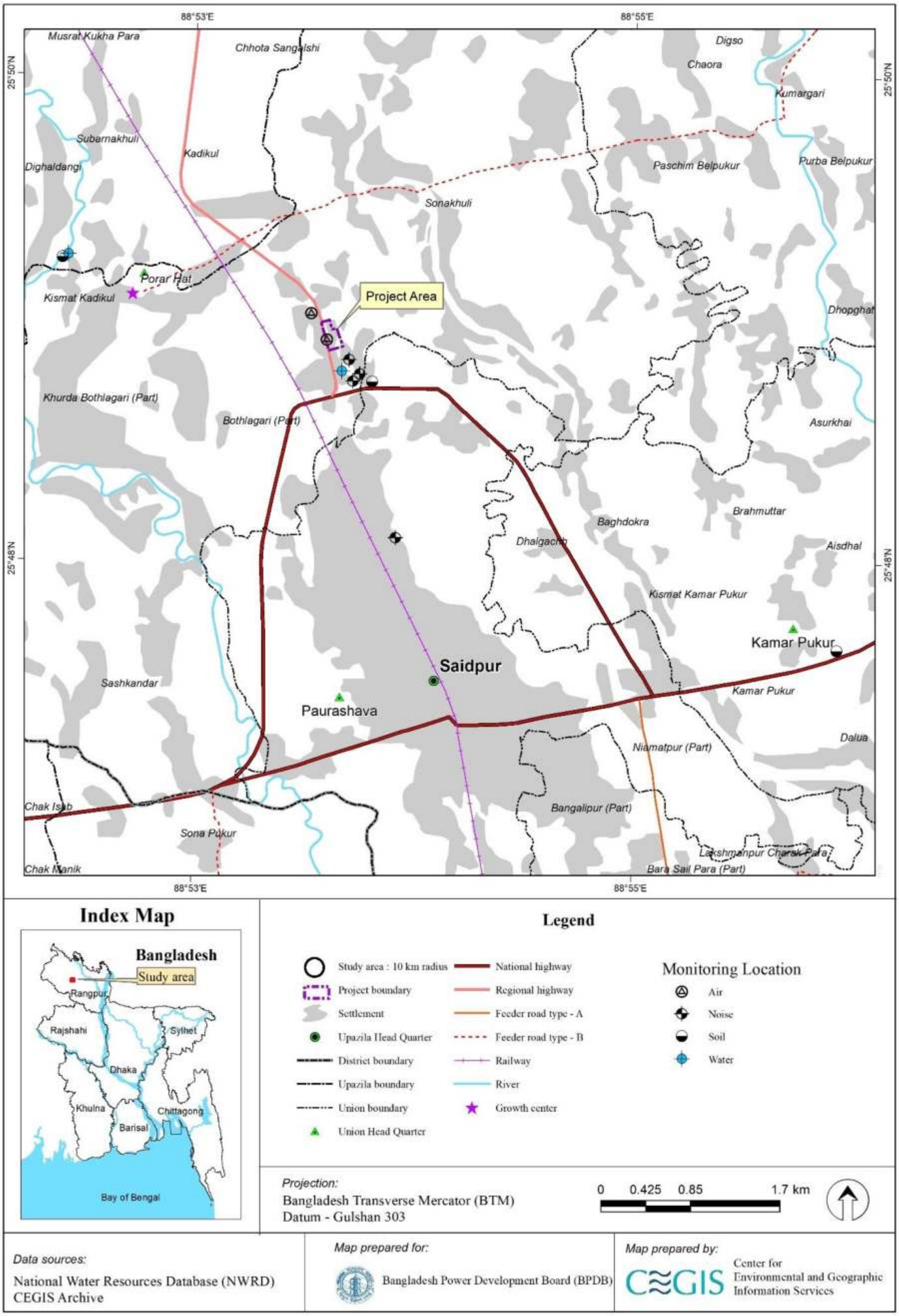


Figure 9.7: Monitoring Map for the proposed Power Plant Project

9.12 Budget for EMP

The cost of implementing the EMP is USD 2 million. Details of EMP and associated costs are given in **Table 9.7**.

Table 9.7: Tentative cost of EMP

Items	Unit	Quantity	Unit Rate (USD)	Amount (USD)
EPC Contractor (Investment Cost)				
Continuous Stack Emission Monitoring System	No	2	30,000	60,000.00
Water Treatment Plant	Included in Project Cost			-
Passive/ Continuous Ambient Air Quality Monitoring Station (min. 1 year)	No	2	20,000	40,000.00
Noise Attenuation Measures	LS	LS	6,000	6,000.00
Environmental Laboratory	No	1	200,000	2,00,000.00
Environmental Management Plan				
Gardening by decorated plant, flowers, fruits and medicinal plants around the power plant				5,000.00
Ecosystem observation				6,000.00
Emergency Response related Equipment				2,00,000.00
Community Health, Safety and Security	LS			10,000.00
EHS Staffs of Contractor	Medical professional Man month	1000	100	1,00,000.00
Contractor's HIV/AIDS Management	LS			10,000.00
Awareness and training for the local people (e.g. fisherman, labor, farmer etc.)	Quarterly meeting for 5 years' time frame			22,500.00
Institutional Arrangements				
EHS Consultant of Owner's Engineer				8,00,000.00
EHS Staffs of EHSU Circle (5 Years)				2,00,000.00
Capacity Building and Training				1,00,000.00
Environmental Monitoring Plan (Demolition, pre-construction and construction)				85,000.00
Environmental Monitoring Plan (Operation)				80,000.00
Independent Monitor for five (5) years period including one (1) year of operation				1,50,000.00
Grand Total=				**2,074,500.00**

Note: LS=lum sum

10. Conclusions and Recommendations

10.1 Conclusions

an ideal one having no cost involvement and free from all social complications as it belongs to BPDB. The site is also near to the load center. The selected fuel HSD is a locally available one and in accordance with PSMP 2016. The existing fuel transportation and storing facilities can be renovated and extended for the proposed one there by reducing the project cost and relieving the hassle of construction.

Technologies including the cooling system is environment friendly and is highly efficient of modern time. The project will accelerate the development of the locality including the life style of the local people and their socio-economy. An addition of 161.603 MW of power to the national grid will boost our national economy through industrialization and will create new job opportunities in different sectors.

10.2 Recommendations

The following recommendations have been made based on the EIA study, which should be considered essential for achieving the goals of minimal environmental impacts and maximum benefits:

- BPDB should engage an independent consultant or depute a group of his competent persons to monitor the work quality of EPC contractor including its compliance with the proposed Environmental Management Plan (EMP) of the EIA report, DoE regulations and other regulation of international financers like world bank, Asian development bank etc. over the entire period of project development and operation;
- All Safety measures for potential risk associated with the proposed power plant including the health, safety and environment should be adopted and implemented;
- The project proponent may provide some social service under corporate social responsibility (CSR) to the local community in the form of subsidized medical service, drinking water supply, repairing of existing approach road etc.;
- Involvement of local people in terms of classified job opportunities should be ensured at each phase of the power plant;
- Special care should be taken for wildlife community protection as per EMP;
- Considering all aspects DoE is requested to approve the EIA study of the proposed Power Plant.

References

Yearbook of Agricultural Statistics 2017, Bangladesh Bureau of Statistics (BBS) 2017. Ministry of Planning, Agriculture Wing, Parishankhyan Bhaban, E-27/A, Agargaon, Dhaka-1207.

SRDI (Soil Resource and Development Institute), 1997. Guideline for Land and Soil Resources Utilization. Thana Nirdeshika, Farmgate, Dhaka-1212.

Annexes

Annex 1: Site Clearance Certificate

Annex 2: Terms of Reference (ToR)

1 Introduction

- 1.1 Background
- 1.2 Objectives
  - 1.2.1 Objective of the Study
  - 1.2.2 Objective of the Project
- 1.3 Need of the Project
- 1.4 Rationale of the Project
- 1.5 Overall Approach and Methodology

2 Analysis of Alternatives

- 2.1 No action Alternatives
- 2.2 Site Alternatives
- 2.3 Fuel Alternatives
- 2.4 Technology Alternatives
- 2.5 Cooling Alternatives

3 Project Description

- 3.1 Project Concept
- 3.2 Project Location and Access way
  - 3.2.1 Project Location
  - 3.2.2 Study Area
  - 3.2.3 Access way
  - 3.2.4 Land Requirement and Acquisition
- 3.3 Project Site Development
- 3.4 Topographic Survey
- 3.5 Geotechnical Investigation
- 3.6 Connectional Project Layout
- 3.7 Project Components and Description
  - 3.7.1 Power Generation
    - 3.7.1.1 Turbo-generator and its Auxiliaries
    - 3.7.1.2 Water Source, Requirement and Management
    - 3.7.1.3 Fuel Type, Source and Requirement
    - 3.7.1.4 Exhaust System and Stack
  - 3.7.2 Power Evacuation
- 3.8 Project Activities
  - 3.8.1 Pre-Construction
  - 3.8.2 Construction
  - 3.8.3 Post Construction
- 3.9 Work Plan for Project Implementation

3.10 Local Resources and Utility Demand
3.11 Transportation of Equipment and Machineries
3.12 Waste Management
3.12.1 Solid Waste
3.12.1.1 Perishable Waste
3.12.1.2 Non-perishable Waste
3.12.1.3 Sanitary Waste
3.12.1 Liquid Waste (ETP)
3.13 Central Control, Monitoring and Protection
3.14 Civil Structure and Urban Facilities

4 Policy, Legal and Administrative Framework

4.1 Introduction
4.2 Legislative Framework
4.2.1 Overview of Approval Process
4.2.2 Administrative Letter
4.2.3 Key Legislative Approval
4.2.4 Relevant Bangladesh Legislation
4.3 Relevant Environmental, natural resources and energy sector in brief
4.3.1 Emission Standards of GOB and IFC relevant for the proposed Project
4.3.2 Ambient Air Quality Requirements
4.3.3 Ambient Noise Level
4.3.4 Effluent Standard
4.3.5 Sewage Discharge
4.4 Port and water ways transportation sector (Brief outlines of some laws)
4.5 Administrative and land acquisition sector (Brief outlines of some laws)
4.7 Health and safety sector (Brief outlines of some laws)
4.8 Environmental and Energy Policy Guidance (Brief outlines of some policies)
4.9 National 3R Strategy for Waste Management
4.10 National Conservation Strategy - 1992
4.11 National Biodiversity Strategy and Action Plan for Bangladesh - 2004
4.12 Relevant International Legal Obligation
4.13 IFC safeguard policies

5 Environmental and Social Baseline

5.1 Introduction
5.2 Physical Environment
5.2.1 Geology

5.2.2 Climate and Meteorology
5.2.3 Ambient Air Quality
5.2.4 Ambient Noise Level
5.2.5 Water Resources
5.2.5.1 Surface Water
5.2.5.2 Ground Water
5.2.5.3 Water Quality
5.2.6 Land Resources
5.2.6.1 AEZ
5.2.6.2 Land use and Land Cover
5.2.6.3 Land Type
5.2.6.4 Soil Condition (Soil Texture and Quality)
5.3 Biological Environment
5.3.1 Agricultural Resources
5.3.2 Livestock Resources
5.3.3 Fisheries
5.3.4 Ecological Resources
5.3.4.1 BEZ
5.3.4.2 Ecosystem of the Project Area
5.3.4.3 Ecosystem of the Study Area
5.4 Socio-economic Condition
5.4.1 Area and Location
5.4.2 Communication System
5.4.3 Demographic Profile
5.4.4 Household Size
5.4.5 Age Composition and Dependency
5.4.6 Occupation and Livelihood
5.4.7 Labor market
5.4.8 Household income and expenditure
5.4.9 Land Price
5.4.10 Housing Tenancy
5.4.11 Migration
5.4.12 Standard of Living
5.4.13 Literacy rate
5.4.14 Access to Health
5.4.15 Poverty Situation
5.4.16 Safety nets

5.4.17 Communication facility
5.4.18 Social Relation
5.4.19 Common Property Resources
6 Stakeholder Consultation
7 Environmental and Social Impacts
7.1 General
7.2 Impacts during Pre-Construction
7.2.1 Impacts on Physical Environment
7.2.1.1 Ambient air quality
7.2.1.2 Ambient Noise
7.2.1.3 Water Resources
7.2.1.4 Land Resources
7.2.1.5 Hazardous Waste Generation
7.2.1.6 Non-Hazardous Waste Generation
7.2.2 Impacts on Biological Environment
7.2.2.1 Agricultural Resources
7.2.2.2 Livestock Resources
7.2.2.3 Fisheries Resources
7.2.2.4 Ecological Resources
7.2.3 Impacts on Socio-Economic Condition
7.3 Impacts during Construction
7.3.1 Impacts on Physical Environment
7.3.1.1 Ambient air quality
7.3.1.2 Ambient Noise
7.3.1.3 Water Resources
7.3.1.4 Land Resources
7.3.1.5 Hazardous Waste Generation
7.3.1.6 Non-Hazardous Waste Generation
7.3.2 Impacts on Biological Environment
7.3.2.1 Agricultural Resources
7.3.2.2 Livestock Resources
7.3.2.3 Fisheries Resources
7.3.2.4 Ecological Resources
7.3.3 Impacts on Socio-Economic Condition
7.4 Impacts during Operation
7.4.1 Impacts on Physical Environment
7.4.1.1 Ambient air quality

7.4.1.2 Ambient Noise
7.4.1.3 Water Resources
7.4.1.4 Land Resources
7.4.1.5 Hazardous Waste Generation
7.4.1.6 Non-Hazardous Waste Generation
7.4.2 Impacts on Biological Environment
7.4.2.1 Agricultural Resources
7.4.2.2 Livestock Resources
7.4.2.3 Fisheries Resources
7.4.2.4 Ecological Resources
7.4.3 Impacts on Socio-Economic Condition
7.5 Summary of Assessed Impacts

8 Mitigation of Impacts

8.1 Preamble
8.2 Mitigation measures for major impacts
8.2.1 Pre-Construction Stage
8.2.2 Construction Stage
8.2.3 Operation Stage

9 Environmental and Social Management Plan

9.1 Objectives of EMP
9.2 Environmental Management Plan during Pre-Construction Phase
9.2.1 Site Preparation
9.2.2 Kitchen Waste
9.2.3 Stakeholder engagement plan
9.2.4 Drinking Water Supply and Water Quality Management
9.2.5 Groundwater Level Management Plan
9.2.6 Management of surface water availability for navigation and consumption
9.2.7 Flooding management plans
9.2.8 Agricultural Land Management
9.3 Environmental Management Plan during Construction Phase
9.3.1 Kitchen Waste
9.3.2 Construction waste management plan
9.3.3 Fisheries Resources
9.3.4 Pollution Prevention Plan
9.3.5 Waste Disposal and Effluent Management Plan
9.3.6 Traffic Management Plan

9.3.7 Management of surface water availability for navigation and consumption

9.3.8 Labor recruitment plan

9.3.9 Drinking Water Supply and Sanitation Plan

9.3.10 Human safety

9.3.11 Goods Handling and Operation of Construction Equipment

9.3.12 Fuel and Hazardous Substances Management Plan

9.3.13 Agricultural Land Management

9.3.14 Ecosystem management plan

9.4 Environmental Management Plan during Operation Phase

9.4.1 Sewerage Management Plan

9.4.2 Waste Water Management

9.4.3 Solid Waste Management

9.4.4 Occupational Health Safety and Environment

9.4.5 Fisheries Resources

9.4.6 Community exposure to diseases

9.4.7 Grievance Redress Mechanism

9.4.8 Management of surface water availability for navigation and consumption

9.4.9 Agricultural Land Management

9.4.10 Ecosystem Protection Plan

9.4.11 Greenbelt Development Plan

9.5 Mitigation Plan

9.6 Administrative Setup and Organogram

9.6.1 Bangladesh Power Development Board (BPDB)

9.6.2 Proposed Saidpur Power Plant

9.7 Environmental Monitoring Plan

9.7.1 Compliance Monitoring

9.7.2 Impacts Monitoring during Construction

9.7.3 Independent/External Monitoring

9.8 Budgets for Monitoring

10 Hazard and Risk Assessment

10.1 Introduction

10.2 Hazard assessment Process

10.3 Identification of hazards and Cause Analysis

10.3.1 Potential Hazard and Risk during Construction and Erection

10.3.2 Potential Hazard and Risk during Operation

10.4 Assessment of Likelihood

10.4.1 Hazard Magnitude & Frequency Analysis

10.4.2 Risk Matrix Development

10.5 Risk Ranking, Recommended Actions and Safety Measures

10.6 Occupational Health and Safety Plan

10.6.1 OHS Policies in Bangladesh

10.6.2 Accountability

10.6.3 OHS Training

10.6.4 Training Procedure

10.6.5 Frequency of training

10.7 Emergency Response Plan

10.7.1 Safety Training

10.7.2 Documenting and Reporting

10.7.3 Occupational Health, Safety and Environment Team

Annex 3: Layout and Design

Annex 4: ECR Standard

SCHEDULE – 1

Classification of industrial units or projects based on its location and impact on environment.

[See Rule 7(2)]

(D) RED Category

1. Tannery.
2. Formaldehyde.
3. Urea fertilizer.
4. T.S.P. Fertilizer.
5. Chemical dyes, polish, varnish, enamel.
6. Power plant.
7. All mining projects (coal, limestone, hard rock, natural gas, mineral oil, etc.)
8. Cement.
9. Fuel oil refinery.
10. Artificial rubber.
11. Paper and pulp.
12. Sugar.
13. Distillery.
14. Fabric dying and chemical processing.
15. Caustic soda, potash.
16. Other alkalis.
17. Production of iron and steel.
18. Raw materials of medicines and basic drugs.
19. Electroplating.
20. Photo films, photo papers and photo chemicals.
21. Various products made from petroleum and coal.
22. Explosives.
23. Acids and their salts (organic or inorganic).
24. Nitrogen compounds (Cyanide, Cyanamid etc.).
25. Production of plastic raw materials (PVC, PP/Iron, Polyesterin etc.)
26. Asbestos.
27. Fiberglass.

রেজিস্টার্ড নং ডি এ-১

বাংলাদেশ গেজেট

অতিরিক্ত সংখ্যা

কর্তৃপক্ষ কর্তৃক প্রকাশিত

মঙ্গলবার, জুলাই ১৯, ২০০৫

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

পরিবেশ ও বন মন্ত্রণালয়

পরিকল্পনা শাখা-৫

প্রজ্ঞাপন

তারিখ, ১ শ্রাবণ ১৪১২/১৬ জুলাই ২০০৫

এস, আর, ও নং ২২০-আইন/২০০৫—বাংলাদেশ পরিবেশ সংরক্ষণ আইন, ১৯৯৫ (১৯৯৫ সনের ১ নং আইন) এর ধারা ২০ এ প্রদত্ত ক্ষমতাবলে সরকার পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭ এর নিম্নরূপ সংশোধন করিল, যথা ঃ—

উপরি-উক্ত বিধিমালার—

(ক) তফসিল ২ এর পরিবর্তে নিম্নরূপ তফসিল ২ প্রতিস্থাপিত হইবে, যথা ঃ—

"তফসিল-২

বায়ুর মানমাত্রা (Air Quality Standards)*

[বিধি ১২ দ্রষ্টব্য]

বায়ু দূষণ	মানমাত্রা	গড় সময়
১	২	৩
কার্বন মনোঅক্সাইড	১০ মিলিগ্রাম/ঘনমিটার (৯ পিপিএম) (ক)	৮ ঘন্টা
	৪০ মিলিগ্রাম/ঘনমিটার (৩৫ পিপিএম) (ক)	১ ঘন্টা
লেড	০.৫ মাইক্রোগ্রাম/ঘনমিটার	বার্ষিক

১	[illegible]	৩
নাইট্রোজেনের অক্সাইড	১০০ মাইক্রোগ্রাম/ঘনমিটার (০.০৫৩ পিপিএম)	বার্ষিক
প্রলম্বিত বস্তুকণা (এস পি এম)	২০০ মাইক্রোগ্রাম/ঘনমিটার	৮ ঘন্টা
বস্তুকণা ১০	৫০ মাইক্রোগ্রাম/ ঘনমিটার (খ)	বার্ষিক
	১৫০ মাইক্রোগ্রাম/ ঘনমিটার (গ)	২৪ ঘন্টা
বস্তুকণা ২.৫	১৫ মাইক্রোগ্রাম/ ঘনমিটার	বার্ষিক
	৬৫ মাইক্রোগ্রাম/ ঘনমিটার	২৪ ঘন্টা
ওজোন	২৩৫ মাইক্রোগ্রাম/ঘনমিটার (০.১২ পিপিএম) (ঘ)	১ ঘন্টা
	১৫৭ মাইক্রোগ্রাম/ঘনমিটার (০.০৮ পিপিএম)	৮ ঘন্টা
সালফার ডাইঅক্সাইড	৮০ মাইক্রোগ্রাম/ঘনমিটার (০.০৩ পিপিএম)	বার্ষিক
	৩৬৫ মাইক্রোগ্রাম/ঘনমিটার (০.১৪ পিপিএম) (ক)	২৪ ঘন্টা

শব্দ সংক্ষেপ ঃ

পিপিএম ঃ পার্টস পার মিলিয়ন।

নোট ঃ * এই তফসিলে বায়ুর মানমাত্রা বলিতে পরিবেষ্টক বায়ুর মানমাত্রা (Ambient Air Quality Standards) কে বুঝাইবে।

(ক) প্রতি বৎসরে একবারের বেশী অতিক্রম করিবে না।

(খ) বার্ষিক গড় মান ৫০ মাইক্রোগ্রাম/মি^{3} হইতে কম বা উহার সমান হইতে পারিবে।

(গ) ২৪ ঘন্টার গড় মান বৎসরে ১ (এক) দিন ১৫০ মাইক্রোগ্রাম/ মি^{3} হইতে কম বা উহার সমান হইতে পারিবে।

(ঘ) প্রতি ঘন্টার সর্বোচ্চ গড় মান বৎসরে ১ (এক) দিন ০.১২ পিপিএম হইতে কম বা উহার সমান হইতে পারিবে।

SCHEDULE – 3

Standards for Water

[See Rule 12]

(A) Standards for inland surface water

Best Practice based classification	pH	BOD mg/l	DO mg/l	Total Coliform number/100
a. Source of drinking water for supply only after disinfecting:	6.5-8.5	2 or less	6 or above	50 or less
b. Water usable for recreational activity :	6.5 – 8.5	3 or less	5 of more	200 or less
c. Source of drinking water for supply after conventional treatment :	6.5 – 8.5	6 of less	6 or more	5000 or less
d. Water usable by fisheries:	6.5 – 8.5	6 of less	5 or more	---
e. Water usable by various process and cooling industries :	6.5 – 8.5	10 or less	5 or more	5000 or less
f. Water usable for irrigation:	6.5 – 8.5	10 or less	5 or more	1000 or less

Notes:

1. In water used for pisiculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.
2. Electrical conductivity for irrigation water – 2250 μmhoms/cm (at a temperature of 25°C); Sodium less than 26%; boron less than 0.2%.

(B) Standards for drinking water

Sl. No.	Parameter	Unit	Standards
1	2	3	4
1.	Aluminum	mg/l	0.2
2.	Ammonia (NH_3)	,,	0.5
3.	Arsenic	,,	0.05
4.	Balium	,,	0.01
5.	Benzene	,,	0.01

1	2	3	4
6.	BOD_5 20°C	,,	0.2
7.	Boron	,,	1.0
8.	Cadmium	,,	0.005
9.	Calcium	,,	75
10.	Chloride	,,	150 – 600*
11.	Chlorinated alkanes		
	carbontetrachloride	,,	0.01
	1.1 dichloroethylene	,,	0.001
	1.2 dichloroethylene	,,	0.03
	tetrachloroethylene	,,	0.03
	trichloroethylene	,,	0.09
12.	Chlorinated phenols		
	- pentachlorophenol	mg/l	0.03
	- 2.4.6 trichlorophenol	,,	0.03
13.	Chlorine (residual)	,,	0.2
14.	Chloroform	,,	0.09
15.	Chromium (hexavalent)	,,	0.05
16.	Chromium (total)	,,	0.05
17.	COD	,,	4
18.	Coliform (fecal)	n/100 ml	0
19.	Coliform (total)	n/100 ml	0
20.	Color	Hazen unit	15
21.	Copper	mg/l	1
22.	Cyanide	,,	0.1
23.	Detergents	,,	0.2
24.	DO	,,	6
25.	Fluoride	,,	1
26.	Hardness (as $CaCO_3$)	,,	200 – 500
27.	Iron	,,	0.3 – 1.0
28.	Kjeldhl Nitrogen (total)	,,	1
29.	Lead	,,	0.05

1	2	3	4
30.	Magnesium	,,	30 – 35
31.	Manganese	,,	0.1
32.	Mercury	,,	0.001
33.	Nickel	,,	0.1
34.	Nitrate	,,	10
35.	Nitrite	,,	<1
36.	Odor	,,	Odorless
37.	Oil and grease	,,	0.01
38.	pH	,,	6.5 – 8.5
39.	Phenolic compounds	,,	0.002
40.	Phosphate	,,	6
41.	Phosphorus	,,	0
42.	Potassium	,,	12
43.	Radioactive materials (gross alpha activity)	Bq/l	0.01
44.	Radioactive materials (gross beta activity)	Bq/l	0.1
45.	Selenium	mg/l	0.01
46.	Silver	,,	0.02
47.	Sodium	,,	200
48.	Suspended particulate matters	,,	10
49.	Sufide	,,	0
50.	Sulfate	,,	400
51.	Total dissolved solids	,,	1000
52.	Temperature	°C	20-30
53.	Tin	mg/l	2
54.	Turbidity	JTU	10
55.	Zinc	mg/l	5

তফসিল-১

[বিধি ৫(২) দ্রষ্টব্য]

এলাকাভিত্তিক শব্দের মানমাত্রা

ক্রমিক নং	এলাকার শ্রেণী	মানমাত্রা ডেসিবল dB(A)Leq* এককে	
		দিবা	রাত্রি
১।	নীরব এলাকা	৫০	৪০
২।	আবাসিক এলাকা	৫৫	৪৫
৩।	মিশ্র এলাকা	৬০	৫০
৪।	বাণিজ্যিক এলাকা	৭০	৬০
৫।	শিল্প এলাকা	৭৫	৭০

ব্যাখ্যা :

(ক) ভোর ৬টা হইতে রাত্রি ৯টা পর্যন্ত ব্যাপ্ত সময় দিবাকালীন সময় হিসাবে চিহ্নিত।

(খ) রাত্রি ৯টা হইতে ভোর ৬টা পর্যন্ত ব্যাপ্ত সময় রাত্রিকালীন সময় হিসাবে চিহ্নিত।

*dB(A)Leq দ্বারা মানুষের শ্রবণেন্দ্রিয়ের সহিত সম্পর্কিত নির্দিষ্ট সময়ব্যাপী শব্দের গড় মাত্রাকে বুঝাইবে (time weighted average) যাহা ডেসিবল এ-স্কেলে নির্দেশিত।

SCHEDULE – 9

Standards for Sewage Discharge

[See Rule 12]

Parameter	Unit	Standard Limit
BOD	miligram/l	40
Nitrate	,,	250
Phosphate	,,	35
Suspended Solids (SS)	,,	100
Temperature	Degree Centigrade	30
Coliform	number per 100 ml	1000

Notes :

(1) This limit shall be applicable to discharges into surface and inland waters bodies.

(2) Sewage shall be chlorinated before final discharge.

SCHEDULE – 10

Standards for Waste From Industrial Units or Projects Waste

[See Rule 13]

Sl. No.	Parameter	Unit	Places for determination of standards		
			Inland Surface Water	Public Sewerage system connected to treatment at second stage	Irrigated Land
1	2	3	4	5	6
1	Ammonical Nitrogen (as elementary N)	mg/l	50	75	75
2	Ammonia (as free ammonia)	,,	5	5	15
3	Arsenic (as)	,,	0.2	0.05	0.2
4	BOD_5 at 20°C	,,	50	250	100
5	Boron	,,	2	2	2

E.C.R.- Schedule-10 ২১০

1	2	3	4	5	6
6	Cadmium (as CD)	,,	0.50	0.05	0.05
7	Chloride	,,	600	600	600
8	Chromium (as total Cr)	,,	0.5	1.0	1.0
9	COD	,,	200	400	400
10	Chromium (as hexavalent Cr)	,,	0.1	1.0	1.0
11	Copper (as Cu)	,,	0.5	3.0	3.0
12	Dissolved Oxygen (DO)	,,	4.5 – 8	4.5 – 8	4.5 – 8
13	Electro-conductivity (EC)	micro mho/ cm	1200	1200	1200
14	Total Dissolved Solids	,,	2,100	2,100	2,100
15	Fluoride (as F)	,,	2	15	10
16	Sulfide (as S)	,,	1	2	2
17	Iran (as Fe)	,,	2	2	2
18	Total Kjeldahl Nitrogen (as N)	,,	100	100	100
19	Lead (as Pb)	,,	0.1	1.0	0.1
20	Manganese (as Mn)	,,	5	5	5
21	Mercury (as Hg)	,,	0.01	0.01	0.01
22	Nickel (as Ni)	,,	1.0	2.0	1.0
23	Nitrate (as elementary N)	mg/l	10.0	Not yet Fixed	10
24	Oil and Grease	,,	10	20	10
25	Phenolic Compounds (as C_6H_5OH)	,,	1.0	5	1
26	Dissolved Phosphorus (as P)	,,	8	8	15
27	Radioactive substance	To be specified by Bangladesh Atomic Energy Commission			
28	pH		6 – 9	6 – 9	6 – 9
29	Selenium (as Se)	mg/l	0.05	0.05	0.05
30	Zinc (as Zn)	Degree	5	10	10

1	2	3	4	5	6
31	Total Dissolved Solids	,,	2,100	2,100	2,100
32	Temperature	Centigrade	40	40	40-Summer
			45	45	45-Winter
33	Suspended Solids (SS)	mg/l	150	500	200
34	Cyanide (as Cn)	,,	0.1	2.0	0.2

Notes:

(1) These standards shall be applicable to all industries or projects other than those specified under the heading "Standards for sector-wise industrial effluent or emission."

(2) Compliance with these standards shall be ensured from the moment an industrial unit starts trial production, and in other cases, from the moment a project starts operation.

(3) These standards shall be inviolable even in case of any sample collected instantly at any point of time. These standards may be enforced in a more stringent manner if considered necessary in view of the environmental conditions of a particular situation.

(4) Inland Surface Water means drains/ponds/tanks/water bodies/ ditches, canals, rivers, springs and estuaries.

(5) Public sewerage system means treatment facilities of the first and second stage and also the combined and complete treatment facilities.

(6) Irrigable land means such land area which is sufficiently irrigated by waste water taking into consideration the quantity and quality of such water for cultivation of selected crops on that land.

(7) Inland Surface Water Standards shall apply to any discharge to a public sewerage system or to land if the discharge does not meet the requirements of the definitions in notes 5 and 6 above.

SCHEDULE – 11

Standards for Gaseous Emission from Industries or Projects

[See Rule 13]

Sl.No.		Parameters	Standard present in a unit of mg/Nm^3
1		2	3
1.		Particulate	
	(a)	Power plant with capacity of 200 Megawatt or above.	150
	(b)	Power plant with capacity less than 200 Megawatt.	350
2.		Chlorine	150
3.		Hydrochloric acid vapor and mist	350
4.		Total Fluoride F	25
5.		Sulfuric acid mist	50
6.		Lead particulate	10
7.		Mercury particulate	0.2
8.		Sulfur dioxide	kg/ton acid
	(a)	Sulfuric acid production (DCDA* process)	4
	(b)	Sulfuric acid production (SCSA* process)	10

(* DCDA: Double Conversion, Double Absorption;

SCSA: Single Conversion, Single Absorption.)

Lowest height of stack for dispersion of sulfuric acid (in meter).

(a)	Coal based power plant		
	(1)	500 Megawatt or above	275
	(2)	200 to 500 Megawatt	220
	(3)	Less than 200 Megawatt	$14(Q)^{0.3}$
(b)	Boiler		
	(1)	Steam per hour up to 15 tons	11
	(2)	Steam per hour more that 15 tons	$14(Q)^{0.3}$

[Q = Emission of Sulfur dioxide (kg/hour)].

1	2	3
9.	Oxides of Nitrogen	
(a)	Nitric acid production	3 kg/ton acid
(b)	Gas Fuel based Power Plant	50 ppm
	(1) 500 Megawatt or above	50 ppm
	(2) 200 to 500 Megawatt	40 ppm
	(3) Below 200 Megawatt	30 ppm
(c)	Metallurgical oven	200 ppm
10.	Kiln soot and dust	mg/Nm^3
(a)	Blast Furnace	500
(b)	Brick Kiln	1000
(c)	Coke oven	500
(d)	Lime Kiln	250

Annex 5: Checklist for Field Data Collection

Baseline data for EIA study: Land, Agriculture and Livestock Resources

Start by collecting data from secondary sources before going to the Project area for primary data collection

Name of Project: IEE and EIA Studies for 150 MW ±10% (Net output 161.603 MW) Simple Cycle HSD-based (Gas Turbine) Power Plant Project

Data collected by: **Date(s):**

A. Land Resources: Secondary information: SRDI /SOLARIS/ NWRD

1. Agro-ecological regions

Name of AEZ	Area (ha)	%	Soil characteristics

2. Land use

Land use	Area (ha)	Percent of gross area
Gross area		
Net Cultivated Area (NCA)		
Settlements		
Water bodies		
Rivers/ Khals		
Forest		
Others (Specify)		

3. Land type

Land Type	Flooding depth	Area (ha)	Percentage
F_0	0 to 30 cm		
F_1	30 to 90 cm		
F_2	90 to 180 cm		
F_3	180-275cm		
F_4	More than 275 cm		
	Total:		

4. Soil Texture

Texture name	Top-soil		Sub-soil		Sub-stratum	
	Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)

5. Soil salinity (From SOLARIS-SRDI)

Soil Salinity class (ECe=ds/m)	Characteristics	Location	Salinity affected areas (ha)	% of NCA
S1 (2.0-4.0)	Non Saline with some very slightly Saline			
S2 (4.1-8.0)	Very slightly Saline with some slightly Saline			
S3 (8.1-12)	Slightly Saline with some moderately Saline			
S4 (12-16)	Strongly Saline with some moderately Saline			
S5 (>16)	Strongly Saline with very Strongly Saline			

B. Agriculture Resources: (Primary information to be collected from the field)

1. Farming practices (Collect information on adjustment of crop production practices with agro-climatic condition, crops grown in different cropping seasons, flooding, drainage, drought, marketing facilities, availability of agricultural labor etc.

2. Major Cropping Pattern by land type

Land Type	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	% of NCA

3. Crop Calendar

Crop name	Seedling		Trans Planting/ Sowing		Harvesting	
	Start	End	Start	End	Start	End

4. Cropped Area

Sl. No.	Name of crop	Area (ha)	% of NCA	Remarks

5. Crop damage

Name of Crop	Location	% damaged	Timing	Cause of damage

Note: Last 3 years average crop damage

6. Crop yield rate and market price

Crop Name	Yield (ton/ha)		Price (Tk/ton)	By-product (Tk/ha)
	Normal	Damaged		

7. Inputs used

Crop Name	Urea (Kg/ha)	TSP (Kg/ha)	MP (Kg/ha)	Others (Kg/ha)	Seed (Kg/ha)	Labor (No/ha)	Pesticide (No. of spray)	Land preparation (Tk/ha)
Note: Name of pests and pesticides:								

8. Irrigation

Crop Name	Irrigation (Surface water)			Irrigation (Ground water)		
	Area irrigated	% of Area	Charge (Tk/ha)	Area irrigated	% of Area	Charge (Tk/ha)

9. Crop production constraints (including land degradation)

Factors	Year of starting LD	Location	Result of LD
Soil erosion			
Sand carpeting			
Salinization			
Acidification			
Nutrient deficiency			
Pesticide use			
Water logging			
Others			

C. Livestock Resources: Primary and Secondary Information

1. Livestock and poultry production

Name of Livestock/poultry	% of HH having Livestock/Poultry	No. of Livestock/poultry per HH
Cow/Bullock		
Buffalo		
Goat		
Sheep		
Chicken		
Duck		

2. Feed and Fodder

Name of Livestock/ poultry	Feed/Fodder Scarcity (Timing)	Causes	Remarks
Cow/Bullock			
Buffalo			
Goat			
Sheep			
Chicken			
Duck			

3. Diseases

Name of Livestock/ poultry	Name of Disease	Disease (Timing)	Causes	Remarks
Cow/Bullock				
Buffalo				
Goat				
Sheep				
Chicken				
Duck				
Note: Support Services				

4. Persons consulted

Sl.	Name	Location	Occupation	Mobile number

Field Researcher: **Scheme Name:** **Survey date:**

Fisheries Baseline Checklist

Rural Power Company (RPC)

Vill: **Mouza:** **Union:** **Upazila:** **District:**

<u>Background</u> Water bodies: *Name: Alphabetic, Area: in Ha/% of area, Length: in km, Depth/Inundation depth: in Meter, Flood Duration: in Month, Production: metric ton*

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List/ Name of Habitat	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
Capture Fisheries: 1. 2. 3.	Total no. of fisher HHs: % / No. of CFHHs: % / No. of SFHHS:	River																
Culture Fisheries:	No. of Days spend	Beel (Leased/ non leased)																

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Produ ction	Production Trend (+/-) and Reason	List of Gears	% of gears	List/ Name of Habitat	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
1. 2. 3.	annually in fishing by CFHHs: SFHHs:	Khal																
Indiscriminate Fishing Activities:		Floodplain																
	Hrs/Day spend in fishing by	Mangrove area																
1.	CFHHs:	Fish pond																
2.		Baor																
3.	SFHHs:	Ghers																

<table>
<tr><th colspan="4" rowspan="2">Fish Migration</th><th colspan="2" rowspan="2">Fish Biodiversity</th><th colspan="5">Species List</th><th colspan="5">Species Composition</th></tr>
<tr><th>River</th><th>Khal</th><th>Beel</th><th>Pond</th><th>Other</th><th>Group</th><th>River</th><th>Khal</th><th>Beel</th><th>Pond</th></tr>
<tr><td rowspan="5">Previous Migration Status</td><td colspan="3" rowspan="5"></td><td rowspan="5">Fish diversity status (%)</td><td rowspan="5"></td><td></td><td></td><td></td><td></td><td></td><td>Major carp</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Exotic carp</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Other carp</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Catfish</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Snakehead</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="5">Present Obstacle to fish migration:</td><td colspan="3" rowspan="5">1.
2.
3.</td><td rowspan="10">Reasons of increase or decrease</td><td rowspan="10">1.
2.
3.
4.
5.</td><td></td><td></td><td></td><td></td><td></td><td>Live fish</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Other fish</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Shrimp/prawn</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Hilsa/Bombay duck/Indian salmon</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Pomfret</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="5">Important breeding, feeding and over wintering ground</td><td colspan="3" rowspan="5"></td><td></td><td></td><td></td><td></td><td></td><td>Jew fish</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Sea cat fish</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Shark/Skates/ Rays</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Rui</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Catla</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">Horizontal Migration pattern</td><td rowspan="4">Sp:
1.
2.</td><td rowspan="4">Season (Months) :</td><td rowspan="4">Routes :</td><td rowspan="4">Significant areas</td><td rowspan="4">1.
2.</td><td></td><td></td><td></td><td></td><td></td><td>Mrigal</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Koi</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Sarputi</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Large shrimp</td><td></td><td></td><td></td><td></td></tr>
</table>

Fish Migration				Fish Biodiversity		Species List					Species Composition				
						River	**Khal**	**Beel**	**Pond**	**Other**	**Group**	**River**	**Khal**	**Beel**	**Pond**
	3. 4. 5.				3.						Small shrimp				
											Silver carp				
											Carpio				
											Tengera				
											Chapila				
					Unavail able						Others				

Post-Harvest Activities		Fishermen Lifestyle	
Fish edible quality:		Socio-economic Status of subsistence level fishermen:	
Source of pollution in each habitat:		Socio-economic Status of part time fishermen:	
Seasonal vulnerability:		**Socio-economic Status of Commercial fishermen:**	
Ice factory (Number, location and name):		Other conflict (with muscle men/ agriculture/ other sector/laws):	
Landing center, whole sale market, other district markets, etc.:		Fishermen community structure (Traditional/Caste/Religion)	
Storage facility (number, location and name):		Traditional fishermen vulnerability (Occupation change/others):	
Fish market (Number, location and name):		***Existing Fisheries Management***	
Marketing problems:		Fishermen Community Based Organizations (FCBOs):	

Post-Harvest Activities		Fishermen Lifestyle	
Fish diseases (Name, Host species, Season, Syndrome, Reason, etc.):		WMOs activity:	
Other backward and forward linkages (Number, location and name):		Fishing right on existing fish habitats (Deprived/Ltd. access/Full access):	
Transport facility (Mode of fish transportation, cost, other involvements)		Leasing system:	
Dry fish industries (Number, location and name):		Enforcement of fisheries regulation (Weak/strong):	
Others information:		Sanctuary/ Beel Fisheries Department of Fisheries (DoF) activity: NGOs activities:	

Note:

Major Carp - Rui, Catla, Mrigal, 2. Exotic Carp - Silver Carp, Common Carp, Mirror Carp, Grass Carp, 3. Other Carp - Ghania, Kalbasu, Kalia, 4. Cat Fish - Rita, Boal, Pangas, Silon, Aor, Bacha, 5. Snake Head - Shol, Gazar, Taki, 6. Live Fish - Koi, Singhi, Magur, 7. Other Fish - Includes all other fishes except those mentioned above.

Marine:

Hilsa/Illish, Bombay Duck (*Harpondon nehereus),* Indian Salmon (*Polydactylus indicus),* Pomfret (*Rup_Hail_Foli Chanda),* Jew Fish (*Poa, Lambu, Kaladatina* etc.), Sea Cat Fish (*Tachysurus spp.),* Sharks, Skates & Rays, Other Marine Fish.

Beels:

Rui (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), Kalbasu (*Labeo calbasu*), Ghonia (*Labeo gonius*), Boal (*Wallago attu*), Air (*Mystus aor / Mystus seenghala*), Shol/Gazar (*Channa spp*.), Chital/Phali (*Notopterus chitala / N. notopterus*), Koi (*Anabas testudineus*), Singi/Magur (*Heteropneustes fossilis /Clarias batrachus*), Sarpunti (*Puntius sarana*), Large Shrimp (*Macrobrachium rosenbergii /M. malcomsonii*), Small Shrimp, Silver Carp (*Hypophthalmichthys molitrix*), Carpio (*Cyprinus carpio*), Grass Crap (*Ctenopharyngodon idellus*), Pabda (*Ompok pabda*), Punti (*Puntius spp.),* Tengra (*Mystus spp*.), Baim (*Mastacembelus spp*.), Chapila (*Gudusia chapra*), Others.

Pond:

Rui (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), Kalbasu (*Labeo calbasu*), Mixed Carp, Silver Carp (*Hypophthalmichthys molotrix*), Grass Carp (*Ctenopharyngodon idellus*), Mirror Carp (*Cyprinus carpio var. specularis*), Tilapia (*Oreochromis mossambicus / O. niloticus*), Shrimp, Aor (*Mystus aor / Mystus seenghala*), Boal (*Wallago attu),* Shol/Gazar & Taki (*Channa spp.),* Chital/Foli (*Notopterus chitala / N. notopterus)*, Koi (*Anabas testudineus*), Singi/Magur (*Heteropneustes fossilis / Clarias batrachus*), Sarpunti (*Puntius sarana*), Thai Sarpunti (*Puntius gonionotus*), Punti (*Puntius spp*.), Others.

Checklist for Ecological Information Collection

Center for Environmental and Geographic Information Services (CEGIS)

(1) Basic Information

Date		**Prepared by**	
Name of the Plant			
Type of PP			
Total Capacity (MW) of PP		**Number of Unit**	
Amount of Acquired land (if any)		**Base Fuel**	
District/s		**Upazila/s**	

(2) Major Habitat Information/ Ecosystem Types along 10 Km periphery

(Please put tick where is applicable)

Agriculture land		**Forest patches including social forest**	
Settlement/Homesteads		**Canal and ponds**	
Orchard		**Mangroves**	
Fallow		**Reserve forest**	
Ridges		**Shoreline/ Sea shore**	

(3) Habitat elements of direct impacted area (inside the existing Power Plant/ acquired land)

Vegetation	Common Wildlife	Anticipated Impacts	Major impacted species

(4) Information of major River or canal flow near the Plant

Name	Distance *(Km.) from PP*	Type *(Seasonal/ Perennial)*	Width (m.)	Avg. Depth *(f) in Dry season*	Avg. Depth *(f) in wet season*	Connectivity	Turbidity (put tick or cross ark)	Biodiversity Richness *(Good/Moderate/Poor)*

(5) Possible impacts by exhausted/ spilled elements from the Plant

Name of fuel (gas/coal/oil)	Name of exhausted elements/particulates	Anticipated Impacts	Range of Impact (km or year)	Anticipated Impacted Species

Note: Exhausted elements/particulates: different gases, hot air, petrochemicals, hot water etc.

(6) Terrestrial Vegetation Checklist (List of Major Plant Species inside 10 Km. periphery)

Species	Status	Canopy coverage (%)	Habit
Homestead Vegetation			
Crop field weeds			
Orchard Vegetation			
Roadside vegetation/Marginal vegetation			
Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others			

(7) Terrestrial Wildlife Checklist (List according to impact intensity inside the 10 Km periphery)

Species	Habitat	Status	Mode of impact / behind impact	Impacts on core habitat (put tick or cross mark)
Mammals				
Amphibians				
Reptiles				
Birds				
Habitat: 1= Homestead forest, 2= Floodplains, 3= Wetlands, 4= River, 5= Pond, 6=Forest Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Migration Status: 1= Local, 2= Local Migratory, 3= Migratory				

(8) Aquatic Wildlife Checklist

Species	Habitat	Status	Mode of impact / behind impact
Mammals			
Amphibians			
Reptiles			

Species	Habitat	Status	Mode of impact / behind impact
Birds			
Habitat: 1= Homestead forest, 2= Floodplains, 3= Wetlands, 4= River, 5= Pond, 6=Forest Status: 1= Very common, 2=Common, 3= Rare, 4= Very Rare Migration Status: 1= Local, 2= Local Migratory, 3= Migratory			

(9) Major Wetland information inside 10 Km. periphery

Wetland	Type of wetland	Area in ha.	Connectivity		Mode of impact
			Canal	River	
Type 1= Beels, 2= Rivers, 3= Open water wetlands, 4= Floodplains, 5= Closed water wetlands, 6= Ponds, 7= Baors (oxbow lake). 1=Fish; 2= migratory bird; 3= other wildlife; 4=aquatic flora					

(10) Wetland vegetation Checklist

Species	Habit	Status	Mode of impact
Habit 1=Submerged, 2=Free floating, 3=Rooted floating, 4=Sedges, 5=Marginal Status 1= High, 2= Moderate, 3= Low Utilization 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others			

(11) Anticipated Impacts due to proposed Plant installation on particular Ecosystems (Impact from changed land use, noise, human presence etc.)

Name of Intervention	Impacts
Movement of labor/Machineries	
Lying Gas Pipe	
Increase noise and lighting	
Discharge of high temperate water	
Construction of new connecting road, or/and other infrastructures	

(12) Comments (If any):

SOCIO-ECONOMIC BASELINE DATA COLLECTION

Checklist for Rapid Rural Appraisal (RRA)

1. Facilitation Information

Name of Facilitator	
Date of Facilitation	

2. Project Information

Name of Project	
Gross Area (ha.)	
Net Area (ha.)	

3. Study Area

Mauza	
Union/Ward	
Municipality (if any)	
Upazila/Thana	
District	

4. Educational Institution

Sl. No.	Type of facility	Nos. of Institution	Type of facility	Nos. of Institution
1	Primary School		Ebtedayee Madrasha	
2	High School		Dakhil Madrasha	
3	College		Alim/Fazil Madrasha	

Note: The category "Primary School" includes only Government Primary School (GPS) and Registered Non-Government Primary School (RNGPS)

5. Disease Prevalence

Ranking by Incidence	Name of Disease	Ranking by Incidence	Name of Disease
1		**6**	
2		**7**	
3		**8**	
4		**9**	
5		**10**	

Note: If the facilitator can collect disease profile from the Upazila Health Complex then this question could be skipped

6. Health Facilities

Sl. No.	Type of Facility	Number of Facilities
1	District/Sadar Hospital	
2	Upazila Health Complex	
3	Union Sub-Center	
4	Union Family Welfare Center	
5	Community Clinic	
6	Private Health Clinics/hospitals	
7	Other (if any)	

7. Peripheral Health Facilities (if any)

Number	
Name	
Description/status	

8. Sources of Treatment Facilities

Sl. No.	Source of treatment facilities	Percentage of Households Received
1	Trained physician	
2	Paramedic/diploma physician	
3	Quack doctor & informal treatments	
4	No treatment facilities at all	

9. Electricity Coverage

Sl. No.	Type of facility	Percentage of Households
1	Grid	
2	Solar	
3	Biogas	
4	Other (if any)	

Note: Percentage of households covered by grid electricity will be cross-checked with the data given in the Population and Housing Census 2011 of Bangladesh Bureau of Statistics

10. Income and Expenditure

Range (Tk./month)	Percentage of Households	
	Expenditure	Income
Less than 1,000		
1,000 - 2,000		
2,000 – 5,000		
5,000 - 9,000		
9,000 - 20,000		
More than 20,000		

11. Labor and Wage

Type of Activity	Male Labor		Female Labor	
	Availability (put √)	Daily Wage (Tk.)	Availability (put √)	Daily Wage (Tk.)
Farming	H M L		H M L	
Non-Farming	H M L		H M L	

Note: H=High; M=Medium; L=Low. Farming activities include agricultural activity and Non-farming activities include earthwork, brickfield work, construction work etc)

12. Self-Assessed Subsistence Poverty

Sl. No.	Poverty Status	Percentage of Households
1	Deficit	
2	Balance/Breakeven	
3	Surplus	

13. GO/NGO Safety Net Programs

Name of GO/ NGO Department	Activity	% of HHs Coverage

14. Land Price

Sl. No.	Lands Type	Sale Value (Tk./per acre)
1	Homesteads land	
2	Agricultural land	
3	Commercial Land	
4	Others (if any)	

15. Land Ownership

Land Holding Categories	Distribution of Household (%)
Absolute Landless (0 decimal)	
Functional Landless (up to 49 decimal)	
Marginal (50-100 decimal)	
Small (101-249 decimal)	
Medium (250-749 decimal)	
Large (more than 750 decimal)	

16. Disaster and Damage (in last five years)

Most Prevalent Disasters					
Ranking by Incidence	**1)**	**2)**	**3)**	**4)**	**5)**
Tangible loss due to Disasters					
Intangible loss due to Disasters					
Impacts on Households					
Impacts on Livelihood					
Proposed Mitigation					

Note: These data will be cross-checked with the multidisciplinary information

17. Migration Trend

Type of Migration	Out Migration		In Migration	
	Place of destination	Number/ Percentage*	Place of origin	Number/ Percentage*
Seasonal Labor migration				
Permanent Household migration				

**Percentage of migration will be applicable in case of seasonal labor migration; whereas number will be applicable in case of permanent migration of households*

18. Professional/occupational Conflict

Type of Conflict	
Reasons of Conflict	
Area	
Groups engaged in conflict	
Proposed solutions	

19. Miscellaneous

Particulars	Number	Name	Brief Description
Ethnic Community			
Vulnerable Community			
Cultural Heritage Site			
Common Property Resources			

20. Profile of RRA Participants

Name	Age	Occupation	Address/ Mobile no.
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Required Photographs: Educational Institutions, Housing Pattern, Water-Sanitation Facilities, Solar/Biogas Plant, Health Facilities, Transportation/Communication Network, Markets, Adverse Effects of Disasters etc.

Annex 6: Environmental Code of Practices

Introduction

The objective of the Environmental Code of Practices (ECPs) is to address all potential and general implementation related impacts during demolition, site preparation, construction as well as implementation of the proposed power plant. The ECPs will provide guidelines for best operating practices and environmental management guidelines to be followed by the contractors for sustainable management of all environmental issues. These ECPs shall be annexed to the general conditions of all the contracts, including subcontracts, carried out under the Project.

The list of ECPs prepared for the Project is given below:

- ECP 1: Waste Management
- ECP 2: Fuels and Hazardous Goods Management
- ECP 3: Water Resources Management
- ECP 4: Drainage Management
- ECP 5: Soil Quality Management
- ECP 6: Protection of Flora
- ECP 7: Protection of Fauna
- ECP 8: Protection of Fisheries
- ECP 9: Traffic Management (Road and Inland)
- ECP 10: Construction Camp Management
- ECP 11: Cultural and Religious Issues
- ECP 12: Workers Health and Safety
- ECP 13: Construction and Operation Phase Security
- ECP 14: Topography and Landscaping
- ECP 15: Air Quality Management
- ECP 16: Noise and Vibration Management

Contractors will prepare site specific management plans, namely Construction Environmental Action Plan (CEAP), in compliance with the Environmental Conservation Rules, 1997 of Bangladesh (amended in 2005), World Bank Group Guidelines, and IFC Performance Standards and based on the guidance given in the ECPs. The CEAP will form the part of the contract documents and will be used as monitoring tool for compliance. It is mandatory for the contractors procured directly by the Project to include these ECPs in their sub-contracts. Violation of these requirements will be treated as non-compliance leading to the corrections or otherwise issuance of non-compliance certificates to the contractors.

ECP 1: Waste Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
General Waste	Soil and water pollution from the improper management of wastes and excess materials from the construction/ demolition sites.	The Contractor shall • Develop site specific waste management plan for various waste streams (e.g., reusable waste, flammable waste, demolition debris, construction debris, food waste etc.) prior to commencing of construction and submit to supervision consultant for approval. • Organize disposal of all wastes generated during demolition and construction in the designated disposal sites approved by the Project authority. • Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. • Segregate all wastes, wherever practical. • Vehicles transporting solid waste shall be totally confined within an enclosed vehicle or is fully covered with a tarp to prevent spilling waste along the route. • Tarp must be undamaged (not torn or frayed) properly secured to the body of the vehicle or trailer with ropes, chains, straps, or cords so that no waste is exposed. The edges of the tarps shall extend 12 inches over the permanent sides and back of the open top vehicle or trailer and must be secured to the permanent vehicle. All loads must be tarped from the point of origin of the waste to the tipping area of the final disposal/landfill. • Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. • Provide refuse containers at each worksite. • Request suppliers to minimize packaging where practicable. • Place a high emphasis on good housekeeping practices. • Maintain all construction sites clean, tidy and safe and provide and maintain appropriate facilities as temporary storage of all wastes before transporting to final disposal. • Potable water should be supplied in bulk containers to reduce the quantity of plastic waste (plastic bins). Plastic bag use should be avoided.
Hazardous Waste	Health hazards and environmental impacts	The Contractor shall

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	due to improper waste management practices	• Collect chemical wastes in 200 liter drums (or similar sealed container), appropriately labeled for safe transport to an approved chemical waste depot. • Store, transport and handle all chemicals avoiding potential environmental pollution. • Store all hazardous wastes appropriately in bunded areas away from water courses. • Make available all Material Safety Data Sheets (MSDS) for hazardous materials on-site during construction. • Collect hydrocarbon wastes, including lube oils, for safer transport off-site to reuse, recycle, treatment or disposal at approved locations. • Construct concrete or other impermeable hard-stand to prevent seepage in case of spills. • Keep sufficient stock of absorbents for generally used chemicals or for petrochemicals (e.g., dirt, sawdust, etc.) within the storage area to contain accidental spills.

ECP 2: Fuels and Hazardous Goods Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Fuels and hazardous goods.	Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals, hazardous goods/materials on-site, wash down of plant and equipment, and potential spills may harm the environment or health of construction workers.	The Contractor shall • Prepare spill control procedures and submit them for supervision consultant for approval. • Train the relevant construction personnel in handling of fuels and spill control procedures. • Refueling shall occur only within bunded areas. • Store dangerous goods in bunded areas on top of a sealed plastic sheet away from watercourses. Store all liquid fuels in fully bunded storage containers, with appropriate volumes, a roof, a collection point and appropriate filling/decanting point. • Store and use fuels in accordance with material safety data sheets (MSDS). Make available MSDS for chemicals and dangerous goods on-site. • Store hazardous materials at above storm surge level, determined for construction. • Make sure all containers, drums, and tanks that are used for storage are in good condition and are clearly labeled with expiry date. Any container, drum, or tank that is dented, cracked, or rusted might eventually leak. Check for leakage regularly to identify potential problems before they occur. • Set containers and drums in temporary storages in clearly marked areas, where they will not be run-

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		over by vehicles or heavy machinery. The area shall preferably drain to a safe collection area in the event of a spill. • Take all precautionary measures when handling and storing fuels and lubricants, avoiding environmental pollution. • All machineries are to be stored and away from any water body, drainage inlets or natural drainage area, where practical. Environmental control measures such as appropriate barriers (i.e. bunding, sediment fence, etc.) will be considered and/or implemented to control runoff away from the machinery and prevent any washout in to adjacent water body, drainage inlets or natural drainage area. • Transport waste of dangerous goods, which cannot be recycled, to an approved waste disposal facility. Safe transport of fuel or other hazardous liquids to and from the storage container will be facilitated through the provision detailed within the Material Safety Data Sheets (MSDS). • Wash down of jetty platform and equipment and vehicle servicing will be performed only in isolated impervious areas away from drainage inlets, connecting the drainage with an oil interceptor. Pits/bunds located away from waterways will be provided for concrete wash near construction areas. The contractor's environmental officer with assistance from supervisors is to ensure that pits/bunds are available, maintained at capacity and drivers instructed regarding the location and required procedures. • Keep stock of absorbent and containment material (e.g., absorbent matting, dirt, sawdust, etc.) where hazardous material is used and stored; and ensure staffs are trained in their correct use. • Oil and chemical spills and washouts shall be cleaned up and collected immediately, where safety permits. Disposal of remediated / cleanup/ washout materials shall be to an approved waste disposal facility. Materials shall be transported by an approved / licensed transporter. Contaminated Material to be removed from site as soon as reasonably practical after the incident. • Provide appropriate personal protective equipment (protective clothing, safety boots, helmets, masks, gloves, goggles, etc.) to the construction personnel, depending on the materials handled.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Avoid the use of material with greater potential for contamination by substituting them with more environmentally friendly materials. • Siting of fuel and hazardous material storage sites, including refuelling facilities, batching plants and construction yards are to be located inside the embankments and at least 500 m away from any residential area. • Preparing inventories of chemicals that will be used, or have the potential to be used onsite. Inventories should include anticipated volumes and types of materials and MSDS. • Outdoor storage will be secured when unmanned, and storage of hazardous or potentially hazardous materials will ideally be arranged so that stored products are away from vegetated areas and there is ≥6 m between stored products, uncontrolled grasses or weeds, and fuel dispensers. • Personnel will avoid mixing chemicals unless specified by the manufacturer, and will use chemicals as specified on labels, in well ventilated areas. • Corrosive materials will be stored away from flammables. • Re-useable or recycled degreasers will be used where possible or appropriate to machinery and equipment. • Exposed stockpiles of materials will be covered with tarpaulin or impervious sheets before rainstorm occurs.

ECP 3: Water Resources Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Hazardous material and Waste	Water pollution from the storage, handling and disposal of hazardous materials and general construction waste, and accidental spillage	The Contractor shall • Follow the management guidelines proposed in ECP 1and ECP 2: Fuels and Hazardous Goods Management. • Minimize the generation of spoils, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways or storm water systems.
Discharge from construction sites	Construction activities, sewerages from construction sites and work camps may affect the surface water quality. The	The Contractor shall • Develop temporary drainage networks (channels and check dams) in areas where sediment and erosion control is required for protecting storage areas for construction materials.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	construction works will modify groundcover and topography, changing the surface water drainage patterns of the area. These changes in hydrological regime lead to increased rate of runoff, increase in sediment and contaminant loading, increased flooding, and affect habitat of fish and other aquatic biology.	• Install temporary sediment lagoons, where appropriate, to capture sediment-laden run-off from work site. • Divert runoff from undisturbed areas around the construction site. • Stockpile materials away from drainage lines. • Prevent all solid and liquid wastes entering waterways by collecting spoils, oils, chemicals, bitumen spray waste and wastewaters from brick, concrete and asphalt cutting where possible and transport to an approved waste disposal site or recycling depot. • Wash out ready-mix concrete agitators and concrete handling equipment at washing facilities off site or into approved bunded areas on site. Ensure that tires of construction vehicles are cleaned in the washing bay (constructed at the entrance of the construction site) to remove the mud from the wheels. This should be done in every exit of each construction vehicle to ensure the local roads are kept clean.
Soil erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion. • Ensure that roads used by construction vehicles are swept regularly to remove dust and sediment. • Water the loose material stockpiles, access roads and bare soils on an as needed basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds).
Construction activities in water bodies	Dredging/ excavation activities associated with construction of pipelines, bulkheads and river training works, and buildings for a facility can cause turbidity and sedimentation in nearby waters, degraded water quality, and substrate alterations. Under water noise from the piling and other sources may compel dolphin, fish and other	The Contractor Shall • Dewater sites by pumping water to a sediment basin prior to release off site – do not pump directly off site. • Monitor the water quality in the runoff from the site or areas affected by dredge/excavation plumes, and improve work practices as necessary. • Protect water bodies from sediment loads by silt screen or other barriers. • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways or storm water systems.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	aquatic organisms leaving the area; sound pressure waves may also adversely affect riverine organisms including vocalization and behavior of fish, dolphins and other animals.	• Do not discharge cement and water curing used for cement concrete directly into water courses and drainage inlets. • Set a large bubble curtain consists of a hose with drilled holes, supplied with compressed air. The hose is placed on the river bed and the air escaping from the holes forms the bubble screen. • Conduct pile driving during low tides in intertidal and shallow in subtidal areas.
	Highly motile adult and juvenile life stages of most fishes could flee when construction is ongoing, however, egg and larval stages as well as non-motile benthic organisms will likely not be able to avoid impacts. As a general rule, the severity of adverse effects tends to be greatest for early life stages and for adults of some highly sensitive species.	The Contractor shall • Avoid dredged material disposal activities in areas containing sensitive or unique benthic habitats (e.g., spawning and feeding sites). • Restrict construction during December-February and May-July when appropriate to avoid temporary impacts to habitat during critical life history stages (e.g., spawning, egg and embryo development, and juvenile growth). • Control of sediment flow from the construction activities • Silt curtains along river training works and/or other industry good practice management controls will be used to restrict the spread of sediment released during construction of Terminal/Jetty/Materials Offloading Facility earthen causeway. • Minimize and restrict clearing of river slope and river bank vegetation as much as possible.
Drinking water	Untreated surface water is not suitable for drinking purposes due to presence of suspended solids and E. coli.	The Contractor Shall • Provide drinking water that meets National and WHO Drinking Water standards. Drinking water to be chlorinated at source, and ensure presence of residual chlorine 0.1 ~ 0.25 ppm as minimum after 30 minutes of chlorine contact time.

ECP 4: Drainage Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Excavation and earth works, and construction yards	Lack of proper drainage for rainwater/liquid waste or wastewater owing to the construction activities harms environment in terms of water and soil contamination, and mosquito growth.	The Contractor shall • Prepare drainage management procedures and submit them for supervision consultant for approval. • Prepare a program to prevent/avoid standing waters, which supervision consultant will verify in advance and confirm during implementation. • Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there. • Rehabilitate road drainage structures immediately if damaged by contractors' road transports. • Build new drainage lines as appropriate and required for wastewater from construction yards connecting to the available nearby recipient water bodies. Ensure wastewater quality conforms to National Standards, before it is being discharged into the recipient water bodies. • Ensure that there will be no water stagnation at the construction sites and camps. • Provide appropriate silt collector and silt screen at the inlet and manholes and periodically clean the drainage system to avoid drainage congestion. • Protect natural slopes of drainage channels to ensure adequate storm water drains. • Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem.
Ponding of water	Health hazards due to mosquito breeding	• Do not allow ponding of water especially near the waste storage areas and construction camps. • Discard all the storage containers that are capable of storing of water, after use or store them in inverted position.

ECP 5: Soil Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Storage of hazardous and toxic chemicals	Spillage of hazardous and toxic chemicals will contaminate the soils.	The Contractor shall • Strictly maintain the wastes management plans proposed in ECP-1 and storage of materials and ECP-2: Fuels and Hazardous Goods Management. • Construct appropriate spill containment facilities for all fuel storage areas. • Establish and maintain a hazardous material register detailing the location and quantities of hazardous substances including the storage, and their disposals. • Train personnel and implement safe work practices for minimizing the risk of spillage. • Identify the cause of contamination, if it is reported, and contain the area of contamination. The impact may be contained by isolating the

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		source or implementing controls around the affected site. • Remediate the contaminated land using the most appropriate available method. • Confine the contaminants immediately after such accidental spillage. • Collect contaminated soils and washouts containing petroleum products treat and dispose them in environment friendly manner. • All areas intended for storage of hazardous materials to be quarantined and provided with adequate facilities to combat emergency situations complying all the applicable statutory stipulation.
Construction material stock piles	Erosion from construction material stockpiles may contaminate the soils	The Contractor shall • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds.
Impact on top soil	Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth	The contractor shall • Strip the top soil to a depth of 35 cm and store in stock piles of height not exceeding 2m. • Remove unwanted materials from top soil like grass, roots of trees and others. • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites.

ECP 6: Protection of Flora

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Vegetation clearance	Local flora is important habitats for birds, provide fruit harvest, timber/fire wood, protect soil from erosion and overall keep the natural balance for human-living. As such damage to flora has wide range of adverse environmental impacts.	The Contractor shall • Prepare a plan to protect flora and submit the plan for supervision consultant's approval. • Minimize disturbance to surrounding vegetation. • Use appropriate type and minimum size of machine to avoid disturbance to adjacent vegetation. • Get approval from supervision consultant for clearance of vegetation. • Make selective and careful pruning of trees where possible to reduce need of tree removal. • Control noxious weeds by disposing of at designated dumping site or burn on site. • Clear only the vegetation that needs to be cleared in accordance with the engineering plans and designs. These measures are applicable to

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		both the construction areas as well as to any associated activities such as sites for stockpiles, disposal of fill, etc. • Not burn off cleared vegetation – where feasible, chip or mulch and reuse it for the rehabilitation of affected areas, temporary waterman and valve access or landscaping. Mulch provides a seed source, can limit embankment erosion, retains soil moisture and nutrients, and encourages re-growth and protection from weeds. • Return topsoil and mulched vegetation (in areas of native vegetation) to approximately the same location from where it came from. • Avoid work within the drip-line of trees to prevent damage to the tree roots and compacting the soil. • Minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible. • Ensure excavation works occur progressively and re-vegetation done at the earliest. • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction • Supply appropriate fuel in the work camps to prevent fuel wood collection. • Include environmental management and awareness as part of training for employees during construction. • Avoid felling of tree species of conservation significance and those that are protected, even those that act as nesting and breeding sites. • Tree planation will be carried out in and other suitable areas near the river training works of the plant jetty at a ratio of 5 new trees per each tree felt.

ECP 7: Protection of Fauna

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities	The location of construction activities can result in the loss of wild life habitat and habitat quality.	The Contractor shall • Prepare a plan for protection of fauna and submit the plan for supervision consultant approval. • Limit the construction works within the designated sites allocated to the contractors. • Check the site (especially trenches) for trapped animals, and rescue them by the help of a qualified person. • Provide temporary access to the animals to cross the trenches. • Use of existing access road and limit the width of new access roads.
	Impact on local and migratory birds, their habitats and active nests	The Contractor shall • Not be permitted to destruct active nests or eggs of birds. • Minimize the tree removal during the bird breeding season. If works must be continued during the bird breeding season, a nest survey will be conducted by a qualified biologist prior to commence of works to identify and locate active nests. • If bird nests are located/ detected within the right-of-way and roadside embankments then those areas should be avoided. • Petroleum products should not come in contact with the natural and sensitive ecosystems. Contractor must minimize the release of oil, oil wastes or any other substances harmful to migratory birds' habitats, to any waters, wetlands or any areas frequented by migratory birds.
	Loss of temporary breeding pools and pans due to refilling of such pools by construction soil or gravel.	The contractor shall • Schedule construction during dry season to reduce impact since the amphibian populations will be low during non-breeding season • Fence off the trenches with nets to prevent amphibians falling into the trap.
	Movement of dredgers, dredging operation, discharge pipelines, and dredged material disposal may have a negative impact on the surrounding homestead Ecosystem (including, terrestrial wildlife and aquatic fauna).	The contractor shall • Ensure enforcement of ECA, 1995 (as amended in 2010) and ECR, 1997 (as amended in 2005) • Forest Protection Act, and other rules, regulation and treaties for conserving the Ecological Critical Areas • Ensure zero disposal of ballast water, zero oil spillage, zero discharge of waste water

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Restrict outside lighting of the dredgers during navigation and dredging operation • Restrict the beaming of searchlight
	Above water noise and vibration can create nuisance to local community, disturb birds	The contractor shall • Reduce the dredger noise at source by isolation of exhaust systems, by keeping engine room doors shut and by additional measures such as shielding. • Equip the dredger with efficient and effective silencer for limiting the generation of noise. • Limit the noisy dredging activity to daylight hours, where possible, rather than at sunrise or sunset (significant for wildlife). Where unavoidable, the contractor should ramp up the levels of engines or other noise producing sources, so that the noise slowly increases. This will encourage riverine and terrestrial fauna to move away from the source area prior to significant noise emissions. • Inspect and maintain equipment in good working condition.
	Excavation works will impact on the loss of habitats especially the terrestrial invertebrates that live in the ground.	The contractor shall • Avoid construction during rainy season • Minimize digging of trenches and vegetation clearance to minimum required level.
Vegetation clearance	Clearance of vegetation may impact shelter, feeding and/or breeding and/or physical destruction and severing of habitat areas	The Contractor shall • Restrict the tree removal to the minimum numbers required. • Relocate hollows, where appropriate. • Fell the hollow bearing trees in a manner which reduces the potential for fauna mortality. Felled trees will be inspected after felling for fauna and if identified and readily accessible will be removed and relocated or rendered assistance if injured. After felling, hollow bearing trees will remain unmoved overnight to allow animals to move of their own volition. Care should be taken to make sure bird habitats are not destroyed. If there is no option available, rehabilitate them in other neighboring trees. Also protect and rehabilitate injured or orphaned birds.
Night time lighting	Lighting from construction sites and construction camps may affect the visibility of night time migratory birds that use the moon	The Contractor shall • Use lower weightage flat lens fixtures that direct light down and reduce glare, thus reducing light pollution, • Avoid flood lights unless they are absolutely required.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	and stars for navigation during their migrations.	• Use motion sensitive lighting to minimize unneeded lighting. • Use, if possible, green lights that are considered as bird's friendly lighting instead of white or red colored lights. • Install light shades or plan the direction of lights to reduce light spilling outside the construction area.
Construction camps	Illegal poaching	The Contractor shall • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching. • Ensure that staff and Subcontractors are trained and empowered to identify, address and report potential environmental problems. • Provide sufficient food allowance to the workers so that they don't engage in illegal poaching or hunting.

ECP 8: Protection of Fisheries

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities (dredging) in River	The main potential impacts to fisheries are dredging, dumping of dredged spoil, hydrocarbon spills and leaks from riverine transport, and disposal of wastes into the river.	The Contractor shall • Prepare procedures for protection of fish and submit them for supervision consultant approval. • Restrict dredging and piling in the intake area during fish breeding and spawning season (December-February) and May-July to avoid hindrance or blockage of fish breeding and spawning. • Ensure the construction equipment used in the river are well maintained and do not have oil leakage to contaminate river water. • Contain oil immediately on river in case of accidental spillage from equipment; make an emergency oil spill containment plan (under the Fuels and Hazardous Substances Management Plan) to be supported with enough equipment, materials and human resources. • Do not dump wastes, be it hazardous or non-hazardous into the nearby water bodies or in the river. • Control of sediment flow from the dredging activities. • Restrict dredging to design section only where required by avoiding sensitive areas (dolphin and fish spawning areas). No dredging will be

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		carried out within one hundred meter of these sensitive areas. • During dry season no disposal of dredged materials in the scour holes. Scour holes are used as a refuge by some large fishes, dolphins and aquatic animals during dry season/winter. • Follow Biodiversity Management Plan. • Follow IFC's PS 6- Biodiversity Conservation and Sustainable Management of Living Natural Resources. • Implementation of ECPs, including ECP 1 Waste Management, ECP 2 Fuels and Hazardous Goods Management, and Noise Management Plan.
	Underwater noise and vibration may disrupt fish and dolphins	The contractor shall • Reduce the dredger noise at source by isolation of exhaust systems, by keeping engine room doors shut and by additional measures such as shielding. • Equip the dredger with efficient and effective silencer for limiting the generation of noise. • Limit the noisy dredging activity to daylight hours, where possible, rather than at sunrise or sunset (significant for wildlife). Where unavoidable, the contractor should ramp up the levels of engines or other noise producing sources, so that the noise slowly increases. This will encourage riverine and terrestrial fauna to move away from the source area prior to significant noise emissions. • Inspect and maintain equipment in good working condition.
	Risk of collision of construction boats with dolphins and other wildlife	The contractor shall • Limit the motor boat speed to ≤15 km/h in accordance with the best international practices and to avoid any collision with dolphins.
Construction activities on the land	The main potential impacts on river are increased suspended solids from earthworks erosion, sanitary discharge from work camps, and hydrocarbon spills	The Contractor shall • follow mitigation measures proposed ECP 3: Water Resources Management and ECP 4: Drainage Management.

ECP 9: Traffic Management (Road and Inland)

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Increased traffic use of road by construction vehicles will affect the movement of normal road traffics and the safety of the road-users.	The Contractor shall • Prepare a traffic management plan and submit the plan for supervision consultant approval. • Strictly follow the Project's 'Traffic Management Plan' and work with close coordination with the Traffic Management Unit. • Prepare and submit additional traffic plan, if any of his traffic routes are not covered in the Project's Traffic Management Plan, and requires traffic diversion and management. • Include in the traffic plan to ensure uninterrupted traffic movement during construction: detailed drawings of traffic arrangements showing all detours, temporary road, temporary bridges, temporary diversions, necessary barricades, warning signs / lights, road signs, construction schedule etc. • Provide signs at strategic locations of the roads complying with the schedules of signs contained in the National Traffic Regulations.
	Accidents and spillage of fuels and chemicals and damage to infrastructures and properties due to vibration	The Contractor shall • Restrict truck deliveries, where practicable, to day time working hours. • Restrict the transport of oversize loads. • Operate vehicles, if possible, to non-peak periods to minimize traffic disruptions. • Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centers, etc. • Inspect structures within the close proximity of construction site for damages.

ECP 10: Construction Camp Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Siting and location of construction camps	Camp sites for construction workers are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.	The Contractor shall • Prepare a construction camp management plan and submit the plan to supervision consultant for approval. • Locate the construction camps within the designated sites or at areas which are acceptable from environmental, cultural or social point of view and approved by the supervision consultant or the Client. • Conduct consultation with communities including local government institutes bodies

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		(Ward Councilor of Pourshava) prior to set-up the camp. • Consider the location of construction camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • Submit to the supervision consultant for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of access roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social, and security matters.
Construction Camp Facilities	Lack of proper infrastructure facilities, such as housing, water supply, and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	Contractor shall provide the following facilities in the campsites • Adequate housing for all workers. • Follow IFC's Performance Standard PS2: Labor and Working Conditions for creating congenial environment for the labor's living. • Safe and reliable water supply, which should meet national/WHO standards. Drinking water to be chlorinated at source, and ensure presence of residual chlorine 0.1 ~ 0.25 ppm as minimum after 30 minutes of chlorine contact time (WHO guideline). • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. Provide separate latrines and bathing places for males and females with total isolation by location. The minimum number of toilet facilities required is one toilet for every ten persons. • Treatment facilities for sewerage of toilet and domestic wastes. • Storm water drainage facilities. • Paved internal roads. • Provide child crèches for women working at construction site. The crèche should have

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		facilities for dormitory, kitchen, indoor and outdoor play area. Schools should be attached to these crèches so that children are not deprived of education whose mothers are construction workers. • Provide in-house community/common entertainment facilities. Dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Disposal of waste	Management of wastes is crucial to minimize impacts on the environment	The Contractor shall • Ensure proper collection and disposal of solid wastes within the construction camps. • Insist waste separation by source; organic wastes in one container and inorganic wastes in another container at household level. • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed. • Do not establish site specific landfill sites. All solid waste will be collected and removed from the work camps and disposed in approved waste disposal sites.
Fuel supplies for cooking purposes	Illegal sourcing of fuel wood by construction workers will impact the natural flora and fauna	The Contractor shall • Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Made available alternative fuels like natural gas or kerosene on ration to the workforce to prevent them using biomass for cooking. • Conduct awareness campaigns to educate workers on preserving the protection of biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. There will be an increased risk of work crews spreading sexually transmitted infections and HIV/AIDS.	The Contractor shall • Follow the IFC's Performance Standard PS4: Community Health, Safety, and Security • Provide adequate health care facilities within construction sites. • Provide first aid facility round the clock. Maintain stock of medicines in the facility and appoint fulltime designated first aider or nurse.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas. • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work. • Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis. • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellant sprays during rainy season in offices and construction camps and yards. • Not dispose food waste openly as that will attract rats and stray dogs. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. Place display boards at strategic locations within the camps containing messages on best hygiene practices.
Security and Safety	Inadequate security and safety provision in construction camps may create security and safety problems of workforces and assets and fire hazards. Security risks for workers and project staffs, especially from pirates and bandits who are known to roam the area and carry-out kidnappings for ransoms.	The Contractor shall • Follow the IFC's Performance Standard PS4: Community Health, Safety, and Security • Provide appropriate security personnel (police or private security guards) and enclosures to prevent unauthorized entry in to the camp area. • Employ night watchman and security personnel from forest department for periods of dredging, significant on-site storage or when the area necessitates. • Consult with the local leaders and local community representatives on security matters. • Maintain register to keep a track on a head count of persons present in the camp at any given time. • Pre-employment screening investigations should be used to verify the applicants relating to their employment, education and criminal history background.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Issuance of Identification Cards to workers and checking them properly when get into the workplace. • Encourage use of flameproof material for the construction of labor housing / site office. Also, ensure that these houses/rooms are of sound construction and capable of withstanding wind storms/cyclones. • Provide appropriate type of firefighting equipment suitable for the construction camps. • All construction material storage should be sit a visible location secured with fence or solid walls with locks to avoid theft and vandalism. • Display emergency contact numbers clearly and prominently at strategic places in camps. • Communicate the roles and responsibilities of laborers in case of emergency in the monthly meetings with contractors.
Site Restoration	Restoration of the construction camps to original condition requires demolition of construction camps.	The Contractor shall • Dismantle and remove from the site all facilities established within the construction camp including the perimeter fence and lockable gates at the completion of the construction work. • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed. • Give prior notice to the laborers before demolishing their camps/units. • Maintain the noise levels within the national standards during demolition activities. • Different contractors should be hired to demolish different structures to promote recycling or reuse of demolished material. • Reuse the demolition debris to a maximum extent. Dispose remaining debris at the designated waste disposal site. • Handover the construction camps with all built facilities as it is if agreement between both parties (contactor and land-owner) has been made so. • Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner.

ECP 11: Cultural and Religious Issues

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities near religious and cultural sites	Disturbance from construction works to the cultural and religious sites, possible cultural conflicts between communities and workers and contractors lack of knowledge on cultural issues cause social disturbances.	The Contractor shall • Communicate to the public through community consultation regarding the scope and schedule of construction, as well as certain construction activities causing disruptions or access restriction. • Not block access to cultural and religious sites, wherever possible. • Restrict all construction activities within the foot prints of the construction sites. • Stop construction works that produce noise (particularly during prayer time) should there be any church/mosque/religious/educational institutions and health center close to the construction sites and users make objections. • Take special care and use appropriate equipment when working next to a cultural/religious center. • Stop work immediately and notify the site manager, if during construction, an archaeological or burial site is discovered. It is an offence to recommence work in the vicinity of the site until 'approval to continue' is obtained by the archaeological authority. • It is imperative to develop a procedure for management of 'Chance Finds'. IFC's PS 8-Cultural Heritage should be followed by the Contractor. • Provide independent prayer facilities to the construction workers. • Show appropriate behavior with all construction workers especially women and elderly people. • Allow the workers to participate in praying during construction time, if there is a request. • Resolve cultural issues in consultation with local leaders and supervision consultants. • Conduct awareness campaign and develop Code of Conduct for workers on local cultural. • Develop and function the grievance redressal mechanism. • Develop and implement strong community participation plan. • Establish a mechanism that allows local people to raise grievances arising from the construction process. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works so as to maintain effective surveillance over public health, social, and security matters.

ECP 12: Workers Health and Safety

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Best practices	Construction works may pose health and safety risks to the construction workers and site visitors leading to severe injuries and deaths. The population in the proximity of the construction site and the construction workers will be exposed to a number of (i) biophysical health risk factors, (e.g., noise, dust, chemicals, construction material, solid waste, waste water, vector transmitted diseases, etc.), (ii) risk factors resulting from human behavior (e.g., STD, HIV/AIDS, etc.) and (iii) road accidents from construction traffic.	The Contractor shall • Prepare an Occupational Health and Safety plan and submit the plan for supervision consultant's approval. • Implement suitable safety standards for all workers and site visitors, with sufficient provisions to comply with international standards (e.g. International Labor Office guideline on 'Safety and Health in Construction; World Bank Group's 'Environmental Health and Safety Guidelines') and contractor's own safety standards, in addition to complying with national standards. • Implement Emergency Preparedness Plan (EPP).Provide the workers with a safe and healthy work environment, taking into account inherent risks in its particular construction activity and specific classes of hazards in the work areas. • Provide personal protective equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, protective clothing, goggles, full-face eye shields, and ear protection. Maintain the PPE properly by cleaning dirty ones and replacing the damaged ones. • Safety procedures include provision of information, training and protective clothing to workers involved in hazardous operations and proper performance of their job. • Appoint an environment, health and safety manager to look after the health and safety of the workers. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works and establishment of construction camps so as to maintain effective surveillance over public health, social and security matters.
	Child and pregnant labor	The Contractor shall • Not hire children of less than 14 years of age and pregnant women or women who delivered a child within 8 preceding weeks.
Accidents	Lack of first aid facilities and health care facilities in the immediate vicinity will aggravate the health conditions of the victims	The Contractor shall • Ensure health care facilities and first aid facilities are readily available. Appropriately equipped first-aid stations should be easily accessible throughout the place of work. • Document and report occupational accidents, diseases, and incidents.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, so far as reasonably practicable, the causes of hazards, in a manner consistent with good international industry practice. • Identify potential hazards to workers, particularly those that may be life-threatening and provide necessary preventive and protective measures. • Provide awareness to the construction drivers to strictly follow the driving rules. • Provide adequate lighting in the construction area, inside the tunnels, inside the powerhouse cavern and along the roads. • Follow relevant IFC Performance Standard (PS) like PS-2 on Labor and Working Conditions; PS-3 on Resource Efficiency and Pollution Prevention and PS-4 on Community Health, Safety, and Security.
Construction Camps	Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	The Contractor shall provide the following facilities in the campsites to improve health and hygienic conditions as mentioned in ECP 10: Construction Camp Management: • Adequate ventilation facilities • Safe and reliable water supply. • Hygienic sanitary facilities and sewerage system. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities. • Recreational and social facilities • Safe storage facilities for petroleum and other chemicals in accordance with ECP 2 • Solid waste collection and disposal system in accordance with ECP1. • Arrangement for trainings • Paved internal roads. • Security fence at least 2 m height and security guards at entrances and every corner of the facility. • Sick bay and first aid facilities
Water and sanitation facilities at the construction sites	Lack of Water sanitation facilities at construction sites cause inconvenience to the construction workers and affect their personal hygiene.	The contractor shall • Provide portable toilets at the construction sites with workforce size 25 people or more, work the whole day for a month. Location of portable facilities should be at least 6 m away from storm drain system and surface waters. These portable toilets should be cleaned once a day and all the sewerage should be pumped from the collection

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		tank once a day and should be brought to the common septic tank for further treatment. • Provide safe drinking water facilities to the construction workers at all the construction sites.
Other ECPs	Potential risks on health and hygiene of construction workers and general public	The Contractor shall follow the following ECPs to reduce health risks to the construction workers and nearby community • ECP 2: Fuels and Hazardous Goods Management • ECP 4: Drainage Management • Air Quality Management Plan • Noise Management Plan • ECP 10: Traffic Management
Trainings	Lack of awareness and basic knowledge in health care among the construction workforce, make them susceptible to potential diseases.	The Contractor shall • Train all construction workers in basic sanitation and health care issues (e.g., how to avoid malaria, transmission of sexually transmitted infections (STI), and HIV/AIDS. • Train all construction workers in general health and safety matters, and on the specific hazards of their work. Training should consist of basic hazard awareness, site specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. • Implement malaria, HIV/AIDS and STI education campaign targeting all workers hired, international and national, female and male, skilled, semi- and unskilled workforces, at the time of recruitment and thereafter pursued throughout the construction phase on ongoing and regular basis. This should be complemented by easy access to condoms at the workplace as well as to voluntary counseling and testing.

ECP 13: Construction and Operation Phase Security

Project Activity/ Impact Source	Impacts /Concerns	Mitigation Measures/ Management Guidelines
Construction Phase	Inadequate construction site security poses a significant risk to assets, construction materials and property. Theft/vandalism of assets, materials and property would increase construction costs and cause delays in project completion.	The Contractor shall: • Follow IFC's Performance Standard PS4: Community Health, Safety, and Security • Provide appropriate security personnel (i.e. security guards) to prevent unauthorized entry into the camp area. • Employ night watchman for periods of significant on-site storage or when the area necessitates. • Ensure all assets (i.e., tools, equipment, etc.) and construction materials at construction site

Project Activity/ Impact Source	Impacts /Concerns	Mitigation Measures/ Management Guidelines
		are identified, inventoried and tracked as closely as possible. All assets should be clearly labeled and marked. Keep records of tool serial numbers and check inventory on a regular basis. • All tools and equipment should have a check out/in system, if not in use should be secured and stored in a proper place to prevent theft or loss. Provide storage sheds for the secure storage of equipment and tools when not in use. • Ensure there is proper fencing around construction site perimeter. Fencing should be chain-link at least 2.5 m high and secured with a steel chain and lock. If possible the entire site should be fenced; if this is not possible, make sure construction trailer and any equipment storage areas are fenced. • Ensure construction site has controlled access points (one or two entry points at most), allowing for close monitoring of comings and goings from the site. • Workers should be easily identified and have credentials that indicate site access. • No trespassing signs should be posted in conspicuous areas throughout the job site. • List of employees who have after hour access to the property should be available to the BCIC PIU and local authorities. • Ensure work site is properly lighted at night. Well-lit areas should include any office trailers and equipment storage trailers. Floodlights operated by sensors should also be installed where appropriate. • Pre-employment screening investigations should be used to verify the applicants relating to their employment, education and criminal history background.
	Improper security measures may pose security risk for construction workers and especially foreign staff on construction sites.	The Contractor shall: • Prepare site specific security plan. • Maintain register to keep track of number of persons present in the camp at any given time. • Provide appropriate security personnel at job sites as mentioned above. • Ensure proper fencing as mentioned above. • Ensure controlled access points to job site as mentioned above. • Ensure works have easily identified credentials as mentioned above.

Project Activity/ Impact Source	Impacts /Concerns	Mitigation Measures/ Management Guidelines
		• Ensure work sites are properly lighted at night, as mentioned above.
Operation Phase	Vandalism/damage (including use of explosives) of water transmission mains, transfer stations Plant, Gas Pipelines, RMS, control stations and storage reservoirs. Theft of infrastructure (i.e. metals and etc.) is also of concern.	• Patrol Men and Pipeline Community Policing Forum shall routinely conduct patrols and inspections of transmission mains Plant area and facilities. • They shall monitor suspicious activity and notify local authorities and BCIC GPUFP along with VH/GVH/TA's in event of any such occurrence/incident. • Ensure strategic infrastructure sites such as reservoirs RMS, Gas Pipelines, and main Plant transfer stations are secure and fenced with controlled access points. Fencing should be chain-link at least 2.5 m high and secured with a steel chain and lock.

ECP 14: Topography and Landscaping

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Construction activities especially earthworks will change topography and disturb the natural rainwater/flood water drainage as well as change the local landscape.	The Contractor shall • Prepare landscaping and plantation plan and submit the plan to supervision consultant for approval. • Ensure the topography of the final surface of all raised lands (construction yards, approach roads and rails, access roads, etc.) are conducive to enhance natural draining of rainwater/flood water. • Keep the final or finished surface of all the raised lands free from any kind of depression that causes water logging. • Undertake mitigation measures for erosion control/prevention by grass-turfing and tree plantation, where there is a possibility of rain-cut that will change the shape of topography. • Cover immediately the uncovered open surface that has no use of construction activities with grass-cover and tree plantation to prevent soil erosion and better landscaping. • Reinstate the natural landscape of the ancillary construction sites after completion of works.

ECP 15: Air Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Air quality can be adversely affected by vehicle exhaust emissions and combustion of fuels.	The Contractor shall • Prepare air quality management plan (under the Pollution Prevention Plan) and submit the plan for supervision consultant approval. • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner. • Cover hauling vehicles carrying dusty materials moving outside the construction site. • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions. • Control the movement of construction traffic. • Water construction materials prior to loading and transport. • Service all vehicles regularly to minimize emissions. • Limit the idling time of vehicles not more than 2 minutes.
Construction machinery	Air quality can be adversely affected by emissions from machinery and combustion of fuels.	The Contractor shall • Fit machinery with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition in accordance with the specifications defined by their manufacturers to maximize combustion efficiency and minimize the contaminant emissions. Proof of maintenance register shall be required by the equipment suppliers and contractors/subcontractors. • Pay special attention to control emissions from fuel generators. • Machinery causing excessive pollution (e.g., visible smoke) will be banned from construction sites. • Service all equipment regularly to minimize emissions. • Provide filtering systems, dust collectors or humidification or other techniques (as applicable) to the concrete batching and mixing plant to control the particle emissions in all stages, including unloading, collection, aggregate handling, cement application, circulation of trucks and machinery inside the installations.
Construction activities	Dust generation from construction sites, material stockpiles and access roads is a nuisance in the	The Contractor shall • Water the material stockpiles, access roads and bare soils on an as needed basis to minimize the potential for environmental nuisance due to dust. Increase the watering frequency during periods

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	environment and can be a health hazard, and also can affect the adjacent water bodies	of high risk (e.g. high winds). Stored materials such as gravel and sand shall be covered and confined to avoid their being wind-drifted. • Minimize the extent and period of exposure of the bare surfaces. • Restore disturbed areas as soon as practicable by grasses or trees • Store the cement in silos and minimize the emissions from silos by equipping them with filters. • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust generation is minimized during such operations. • Use water as dust suppression in such way that will never produce any liquid waste stream. • Crushing of rock and aggregate materials shall be wet-crushed, or performed with particle emission control systems. • Not permit the burning of solid waste.

ECP 16: Noise and Vibration Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Noise quality will be deteriorated due to vehicular traffic	The Contractor shall • Prepare a noise and vibration management plan (under the Pollution Prevention Plan) and submit the plan for supervision consultant/Owners Engineer (OE) for approval. • Maintain all vehicles in order to keep it in good working condition in accordance with manufactures maintenance procedures. • Make sure all drivers will comply with the traffic codes concerning maximum speed limit, driving hours, etc. • Perform the loading and unloading of trucks, and handling operations minimizing construction noise on the work site.
Construction machinery	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Appropriately organize all noise generating activities to avoid noise pollution to local residents. • Use the quietest available machinery and equipment in construction work. • Maintain all equipment in order to keep them in good working order in accordance with manufactures maintenance procedures. Equipment suppliers and contractors shall present proof of maintenance register of their equipment.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Install acoustic enclosures around generators to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment. • Avoid unnecessary use of alarms, horns and sirens.
Construction activity	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Notify adjacent landholders prior to typical noise events outside of daylight hours. • Educate the operators of construction equipment on potential noise problems and the techniques to minimize noise emissions. • Employ best available work practices on-site to minimize occupational noise levels. • Install temporary noise control barriers where appropriate. • Notify affected people if major noisy activities will be undertaken, e.g. blasting. • Plan activities on site and deliveries to and from site to minimize impact. • Monitor and analyze noise and vibration results and adjust construction practices as required. • Avoid undertaking the noisiest activities, where possible, when working at night near the residential areas.