BANGLADESH ECONOMIC ZONES AUTHORITY (BEZA)

NATIONAL SPECIAL ECONOMIC ZONE DEVELOPMENT PROJECT

CHIEF ADVISER'S OFFICE

Environmental and Social Impact Assessment (ESIA)

for the Gas Pipeline Network in Zone 2A-2B and its adjacent Area of the National Special Economic Zone (NSEZ)

Volume 1: Final Report

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LIST OF ACRONYMS AND ABBREVIATIONS

AOI	Area of Influence
APHA	American Public Health Association
APs	Affected persons
AQ	Air Quality
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCSIR	Bangladesh Council of Scientific and Industrial Research
BECA	Bangladesh Environment Conservation Act
BEPZA	Bangladesh Export Processing Zone Authority
BEZA	Bangladesh Economic Zone Authority
BFD	Bangladesh Forest Department
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BOD	Biological Oxygen Demand
NSEZ	National Special Economic Zone
C-ESMP	Construction Environmental and Social Management Plan
CGS	Central Gas Station
CO_2	Carbon dioxide
CO_2e	Methane mass to carbon dioxide equivalent
COD	Chemical Oxygen Demand
CR	Critically Endangered
DIFE	Department of Inspection for Factories and Establishments
DoE	Department of Environment
DoF	Department of Fisheries
ECA	Ecologically Critical Area
ECC	Environmental Clearance Certificate
ECR 2023	Environment Conservation Rules 2023
EHSO	Environment, Health and Safety Officer
EIA	Environmental Impact Assessment
EMSP	Environmental and Social Management Plan
ERP	Emergency Response Plan
E&S	Environmental and Social
ESIA	Environmental and Social Impact Assessment
ESMoP	Environmental and Social Monitoring Plan
ESSs	Environment and Social Standards
EZs.	Economic Zones
GBV	Gender Based Violence
BFD	Bangladesh Forest Department
GHG	Greenhouse Gas
GOB	Government of Bangladesh
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GSB	Geological Survey of Bangladesh
GTCL	Gas Transmission and Distribution Company Ltd
GW	Groundwater
HIV	Human Immunodeficiency Virus
ICTPs	International Conventions, Treaties, and Protocols
IUCN	International Union for Conservation of Nature
KGDCL	Karnaphuli Gas Distribution Company Ltd
KII	Key Informant Interview

LMP	Labor Management Procedure
LPG	Liquefied Petroleum Gas
MSCFD	Million standard cubic feet per day
MoEFCC	Ministry of Environment, Forest and Climate Change
MoLE	Ministry of labor and employment
MP	Master Plan
MSL	Mean Sea Level
NBSAP	National Biodiversity Strategies and Action Plans
NCS	National Conservation Strategy
NEMAP	National Environment Management Action Plan
NEP	National Environmental Policy
NGOs	Non-Governmental Organizations
NL	Noise Level
NOC	No Objection Certificates
NOx	Oxides of Nitrate
NSEZ	National Special Economic Zone
OHS	Occupational Health and Safety
PAs	Protected Areas
Pb	Lead
PD	Project Director
PIU	Project Implementation Unit
PM	Particulate Matter
PMU	Project Management Unit
PPE	Personal Protective Equipment
PRIDE	Bangladesh Private Investment and Digital Entrepreneurship
RoW	Right of Way
SOx	Oxides of Sulphate
STD	Sexually Transmitted Disease
SW	Surface Water
ToR	Terms of Reference
TSS	Total Suspended Solid

EXECUTIVE SUMMARY

I. PROJECT BACKGROUND

The Government of the People's Republic of Bangladesh (GoB) has received financing from the World Bank (WB) for the implementation of the NSEZ Development Project, a project of Bangladesh Economic Zones Authority (BEZA) under Bangladesh Private Investment and Digital Entrepreneurship (PRIDE) project. As per the Master Plan, many industries, and factories including a couple of gas fired power stations, water treatment plant, road networks, residential areas and other establishments will be developed in NSEZ area, as the sub-project components of the PRIDE project. Construction of Gas Pipeline Network is one of sub-project components. Presently, there is no gas connection in the Zone 2A and 2B, and its adjacent areas of the NSEZ. It is estimated that around 200 million standard cubic feet gas per day (MMSCFD) will be required to the NSEZ areas. Therefore, the Karnaphuli Gas Distribution Company Ltd (KGDCL) is assigned to establish Gas networks in Zone 2A-Zone 2B and its adjacent sites of the NSEZ areas, and a total of 30 km gas pipeline will be established along with other associated installations like District Regulating Station (DRS) and Valve Station (VS) and civil works. The project aims to promote private investments and jobs creation in economic zones with an emphasis on green technology and climate resilience processes.

II. GAS PIPELINE SUB PROJECT COMPONENT

The gas pipe network of 30 km length will cover the construction of a 6 km gas pipeline of 24-inch diameter and 350 psig pressure, construction of 6 km gas pipeline of 16-inch diameter and 350 psig pressure, construction of 13 km gas pipeline of 10-inch diameter and 150 psig pressure, construction of 7 km gas pipeline of 8-inch diameter and 150 psig pressure, construction of River/Khal crossing structures, construction of 5 no. of Valve Stations, construction of 2 nos of HP-DRS and necessary civil works etc.

III. SUB PROJECT LOCATION

The project site is in Mirsharai Upazila of Chattogram district, 12 km west of the national Highway (Dhaka-Chattogram Highway) and 60 km (South) away from Chattogram City. While Mirsharai Railway station is approximately 10.0 km east of the site. In the southern direction, the Shah Amanat International Airport at Chattogram is about 79 km away, and the seaport at Chattogram is situated 67 km to the south of the site. The sluice gate of Feni River / Muhuri River is roughly 9 km west/northwest from the site. The location is positioned at the eastern end of the Bay of Bengal, and a Super Dyke has been built along the western boundary of Zones 2A - 2B to safeguard the site from the flooding during high tide and surges.

IV. OBJECTIVES OF SUBPROJECT

The major objectives of the subproject are to ensure gas supply to meet the demand of a large number of factories, industries and other structures in NSEZ areas as committed by the BEZA for stimulating, and expediting the rapid economic growth in order to foster a greater variety of enterprises, promote industrial output and export promotion, and increase employment generation in the NSEZ areas etc.

V. OBJECTIVE AND SCOPE OF WORKS

The objectives of this subproject are to identify the potential impact on the natural environment (physical and ecological) and social issues due to the construction of a gas pipeline network in the project areas and formulate measures to mitigate or reduce the adverse impacts to an acceptable level during construction of Gas Pipelines to ensure the sustainable development of the Gas pipeline network subproject.

The scope of works includes a collection of the relevant information on physiography, geology climate, topography, drainage, soil characteristics, hydrology and water resources, air quality, noise level, soil & sediment quality water quality, flora and fauna as well as socioeconomic condition the study area to establish the baseline conditions of the sub-project site. Preparation of an ESIA report describing the potential environmental and social impacts, and mitigating the impacts to lessen or avoid the anticipated impacts.

This ESIA report is prepared based on field investigations (natural environmental and socioeconomic study) and stakeholder consultations that have been carried out and integrated into the environmental impact assessment process. Secondary data was also collected from the BEZA, KGDCL, GTCL, BBS, BMD, IUCN, BFD, DOE and other relevant reports, journals, articles etc. The significance of impacts from the proposed project were then assessed and for those impacts requiring mitigations, possible measures projected to reduce or avoid impacts to within acceptable limits as per local and international applicable regulations. A detailed environmental and social management and monitoring plan was also developed to warrant compliance requirements of the World Bank safeguard during the project implementation. The AOI under the scope of study was considered 10 km radius

from the project site, considering air quality, noise, water, and biodiversity impacts, and discussions with the local community and other stakeholders etc.

VI. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The sub project on gas pipeline network development in Zones 2A and 2B will be implemented in compliance with applicable environmental and social laws and regulations of the GoB and World Bank (WB). In the ESIA study the relevant national, international, and World Bank's Environmental and Social Standards (ESS-1 to ESS-10) under ESF 2018 were followed. The national environmental conservation acts, laws and policies such as ECA, 1995, ECR 1997 (amended in 2023), Labor Act 2006 (amended in 2013) etc. relevant to the gas pipeline sub project were reviewed. In addition, the relevant national and international laws and regulations on environmental protection, biodiversity conservation, linking with WB ESF reviewed and Gap Analysis between national and WB ESF took part within the project activities as a holistic approach. However, the sub project consists the construction gas pipeline supply network of 30 km length, which fall under Red Category as per ECR, 2023, Schedule 1 Item 67. Given the nature and scale, potential environmental and social risk and impacts, the sub-project has been categorized as "Substantial Risk" in accordance with the WB ESF.

VII. DESCRIPTION OF EXISTING ENVIRONMENT

Physical Environment:

The project site falls under the Chittagong coastal plain physiographic unit. The soil of the subproject area is mainly formed from recent alluvial sediments, mainly, Grey Piedmont soils, & Calcareous Alluvium Soils. The geology of the project area can generally be classified as sedimentary with limestone including metamorphic rocks such as travertine. The site is close to the Sandwip channel and covered with clay and sand deposits. The land resource includes the overall project's area is approximately 19.65 sq km, of which 1.04 sq km are highland and 6.14 sq km are low land (or 4% of the total). Most of the project's area of 26% of the total area, is flat ground. A proposed road would make up 1.75 sq km, or 4% of the total area; pond would make up less than 1% of the space of 0.01 sq km, and canal (khal) would make up 0.62 sq km, or 1%.

The general hydrology of the study area comprised three canals (khal) such as Ichakhali khal, Daborkhali khal and Bamonsundar khal. Located in project study area, lies in the flood plain of Feni River. The Ichakhali khal passes within the project area Zone 2A and Zone 2B and the shallow aquifer of about 20-50m thickness exists near the surface. Aquifers are semi-confined to confine in nature. To determine the baseline quality of the surface water, four water samples collected. Of them, three (3) were from the canals and 1 (one) from the pond surface water were analyzed on chemical and biological parameters and such as DO, TDS, TSS ,EC, Turbidity, pH, Salinity, COD, BOD, Hg, Pb, Cd, Oil and Grease, FC, TC. The tested water quality parameters were compared against the standard values set in ECR, 2023, Schedule 3 2 (A). (a) Following the best standard practices in Bangladesh. The results showed that most of the parameters complied with the national standard, while some parameters do not comply. The physical and chemical properties of all water samples, except TDS of Bamonsundar (SW1) and Daborkhali (SW 2) waters were within the permissible limit. The tested results show the salinity of the Bamonsundor, Daborkhali, and Ichakhali were 2.1 ppt, 1.4ppt, and less than 0.1 ppt, respectively. Even the salinity concentration of the pond water was 0.2 ppt. Saline water of Sandwip channel connected with sea entrance into the canals that control by the sluice/ regulators, and due to lack of proper maintenance the sea water entrenches into the canals and mix with fresh water. As a results, the water in these canals varies from fresh to brackish,

The tested groundwater parameters of the collected three samples have been compared with ECR, 2023, Schedule 2 (B) and found that the TDS in near CP More tube well (GW3) exceeded the national ECR 2023 standard, as well as turbidity and the number of EC of the GW3 water also surpassed the limit. Furthermore, the iron concentration in all samples slightly exceeds the standard set by the ECR. Nevertheless, other parameters indicate water quality suitable for the drinking purpose.

The sub-project area located in Mirsharai Upazila, experiences a humid subtropical climate, marked by substantial fluctuations between summer and winter temperatures. The Sitakunda Meteorological station recorded data during 10 years period 2013-2022 are considered for the study area, which is closest distance from the study area. The average minimum and maximum temperature were 12.28°C & 32.94 °C, respectively. The average monthly rainfall was 898.5 mm during July. Monthly normal relative humidity in the project area varies between 72% in February and 87% in July. Cyclone Risk Zone Map of the coastal areas of Bangladesh indicates that, the project site is in the high-risk area of Bangladesh. There are erosion problems in the project site area. However, super dike and embankments are protecting the EZ from erosion and inundation.

In the ESIA study, the ambient air quality, noise level and vibration measurement results show that the air quality parameter PM_{10} and $PM_{2.5}$ did not cross the standard limit set by the Air Pollution (Control) Rules 2022. Also, NOx, O_3, CO, SO_2 within the limit of ECR 2023 standards. Noise and vibration levels in the study areas, both during the day and night, conform to the standards outlined in the Noise Pollution Control Rules of 2006.

Ecological Environment

The study area contains different types of habitat and landforms and ecosystems, including mangrove forest, mudflat, offshore, salt pan, cropland, freshwater aquaculture pond, sea beach, settlements, rivers, and so on. Terrestrial ecosystems are categorized based on their habitat. Each habitat supports various plant species and maximum plant species were identified in the study areas, and confirmed by close photographs of flowers, leaves, and stems and/or fertile specimens of leaves, stems and roots were collected through quadrat survey. However, implementation of this sub-project will not affect any forest, protected areas and trees, except some vegetations. There is no sensitive area such as ECAs, PAs, national parks or biological hotspot i.e., game reserve, wildlife sanctuary etc., in or around the proposed subproject sites. However, no Dolphine observed and also not reported in the Sandwip Channel during field survey, and the spotted deer observed in the Charsoroti mangrove area which is far away from the 2A and 2B Zones and sub project works will not harm them. Fish resources are limited, particularly in the Ichakhali, Daborkhali and Bamonsundar khals. No fish available in these waterbodies, since surface water in these canals changes from fresh water to brackish, and also khals are mostly dried up.

Social baseline conditions

To assess the present social baseline condition, a total 112 HHs have been surveyed as sample basis in the study area those who are living outside the NSEZ premises but close nearby. The surveyed population was 491and their average HH size 4.38%. Distribution of sample by gender and age group were 20.57% under 21 to 30 ages followed by 15.89% under 30-40 ages and so on. Total population aged in between 0-14 and aged above 65 years constitute about 34.22% HHs who apparently are dependent on the rest 65.78% members of the same HHs. Thus, the dependency ratio comes around 52.01%. About 56.70%of total male and 34.43% of female are fully employed. In response to a question whether they know about Sexually Transmitted Diseases (STD), 23.08% women reported to have heard of HIV/AIDS and about 7.69% claimed to be aware of the reasons for spreading HIV/AIDS. About 98.21% of the respondents believe that migrant workers will come here for work in BEZA to fill the labor shortage. Local market, businessman and shop owners will also be benefited from the construction activity as a considerable number of manpower will engage in this project. About 95.54% of respondents said that local business will be improved for the NSEZ project. About 97.32% of people believe that the project will improve livelihood facilities of the people living surrounding project site.

VIII. ANALYSIS OF ALTERNATIVES

Alternative analysis is carried out considering three options in terms of different gas pipeline alignments, obstacles, crossing of the water body, methods of pipeline installation. The technological issues are also considered, such as methods of pipeline installation as open cut method and horizontal directional drilling method (HDD) method, etc. Three options studied for this analysis are i) proposed designed gas pipeline network; ii) new alignment as Alternative-1, and iii) another new alignment as Alternative-2. The impacts in terms of the physical environment, ecological, including social environments, and construction cost for each option have been evaluated. A detailed comparison and evaluation of the three options based on Leopold Matrix, the proposed gas pipeline network alignment was found highest Environmental Impact Value than the other two alternatives and can be concluded as the best option, more viable and as well as less economical cost for the construction gas supply network in Zones 2A-2B and its adjacent areas, NSEZ.

Without Project scenario: Presently no gas connection is in the Zones 2A and 2B and its adjacent areas. As per Master Plan, gas will be required for 1200 customers to operate the industries in the sub-project area and the NSEZ committed to provide the gas facilities at the site. If 'No Project' is chosen, no benefits, such as no gas supplies to the industries in the national special economic zone will be expected. Industrial output will be restricted without this sub-project, and the ultimate goal will not be met. It is stated that the 'Without Project' alternative is undesirable, and that the potential socioeconomic benefits of carrying out this sub project far outweigh the government's ultimate goals of increasing employment opportunities and economic growth in order to achieve the status of a medium-income country.

VIX. STAKEHOLDERS ENGAGEMENT AND DISCLOSURE PROCEDURES

A combination of mixed methods of information disclosure and consultation process was adopted at this stage of ESIA preparation. The method selected for consultation was designed keeping in mind the profile of the stakeholders, type of information desired and the level of engagement required. Nineteen KIIs, seven FGDs and one Stakeholder Consultation Meeting were conducted. The KIIs were conducted with the key Government agencies, like official of BEZA, KGDC, BEPZA, DPHE, DoF, BWDB, BREB, Mirsharai BIWTA, DIFE, DOE Mirsharai Upazila Parishad etc., and, local community and elites. One out of seven FGDs was women group and other were different groups of project impacted people focusing on information and environmental and risks and social issues due to the construction of gas pipelines networks and in operation. The 64 participants (54 males and 10 females) of FGDs provided feedback/suggestions and their expectations to mitigate the impacts. All participants expressed their appreciation towards the implementation of the sub-project. They opined that, the

project will bring positive impact on local communities as well as regional level, for example, opportunities of increased employment during construction works, development of communication system, development of a business, the overall the quality of life will be improved. The participants raised their concerns about environmental and social issues such as pollution and risky from the construction activities. The participants' concerns were regarding occupational and public health and safety, as well as infectious diseases caused by the number of workers (30-40 local and migrant labors) etc., at the construction sites. During construction period, migrant workers will come from different areas of nearby districts. So, there is also possibility of sexual harassment due to labor influx and they will create additional burden in the area, because of migrants need food, shelter, school, medical facilities and market facilities.

X. POTENTIAL IMPACTS AND MITIGATION MEASURES

Environmental and social impacts and mitigation measures for the pre-construction, construction, and operation & maintenance stages are summarized as follows;

Pre-Construction and Construction Phase

Impacts related to ESS-1: Assessment and Management of Environmental and social Risks: Vulnerable to land use-trenching, excavation, and trench filling after digging the gas pipeline will cause erosion of the slope, but the effect will not be significant if proper mitigations measures are undertaken at the sites such as using backhoe, ripper or other approved technique, ditch shall provide minimum cover (1.22 meter) from the top of the pipe surface to the original or final ground surface, contractor shall provide additional cover to meet special construction requirements contained in right of way and permit conditions and prior to lowering-in, any loose rock, debris, metal of any kind and hard objects shall be removed from the ditch etc. can help to minimize the impacts to land use pattern in the project areas.

Impacts related to ESS-2: Labor and Working Conditions: The health and safety of the workers, who may be vulnerable to infectious diseases like HIV/AIDS and other contagious diseases, due to the influx of workers (about 30 to 40) at the project locations. To protect the health and safety of the workers, the sites should include a drinking water supply, toolbox meetings, and sanitary facilities for all employees, and female restrooms for female personnel and appropriate PPE (Hard boots, life vest, safety goggles, and hand gloves) for all etc. Workers should be provided with on-the-job training on OHS issues to reduce or avoid this anticipated risk.

Employment opportunities: employment opportunities will occur at the site both for skilled and unskilled workers. It is suggested to recruit at least 30% of local people and ensuring non-discriminated wages for all at the sites.

Labor camp and Construction camp establishment: The surface water contamination, drainage congestion, fire and electrical hazards, and traffic accidents are among potential health risks associated with the formation of labor and construction camps. One sanitary toilet for 15 people, bathing and urinal facilities, labor camps inside project sites, and accommodations with enough ventilation and decent housekeeping are all necessary to lessen these effects. Construction camps should be kept at least 500 meters from neighboring homes and one kilometer from water supplies.

Occupational Health and Safety: The site's clearance, base camp selection, RoW (right of way), and heavy vehicle traffic for the delivery of materials supplies at the project locations will all put OHS at risk. During construction, workers will face health risks from trenching, excavation, pipe laying, moving heavy equipment and materials, grading, stringing, coatings, and wrapping, among other tasks. The implementation of hard barricades, safety signage, portable restrooms and drinking water facilities, toolbox meetings, on-the-job safety trainings, accident-incidental records, emergency contact numbers, emergency vehicles, the use of forklifts and cranes for material handling, the insulation of electrical conductors with glass, rubber, or plastic, and appropriate PPE are all necessary to protect the health and safety of the workers.

Gender Based Violence (GBV): The risks of sexual exploitation, abuse, and harassment (SH) as well as gender-based violence (GBV) will arise from the influx of workers at the site. Low pay for female employees is also a regular occurrence at construction sites. In order to address this issue, it is necessary to inform the workers about national laws and regulations, have them sign a Worker Code of Conduct as part of their employment contract, include penalties for non-compliance (such as termination), and notify the local law enforcement agency of any incidents that may occur at the sites. In addition, to avoid the GBV the PIU will consider the Gender Action of PRIDE project. a grievance mechanism on potential GBV/SEA/SH cases under the guidance of the Project PIU and shall take into account in submitting bid the provisions for service providers in case of potential GBV victims/cases.

Child Labor and Force Labor: Child labor will occur at the sites as a result of low pay and being forced to work longer hours. Therefore, it should be strictly prohibited for anyone under the age of 18 to work there in order to prevent child labor. Following the Labor Rules 2015 if child labor occurs, it should be penalized. Although force

labor is not permitted on construction sites, it may happen there owing to unforeseen construction schedules. The PIU will implement the LMP of the PRIDE proejct to avoid child and force labor.

Impacts related to ESS-3: Resource efficiency and Pollution: **Air pollution; the pollution** will occur due to site preparation, construction works, earth filling, stack yards and labour shed construction, grading and movement of vehicles etc. The PIU will ensure that all vehicles and machines comply with technical and environmental safety regulation. Schedule the operation times for vehicles, machines working in the construction area to reduce air emissions. The contractor shall maintain an inventory of the number, type and location of all stationary emission sources within the boundary of the construction site during the period of construction. The Contractor shall restrict all vehicles on the Site to a maximum speed of 15-20 km/hr. km per hour and confine haulage and delivery vehicles to designated roadways inside the site The PIU will implement suggested mitigation measure in the chapter 7 and the best practice guidance note to avoid the pollution.

Noise Pollution: The operation of trucks and equipment during site preparation, earthwork, stack yards and labor shed construction, delivery of construction materials, excavation, trenching, wielding, pipe laying etc., can all result in noise pollution. In order to prevent, construction works should only be done during the day, and vehicles should not exceed 15 to 20 km/h. Make sure the motor engine and construction equipment have the appropriate mufflers and silencers, padding or noise isolators, and low-noise machines. Employees should also wear earplugs when working in areas that produce a lot of noise.

Water Pollution: Sewage and wastewater from labor camps, dumping of wet soil, effluent disposal, construction waste etc., can contaminate water resources. Toilets with septic tanks or sanitary pits must be provided by the contractor in order to minimize water pollution; overflows from storage tanks to surface water drains are not allowed. Cement, glues, diesel, and oil, paint, other hazardous chemicals, etc., must be handled carefully and all drains must be covered.

Soil Pollution: The disposal of solid and liquid waste from construction activities, heavy machinery operation, oil spills, etc., can all damage soil and sediment. Storage spaces for fuel, lubricating oil, and used oil shall be located in the assigned area. The contractor is responsible for making sure that construction trash, debris, oil, gasoline spills, used oil, etc. are collected and disposed of every day. In the trenching and excavated sites, sandbags can be employed to more efficiently capture sediments, and only designated haul routes would be utilized for transportation

Impacts related to ESS-4: Community Health and Safety: **Community health and safety**: Heavy vehicle traffic, excessive noise production, dust emissions, traffic accidents, trenching, excavation, backfilling, pipe laying, wielding, and other activities will put the health and safety of the community at risk. To reduce this anticipated risk, site security must be maintained, information about construction activity must be communicated, and a boundary fence (at least two meters high) must be erected around the working area. Signage and safety markers will be installed across the site by the contractor following the engineer's directions for sign location and size. Communicable diseases can spread among the local community from the influx of construction workers due to improper management of construction camp, which should be controlled by the contractor.

Utilities, Traffic and Transport: Utility shifting may cause disruptions, obstruct pedestrian access roads, endanger public and occupational safety, and result in accidents as a result of excavators, pay loaders, graders, and dump trucks moving about. Drivers must get defensive driving instruction and cars must be properly maintained in order to reduce these expected effects. Construction vehicles should be moved during off-peak hours, diversion roads should be established, traffic signs and cautionary signs should be placed to prevent excessive traffic congestion, flagmen should be outfitted with red and green flags and an illuminating vest at night, especially near intersections, etc.The contractor will develop the traffic management plan in line the chapter 7 and PIU will implemnt it accordingly.

Hazardous and Non-hazardous Waste: The Project will generate both non-hazardous and hazardous wastes such as excavated material, broken aggregates, solid trash, filling materials, wastewater, etc. are examples of non-hazardous waste, and hazardous waste like discarded batteries, empty drums, or replaced parts of construction equipment. The contractor must supply enough containers for the temporary storage of solid waste and liquid waste including distinct containers for hazardous and non-hazardous wastes, and they must be properly labeled in order to lessen the expected impact. E-waste and hazardous garbage should be gathered in steel drums and containers, kept in a separate roofed location, and disposed of at authorized waste disposal facilities on a regular basis

Impacts related to ESS-6: Biodiversity Conservation and Sustainable Management of Living Natural Resources: Terrestrial and Aquatic ecology: The proposed project sites will not cover any protected areas, or ecologically sensitive areas. No trees will be affected by the construction activities except some bush types of vegetation. The project has limited impacts to aquatic biodiversity during crossing the canal and ditches and low-lying areas etc. However, to lessen the effects on biodiversity, bubble curtains or creation of agitation in water

should be carried out prior carrying out the construction to provide avoidance time and let the species move away from crossing point and to prevent any injury/mortality. Contractors should submit SOPs and action time charts with risk management plan prior to any construction work.

Impacts related to ESS-10: Stakeholder consultations: It should be regularly held with the project affected people, workers and local community to avoid social conflict and strengthening the environmentally friendly project implementation.

Operation and Maintenance Period:

Impacts related to ESS-2: Labor and Working Conditions: Occupational health and safety: During the operation period, occupational health and safety will be affected by the gas pipe leakage, fire and explosions but to avoid this anticipated impact, maintenance like checking, re-testing of gas pipeline should be carried out regularly and if leakage found, immediately shut down the gas supply and repairing the line as early as possible etc. Regular emergency exercises are required to increase preparedness by ensuring that responders are properly equipped and trained for rescue and firefighting duties and that the rescue and evacuation plan is implemented. To ensure quick action, it is vital to make sure that communication lines are open. Fire extinguishers and fireballs and other latest technology should be accessible at the site and capacitate the workers to use this equipment during fire events and explosion etc.

Impacts related to ESS-3: Resource Efficiency, Pollution prevention and Management: Noise and Vibration**:** The valve stations, and others pipeline facilities can produce excessive noise, affecting the local terrestrial ecosystem and human health. Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less than 90 dB (A). Workers in the vicinity of high noise levels will be provided earplugs, to prevent prolonged exposure to noise levels of more than 90dB (A) per 8-hour shift.

Air Pollution: Air pollutants such as VOCs, NOx, and PM may be released from the gas pipeline operation, RMS operation and maintenance such as pipeline pigging, fire and explosions, gas pipeline leaks etc. These pollutants can significantly contribute to deteriorating the local air quality and affecting human health and natural environments. To mitigate this problem, implement regular maintenance and inspection schedules, develop and practice emergency response plans, provide personnel with the necessary training on handling pipeline leaks, install fire and explosion detection systems, implement automatic fire suppression systems, create evacuation plans for nearby areas, strengthen coordination with local fire departments for rapid response, and use advanced leak detection systems for early identification and the installation of automatic shut-off valves to minimize gas release in the event of a leak..

Impacts related to ESS-4: Community Health and Safety: Community health and safety**:** The community and workers Health and Safety (OHS) will be affected by pipeline ruptures, equipment failures, spillage accidents etc., In addition, gas pipe leakage can occur caused faulty construction, damage from excavation equipment or corrosion can also affect the community and worker**s** health and safety in the working areas. Gas leaks can contribute to accumulation of gas that will ignite easily and cause fire accidents or explosions. To avoid this anticipated impact, maintenance like checking, re-testing of gas pipeline should be carried out regularly and if leakage found, immediately shut down the gas supply and repairing the line as early as possible etc.

It is necessary to establish strict evacuation protocols and safety zones. Ensure responders have the appropriate tools and training for fires, increase preparedness, and provide workers with the appropriate personal protective equipment (PPE), such as breathing protection and flame-resistant clothes, fighting and performing rescues, regularly practicing emergency response, and putting rescue and evacuation strategies into action keep lines of communication open to facilitate quick action, offer psychological support and counseling to those affected, and ensure that workers have access to fire extinguishers, fireballs, and other state-of-the-art tools on the job site so they can use them in the event of an explosion, fire, etc.

Traffic and transport: Emergency response activities, road closures, and evacuation procedures can lead to significant disruptions in traffic flow, potentially causing delays and congestion. Smoke, flames, or hazardous materials released during a pipeline incident can reduce visibility on roads, increasing the risk of accidents. To reduce this impact, maintain liaison with local traffic department and share the project traffic management plan for their information.

XI. ENVIRONMENTAL AND SOCIAL MNAGEMENT PLAN AND MONITORING PLAN

The ESMP, an integral part of this ESIA, was developed, defining the actions required for addressing the environmental and social impacts and issues, including a description of when, where and by whom the mitigative actions are to be implemented and the monitoring follow-up completed. The ESIA identified mitigative actions needing to be addressed during the pre-construction, construction and operating phases of the sub-project as presented in **Table 8-1,** such as the adverse impacts from the trenching, excavation, and trench filling after digging

the gas pipeline, erosion of the slope, influx of labor, involvement child labor, movement of heavy equipment and vehicles, labor base camp, gender-based violence, disturbance of local communities, etc. To track the mitigation, work an air, noise and surface water quality monitoring program will be started in every quarter during the construction period and also during the operating period throughout the contractor's "Defect Notification Period" as shown in **Table 8-2**. The cost for implementing the ESMP was estimated and this budget (19.39 Million BDT) will form part of the total Project budget as an environmental specification in the bidding documents including the specific environmental BOQ items.

Institutional Arrangement: The environmental and social management will be carried out under the direct supervision of the Project Management Unit (PMU) of NSEZ and oversee the contractor works, The BEZA has appointed a Design and Supervision Consultant (DSC) and their qualified Environmental and Social specialists will daily monitor the contractors' activities in compliance of the ESMP and ESMoP and review the contractor's prepared report on the implementation of the ESMP and will also ensure ESMP, and ESMoP are duly implemented during the Pre-Construction and Construction Periods. For effective implementation of Gas Pipeline sub project, a third-party consulting firm may be hired by the BEZA/Contractors to evaluate the contractor's overall performance independently in complying with the provisions of the ESMP as well as for satisfactory compliance with the World Bank's E&S framework and DoE requirement. Under the PIU, PRIDE project will be selected Contractor by proper international bidding as turnkey contract to develop the Gas Network System in Zone 2A- 2B. About 30 months would be required to accomplish the project by the Contractor. Engagement of contractors to complete the work and supervision and payment to contractors will be carried out by the KGDCL on behalf of BEZA. Before construction works begin, the Contractor (s) will prepare the C-ESMP in accordance with the environmental and social specifications and EHS specialist of the contractor who will be assigned to implement the ESMP following their site-specific C-ESMP. .This will include the environmental and social code of practices as well as the labor management, waste, and traffic management plans; occupational health and safety; spill, and drainage management plans; tree planting, and greenery plans. For the purpose of addressing labor rights and other relevant matters, the C-ESMP will adhere to the NSEZ labor management plan. Throughout the Construction and Operation Period, PIU-BEZA will assume greater accountability for the social and environmental challenges.

1. INTRODUCTION

1.1. BACKGROUND OF THE PROJECT

1. The Government of Bangladesh (hereinafter referred to as GoB) has development plan that; Bangladesh will become a developed country within next 20 years , and has been promoting its industrialization policy with medium to long-term goals. The economic development as one of its foremost priorities, the GoB has been working on the development of the Economic Zones in Bangladesh and the NSEZ is the priority economic zone in the country. These efforts have been coupled with the further promotion and diversification of exports, as well as the improvement of infrastructure and employment generation.

2. The Government of Bangladesh has received financing from the World Bank (WB) for the implementation of the NSEZ Development Project, under the Bangladesh Private Investment and Digital Entrepreneurship (PRIDE) project. As part of the several components of the PRIDE project (Component 1-3), Component 2 of the project will support the phased development of NSEZ Green Industrial City based on Master Plan of BEZA. The PRIDE would provide support for the construction of some basic infrastructures (such as internal road network, gas pipeline connection, water supply, boundary wall, sewer and storm drainage system, central effluent treatment plant (CETP), Desalination Plant, Solar Power, and environment-friendly green Economic Zone etc. Amongst the different infrastructures, the development Construction of Gas Pipeline in zones 2A- 2B and its adjacent areas of NSEZ at Mirsarai Chattogram is one of the Sub-Project, which will be undertaken to expand gas distribution network to meet customer demands as 350 psig and 150 psig pipe networks. The sub project is financed by the BEZA through the World Bank.

3. The NSEZ with an area of around 33,800 acres located in Mirsharai Upazilla of Chattogram district and Sonagazi Upazilla of Feni district that includes approximately 1,450 acres of land under Zone 2A & zone 2B of the NSEZ areas. Most of the plots under the both zones have been allocated to private investors by the BEZA. According to the Master Plan (MP), approximately 584.9 million standard cubic feet gas per day (MSCFD) is required to meet the demand of a large number of factories, industries, gas-based power stations, and other establishments in NSEZ, which will cover approximately 1200 customers in order to run the industry in NSEZ. To ensure gas connections and supply in the industries of NSEZ, the Karnaphuli Gas Distribution Company Ltd (KGDCL) is assigned to build a gas pipeline network, as well as other related infrastructure, at the project sites. It has already established a Central Gas Station (CGS) in Barotakia (Mirsharai) to connect the projected gas network to the project areas. The site will receive natural gas supply from Bakhrabad-Chattogram Transmission Line through Noapara CGS and two district regulating stations (Ichakhali Village and Char Sadar Bangla Bazar village.

1.2. IMPORTANCE FOR THE SUB-PROJECT

4. The NSEZ area is very potential due to its strategic location. The NSEZ Development Project is considered rational due to several key reasons like economic advancement, infrastructure enhancement, industrial diversification, regional progress, foreign investment attraction, etc. The, development project is essential for driving economic growth by improving infrastructure and diversifying industries, and attracting foreign investment in Bangladesh as well national investors. Recognizing the pivotal role of robust infrastructure in supporting industrial activities, the sub-project emphasizes investing in essential infrastructure element such as gas supply, where gas supply provision does not exist.

5. The main importance of the Gas Pipeline network development is to supply the gas to all investors in the NSEZ, as committed by the BEZA for stimulating rapid economic development by promoting increased and diversified industries, generating employment, and enhancing production and exports.

1.3. OBJECTIVES OF SUB-PROJECT

6. The major objectives of the subproject are to ensure gas supply to meet the demand of a large number of factories, industries and other structures in NSEZ areas, expedite economic growth in order to foster a greater variety of enterprises, promote industrial output and export promotion, and increase employment generation in the NSEZ areas etc.

1.4. OBJECTIVE OF THE ESIA STUDY

7. The objective of the ESIA to identify and evaluate the potential environmental and social impacts associated with the proposed construction of the Gas Pipeline network in Zone 2A and Zone 2B of the NSEZ and its adjacent areas. To formulate the possible mitigation measures to lessen or avoid the anticipated adverse impacts following the World Bank Environmental and Social Standards (ESS) Guidelines and the Bangladesh Environmental Conservation Rule (ECR) 2023 and other applicable rules and regulations. The ESIA has four basic objectives; (i) identify the valued components (VCs) including environmental and social issues that should be taken

into account due to gas pipeline construction activities; (ii) establish baseline condition of thes study area, iii) alteternative analysis of the proposed gas pipeline alignment networks, iv) determine the magnitude of potential environmental and social concerns and to ensure that environmental considerations are given adequate weight at preconstruction, construction and operation phases of the Gas pipeline network in the Zone 2A and Zone 2B. (iii) mitigation measures formulation against the adverse impacts with budgetary for compensation measures; iv) suggest enhancement measures, if any.

1.5. SCOPE OF THE STUDY

8. The Consultant's Scope of Work for this sub project covers to carry out a detail environmental and social impact study (ESIA) for the Gas Pipeline networks as follows

- Conducting Environmental and Social screening (ES) and Identifying ES risks;
- Identifying the Valued Components (VCs) which might be impacted due to project implementation on Environmental and Social environment;
- Collecting and updating the Environmental Baseline Conditions that includes ambient air quality, noise and vibration level, surface water quality, soil and sediment quality, and identifying the types of habitats that could be at dangers and the effects on the ecological conditions;
- Assessing the socio-economic conditions of the project sites and conducting stakeholder consultation meetings with stakeholders at various levels including project affected peoples, governmental agencies, private organizations, and non-governmental organizations etc., and other instruments.
- Carry out a detailed Environmental and Social Impact Assessments (ESIA) & prepare Environmental and Social Management Plan (ESMP), monitoring plan with budgetary allocation for the implementation of ESMP
- To prepare Occupational Health and Safety (OHS) Management Plan and other important plans for all the proposed activities;
- To prepare Environment and Social (ES) specification to be included in the contractors'/suppliers' bidding documents for all the contract packages;

1.6. THE PROJECT PROPONENT

9. The Bangladesh Economic Zone Authority under the Chief Advisors Office. is responsible for the construction and operation all economic zones in Bangladesh. As an implementing agency, the BMSSN is accountable for the environmental and social assessments (EISAs) with formulating mitigation measures and environmental and social management plan (ESMP) for this Gas Pipeline Network in Zone 2A and Zone 2B in NSEZ areas in Mirsharai Upazila in Chattogram district. In this regards, the project proponent has appointed the BCL Associated Limited as the Consultant for the Environmental and Social Consultancy Services PMC-16-NSEZ-BEZA on 24 August 2023. The Consultant's one of Scope of Works is preparation of this ESIA report for this proposed Gas Pipeline Network sub project of the NSEZ.

10. The address of the project proponent is as follows: **Project Director**, NSEZ Development Project, Bangladesh PRIDE (P170688) BEZA, Biniyog Bhaban (Level 9), Plot#E-6/B, West Agargaon, Dhaka 1207, Bangladesh.

1.7. APPROACH AND METHODOLOGY

11. The environmental and social assessment was carried out by field investigations; analytical testing and stakeholder consultations following the ECR 2023 and World Bank Environment and Social Standards (ESSs), 2018. In addition, the relevant reports and the legal requirements for the project were also reviewed.

12. The ESIA study of the proposed sub-project has adhered to the sequence of events depicted in **Figure 1-1**. The following sections provide descriptions of the tasks performed at each stage of the ESIA process.

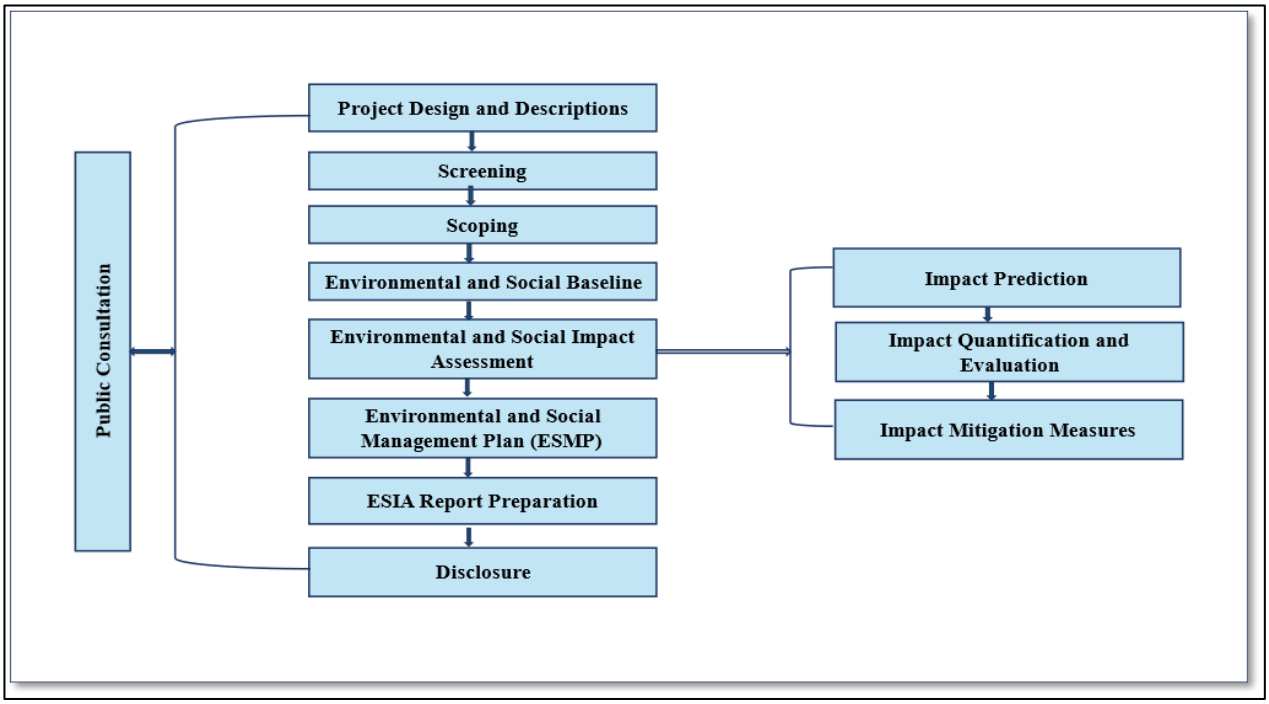


Figure 1-1: Steps of Environmental and Social Impact Assessment

Step-1: Sub-project design and description

13. Physical interventions in human and natural systems can have an impact on the environment, hence while doing the ESIA, it is crucial to comprehend the proposed interventions. The ESIA team obtained comprehensive information about the project design from the Project Implementing Unit (PIU) of the BEZA, Mirsharai, which allowed them to gain a full knowledge of the proposed interventions and associated potential environmental and social effects.

Step-2: Screening

14. The screening process was mainly:

- Desk review of pertinent documents and information of the project site and its surrounding areas;
- Reconnaissance survey of the site, surrounding areas, approach road, and initial conversations with local stakeholders;
- Conversations with the Department of Environment (DoE), Bangladesh Forest Department (BFD), BEZA, Department of Fire Service and Civil Defense, Department of Inspection for factories and establishments (DIFE), Department of Explosives, Karnaphuli Gas Distribution Company Ltd (KGDCL) etc., to stay up to date on regulatory requirements, and other details;
- Results of screening to identify the study area, important data to be gathered, and project categorization;
- A preliminary mapping of stakeholders to identify important stakeholders from the local, levels of the community, government, and pertinent government agencies and non-governmental organizations (NGOs). The project will use this information for consultation at various points in time.

Step-3: Scoping

- Discussion with BEZA, KGDCL and others relevant stakeholders are used for defining scopes for the impact assessment;
- Planning and implementation of mitigation and monitoring;
- Reporting for the project that will satisfy the World Bank, Government of Bangladesh (GoB), and BEZA requirements;
- In accordance with the Environmental Conservation Rule 2023 (ECR 2023) and the World Bank's Environmental and Social Framework , 2018, and Environmental and Social Standards (ESS-1 to 10) are considered based on the type, scale, and working methods of the sub- project;
- Consultations with the primary and secondary stakeholders etc.;
- Identification of the Valued Components (VCs) including environmental and social components (ESVC) for analysis of the environmental and social impacts. The VCs, which means specific physical environment, ecological, economic, and social attributes that may be potentially impacted by the proposed project activities

and that were assessed based on baseline environmental and social conditions with associated proposed sub -project activities.

Step-4: Environmental and social baseline

15. The environmental and social baseline information was collected based on the VCs. Sub-project activity areas are considered as core areas and the remaining study areas as buffer zones. Likely impacts and risks in the context of the project's Area of Influence (AoI), a 10 km buffer zone around the NSEZ has been considered as an AOI of the sub-project site for establishment of the baseline condition. The project's AOI covers the project site and nearby areas where project activities could have an impact directly and indirectly to the receptors (**Figure 1-2**).

16. The study area occupied various types of physical environmental setting , ecosystems such as vegetation, roadside vegetation and low-lying wetlands and social aspects such as rural settlements. The project's area of influence encompasses (i) the primary project site (s) and related facilities (ii) associated facilities whose viability and existence depend exclusively on the project (iii) areas and communities potentially affected directly or indirectly by the project activities.

- Baseline Data Collection

Environmental baseline data are gathered by primary baseline surveys and supplemented with secondary data as available. The primary data on air, noise and vibration levels, surface and groundwater quality and soil quality were collected and analyzed in the renowned laboratories.

- Direct Observation

Direct observations of the presence and diversity of flora and wildlife are available. In addition to direct sightings, animal activity is detected by tracks, footprints, feeding signals, and calls. This exercise often employed suitable field guides and data forms to ensure that information is appropriately recorded.

- Interviews with Locals

Many mammalians and reptilian species are cryptic and unlikely to be discovered by traditional field sampling methods. During the field survey, detailed interviews with local inhabitants are conducted to collect information on animal and plant existence, such as occurrences, behavior, breeding, distribution, and seasonal appearance.

- Socio-economic Data Collection

Socioeconomic evaluation is conducted following the semi-structured questionnaire by HHs survey on a random basis or using relevant statistical formulas.

- Stakeholders Engagement

Several small group meetings, primarily focus group discussions (FGDs), are held during data collection, followed by public consultation meetings (PCMs) during baseline data collection. However, during the socioeconomic baseline survey, some interviews with local inhabitants are conducted on environmental and social issues, as well as the status of the gender violence issues in the study area.

- GIS Mapping

In the ESIA study, GIS-based maps of existing physiography, land use and other are prepared using the most recent cloud-free Landsat 7 ETM+ satellite imagery and confirmed with high-resolution Google Earth pictures

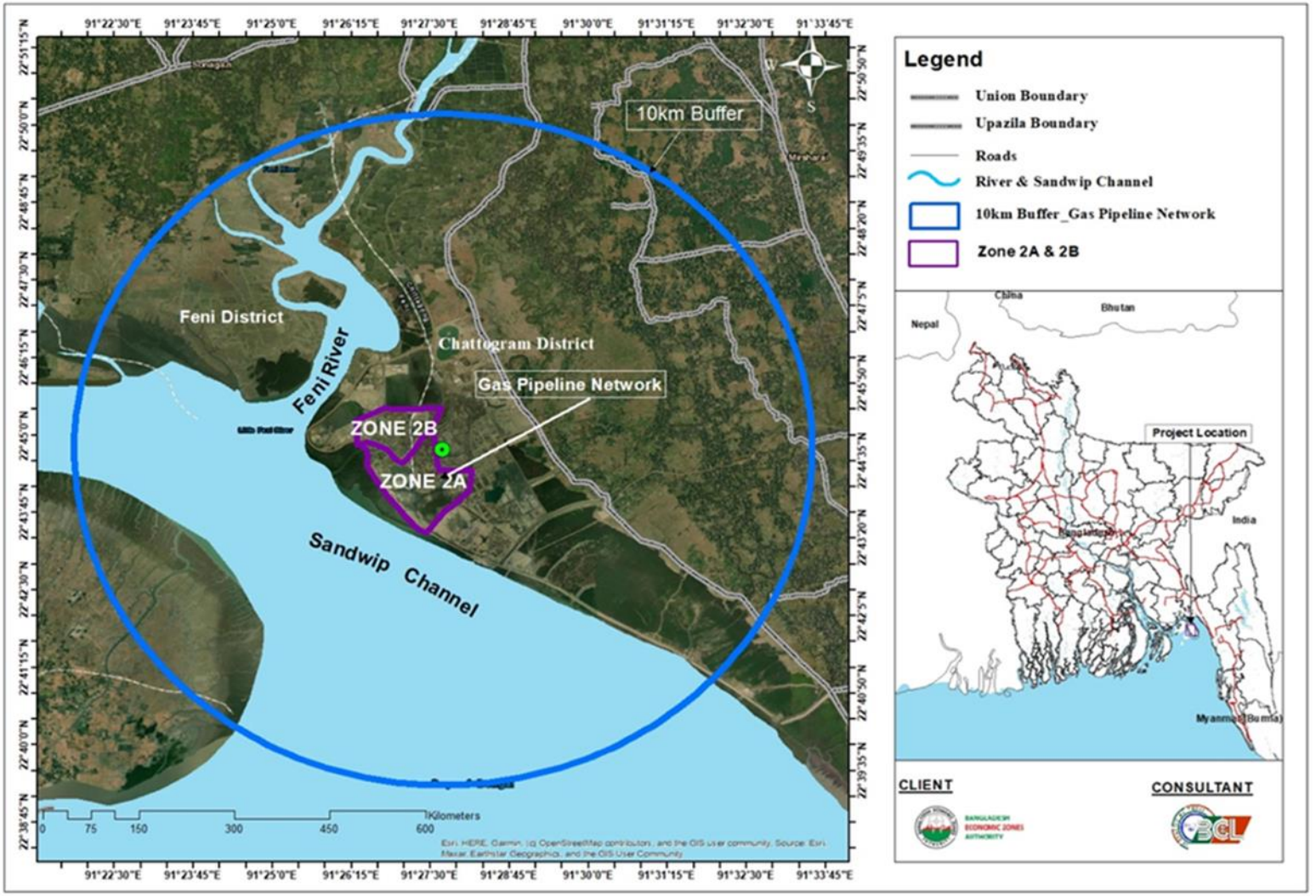


Figure 1-2: Gas Pipeline Sub-project's Area of Influence

Step-5: Environmental and social impact assessment

17. **Impact Identification**: The impacts are identified and assessed for intensity using modeling and/or matrix methodologies, and classified as Low, Moderate, **Substantial** and High impacts on the environment and communities in the study region, in accordance with the World Bank risk category. The impact assessment process predicted using prediction tools (**Figure 1-3**), as described below.

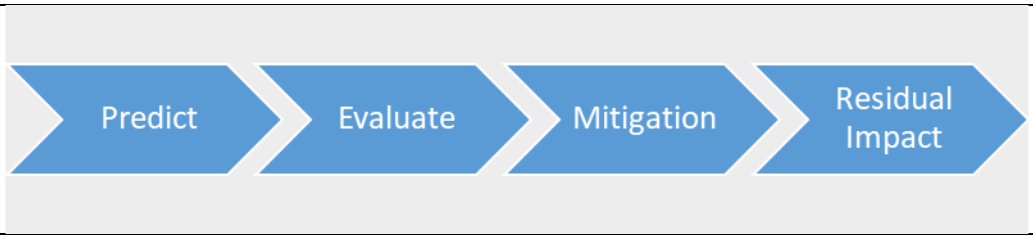


Figure 1-3: Impact Assessment Process

18. Analysis of the environmental and social impacts was carried out based on collected primary data and secondary data on physical environment and ecological environment, as well as social issues at project study area through the assessed the Valued Components (VCs).

19. Finally, assessed the potential environmental implications necessitates considerable data on ecosystems, biodiversity, and physical properties. It is also vital to learn how present environmental processes interact to form a complex ecosystem. This information can be used to detect potential environmental changes induced by the project, as well as to offer strategies for avoiding, reducing, or managing such environmental consequences.

Step-6: Impact Qualitative and Quantification, and Evaluation

20. Qualitative assessment of potential consequences was conducted using the criteria to determine their significance. Potential consequences were determined based on their size and receptor sensitivity. The project's potential impacts are classified as Low, Moderate, Substantial and High based on factors such as duration, spatial extent, reversibility, likelihood, and legal standards and professional criteria. The, quantitative assessment was assessed based on the magnitude of the anticipated impacts which was scored as for Low-1, Moderate -2, Substantial-3, High-4. However, the impacts are evaluated on the basis of magnitude, immediacy, sustainability and reversibility. A 10-point scale is adopted, for example: 1 to 10 for beneficial impacts, 0 for no impact, 1 to -10 for negative impacts. Chapter 7 presents a detailed-on impact evaluation.

21. The significant issues highlighted during the Scoping Phase were examined using baseline information. Each issue has either positive or negative impacts on the project or the environment. The ESIA evaluates potential repercussions before and after mitigation measures are adopted, taking into account direct, indirect, and cumulative implications in the short and long term.

Step-7: Environmental and Social Management and Monitoring Plan

The environmental and social management plan (ESMP) was developed once the impact assessment was completed and mitigation strategies were identified. During the ESMP compilation process, institutional arrangements for the project's environmental and social management were recommended, mitigation and monitoring plans were developed, documentation and reporting protocols were established, training requirements were assessed, and the cost of ESMP implementation was estimated.

Step-8: ESIA Report preparation

22. Finally, the ESIA report was prepared based on the World Bank environmental and Social Framework, 2017 and GoB- ECR 2023 and other relevant regulatory policies.

1.7.1. ROUTE SURVEY FOR THE GAS PIPELINE CONNECTION

23. A topo survey was carried out along the proposed ROW based on KMZ file provided by the Client. Cement concrete pillars were embedded at TPs & Ips location at a regular interval. Vertical control has been established by transferring levels from nearest GTS Benchmark (after stability check) to the site. The originating point was transferred and fixed on the ground by transferring exactly the point from the BM to the route map using Differential Global Positioning System (DGPS). In addition, based on the Turning Points established, Alignment strip survey was conducted for a corridor width of 50m on either side of the trench center line using high-end Total Station and all Topographical features have been recorded as shown detailed in **Volumn-3**. The National Survey Organization (NSO) was involved for this assignment.

1.7.2. GEOTECHNICAL INVESTIGATION

24. The investigation works includes execution of 10 (ten) boreholes up to depth 30.0 m of Geotechnical Investigation Percussion method was used in drilling the borehole after driving a 120mm diameter casing pipe. The overall field investigation works includes the following sub items of works.

- Extraction of Disturbed Soil Sample;
- Extraction of Undisturbed Soil Sample;
- Standard Penetration Test;

25. All borehole soil samples are classified as per ASTM D-2487. The details of testing results and analysis are presented as a separate soil investigation report under **Volume-4**.

1.8. ESIA TEAM

26. A multi-disciplinary ESIA team was engaged to collect data, information, baseline study, impact prediction and assessment and formulation of mitigation measures during the ESIA study. The professional members of the ESIA team are as follows:

Table 1-1: ESIA study Team

Sl. No.	Name of the expert	Position in the team
1	Mrs. Nahid Amin, PhD	Acting Team Leader
2	Md. Kamrul Hasan Bhuiyan	Environmental Expert
3	Mr. Tajul Islam, PhD	Ecologist
4	Mr. Mamun Ur Rashid	Social Expert
5	Md. Mustafizur Rahman	Junior Environmental Expert
6	Mrs. Sadia Afrin Nitu	Quality Control Expert
7	Mr. Nahid Hasan	Junior Social Expert

27. Besides the expert team, a junior team was involved in conducting interviews with different types of stakeholders consultations following the semi-structured questionnaire and socio-economic survey at the project areas and data collection and analysis.

1.9. STRUCTURE OF THE REPORT

28. The report has been prepared based on the following structures:

Executive Summary: This section provides a summary of the ESIA report

Chapter-1: Introduction

Chapter-2: Administrative and Legal Frameworks

Chapter-3: Project Description

Chapter-4: Environmental and Social Baseline

Chapter-5: Analysis of Alternative

Chapter-6: Stakeholder Engagement and Information Disclosures

Chapter-7: Impacts and Risks Mitigation Measures

Chapter-8: Environmental and Social Management Plan

Chapter-9: Conclusion and Recommendations

1.10. LIMITATION

29. The study area is limited to the project's Area of Influence (AOI), and study work was extended 10 km radius for all mapping of the physical, ecological and social environments. Also considered 10km buffer zone to identify the ecologically sensitive areas e.g., reserved forest, national parks, wildlife sanctuaries, Haor, biosphere reserve, and protected areas, etc. are located. The topo survey of the gas pipe lines was conducted based on the GIS based Gas pipeline network map provided by the Client. Some sections, there are no indications on the proposed gas pipelines alignment regarding in which side of the existing roads network will be constructed, and some roads yet to be developed in Zones 2A-2B and the adjacent areas. This ESIA report has been prepared based on the primary data, field investigation/survey and assessment those information, secondary data from different government agencies (DoE, BMD, BBS, KGDCL and PGCP) and relevant ES documents of the BEZA, published journals and books, public consultation, site observations. The impact assessment carried out based on preliminary information available from the PIU, PRIDE, BEZA and consultants' professional judgement.

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1. BANGLADESH ENVIRONMENTAL AND SOCIAL POLICIES, ACT AND RULES

30. The GoB has developed a policy framework that requires environmental issues to be incorporated into economic development planning. The applicable national policies, acts, legal and administrative framework to the subproject is given in **Table 2-1**.

2.2. WORLD BANK ENVIRONMENTAL AND SOCIAL FRAMEWORK

31. The World Bank's Environmental and Social Framework (ESF) is strategically supporting green, resilient and inclusive development by strengthening protections for human being and the natural environment, and making important advances in areas such as labor, inclusion and non-discrimination, gender, climate change, biodiversity, community health and safety. Additionally, the ESF document discusses the relevance and requirements relating to other guidance notes of the World Bank. The ESF covers 10 Environment and Social Standards (ESS)s those are essential tools for ensuring that World Bank-funded projects contribute to positive development outcomes while minimizing potential adverse impacts on people and the environment. As per World Bank Environment and Social Standards (ESSs), ESSs (1-10) are applicable to this project, except ESS-9. World Bank's Environmental and Social Standards (ESSs) pertinent to the proposed sub project and a comparison with the GoB's relevant rules and regulations including the gaps are summarized in **Table 2-2.**

Table 2-1: National Environmental and Social related Legal instrument relevant to the Sub-project

Sl no	Acts /Rules/ Polices/ Plans	Key provisions and purposes	Relevance to this Project
1	National Environmental Policy, 1992	Key elements of this Policy are: maintaining ecological balance and ensuring sustainable development of the country through protection, conservation, and improvement of the environment; protecting the country from natural disasters; identifying and regulating all activities that pollute and destroy the environment; ensuring environment- friendly development in all sectors; ensuring sustainable and environmentally sound management of the natural resources and promoting active association, as far as possible with all international initiatives related to the environment. The Environmental Policy of 1992 requires specific actions with respect to the industrial sector which are as follows: to carry out corrective measures in polluting industries; to conduct EIAs for all new public and private industrial developments; To ban or find environmentally sound alternatives for the production of goods that cause environmental pollution and to minimize waste and ensure sustainable use of resources by industry.	To ensure sustainable development and environmentally sound management of the natural resources and to meet the DoE/GOB regulatory requirement, Gas pipeline network sub project will comply this policy.
2	National Environmental Management Action Plan, 1995	NEMAP was developed to achieve the following broad objectives: identification of key environmental issues affecting Bangladesh; identification of actions necessary to halt or reduce the rate of environmental degradation; improvement of the natural environment; conservation of habitats and biodiversity; Promotion of sustainable development and improvement of the quality of life of the people.	This Environmental and Social Impact Assessment has been prepared considering the objectives of the NEMAP.
3	Bangladesh Climate Change Strategy and Action Plan 2009	The GOB has prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) in 2008 and revised in 2009. This is a comprehensive strategy to address climate change challenges in Bangladesh. There are 44 specific programs proposed in the BCCSAP under six themes. Establishment of six strategic pillars for action, including (l) food security, social protection, and health, (2) disaster management, (3) protective infrastructure, (4) research and knowledge management, (5) Decreased carbon development, and (6) capacity building and institutional strengthening.	The sub-project will involve greenery activities which will offset carbon emissions. The sub project promotes energy efficient and cleaner production gas supply to industries.
4	National Land Use Policy, 2001	Deals with several lands uses including agriculture (crop production, fishery, and livestock), housing, forestry, industrialization, railways and roads, tea and rubber and identifies land use constraints in all these sectors.	Land use pattern is being changed due to the installation of Gas pipeline networks, and operation of DRS and valve stations.
5	Environment Conservation Act, 1995 and subsequent amendments 2010	Defines applicability of environmental clearance; regulation of development activities from environmental perspective; framing applicable limits for emissions and effluents; framing of standards for air, water, and noise quality; formulation of guidelines relating to control and mitigation of environmental pollution, conservation, and improvement of environment and declaration of Ecologically critical areas.	Environmental issues are taken care of under this act.
6	Environmental Conservation Rules, 2023	Environment Conservation Rules, 2023 and Environmental Clearance (EC) Procedures the Environment Conservation Rules (ECR), 2023 provides a basic framework for environmental evaluation of proposed projects in all sectors and establishes procedures. Accordingly, the project proponent should first obtain a location clearance and conduct the appropriate study to obtain environmental clearance of the project. Any project constructed in Bangladesh must	Environmental issues are taken care of under this act. As per the ECR 2023 Schedule the project falls under the Red Category: Therefore, site clearance and Environmental

		obtain an Environmental Clearance Certificate (ECC) before its operation. Like Environmental Screening process of the projects, Rule 5 of ECR, 2023 has classified the projects into following four categories based on the site conditions and the impacts on the environment. The projects are categorized into four categories they are: Green, Yellow, Orange and Red. Various industries/projects falling under each category have been listed in schedule-1 of the ECR, 2023. According to the rules of ECR, 2023, Red category projects require location clearance certificate and followed by issuing of ECC upon the satisfactory submission of the required documents.	Clearance Certificate (ECC) would be required.
7	Environment Court Act, 2000 and amendment in 2002.	Provides the jurisdictions of environment court, the penalty for violating court's order, trial procedure in special magistrate's court, the power of entry and search, the procedure for investigation, procedure and power of environment court, the authority of environment court to inspect, appeal procedure and formation of environment appeal court.	Will be applicable in case of violation of Environment Court Act, 2000.
8	Noise Pollution (Control) Rules 2006	Prevention of Noise pollution and standards for noise levels. The rules provide for standard limits of noise level of vehicles and designated areas. According to the rule, motor honking within a 100-meter radius of a hospital, school and office is prohibited. The rules also do not allow use of brick crushers and cement mixers within a 500-meter radius of a residential area. Besides, prior permission is mandatory for using loudspeakers or megaphones. The rules stipulate safety and precautionary measures in workplaces, designated authorities for allowing noise generating appliances.	This is relevant to identify the potential impact on health and wellbeing of workers and the surrounding communities.
9	Air Pollution (Control) Rule 2022	The main objectives of this rule are to prevent, control, and reduce air pollution. The government will appoint a director general who will be responsible for managing and maintaining the environmental issue. The Rule specified several types of pollution such as pollution caused by factories, vehicles, construction, garbage, etc. According to the new rule, there will be a committee that will impose damages and punishment for such pollution. As stated by the rule, the government will give rewards to those who will protest against pollution and do not cause any type of pollution.	This is relevant with the project since potential impact (emission of smoke, dust and flumes) will generate due to project activity.
10	Solid Waste Management Rules 2021	The Regulations define the responsibilities of businesses involved in solid waste management and impose collection, recycling, and disposal obligations according to Extended Producer Responsibility (EPR) on manufacturers of non-biodegradable products such as glass, plastic, and bottles. The Regulations also include provisions for the treatment of solid waste such as composting and energy recovery.	This rule is applicable for this project to ensure waste management.
11	National 3R Strategy for Waste Management, 2010	The strategy for solid waste management is essential in order to minimize the environmental, social and economic problems by applying 3R (reduce, reuse & recycle) strategy.	This strategy is applicable for Zone 2A & 2B for the management of construction waste.
12	The Vehicle Act, 1927; The Motor Vehicles Ordinance, 1983; and The Bengal Motor Vehicle Rules, 1940, The Road Transport Act, 2018	Exhaust emissions, vehicular air and noise pollution; road/traffic safety; fitness of motor vehicles and parking.	Substantial number of vehicles will be in operation during construction phase of this project.

13	The National Water Act, 2013	The National Water Act, 2013 is based on the National Water Policy, 1999 and provides the legal framework for integrated development, management, abstraction, distribution, usage, protection and conservation of water resources in Bangladesh. The Act authorized DoE to prevent water pollution. The Act denotes water pollution as 'direct and indirect harmful changes of physical, chemical and organic properties of water'.	The project will comply with the provisions of the Act by ensuring that storm water disposal structures intended to control runoffs from project area into the aquatic environment. Moreover, this is also applicable for the preservation of water quality during construction work and camps site effluent.
14	National Water Bodies Protection Act, 2000	The characterization of water bodies as river, canal, tank or floodplain identified by municipalities in division and district towns shall not be changed without approval of concerned ministry.	The Gas pipeline will cross the Ichakhali canal, Bamonsundor and other canals, low lying area, etc. in the sub-project areas (Zones 2A-2B) and adjacent area.
15	Labor Act 2006 and amendment 2013	The Labor Act is the most comprehensive labor and workplace related legislation of the country, consolidating the provisions of 25 separate acts into a single labor code in 2006. Among others, it sets occupational safety and health standards, compensation for injury and accidents in the workplace, maternity benefits, factory inspectorate and restrictions in child labor. The responsibility of enforcing workplace safety such as fire safety, and welfare of workers has been given to the Department of Inspection for Factory and Establishments (DIFE), which is under the Ministry of Labor and Employment. The agencies mandated to implement the law include the Department of Labor/Labor Directorate (DOL) . The DOL is mainly responsible for facilitation of effective labor management relations, collective bargaining and negotiations and ensures prompt and efficient settlement of labor disputes in the industrial sectors of Bangladesh while the DIFE is responsible for ensuring workplace safety including fire safety, structural integrity of workplace buildings and welfare of workers. The labor courts deal with both industrial disputes and individual grievances. Bangladesh modified its maternity benefit provisions by enacting the Bangladesh Labor Act, 2006, repealing three different Acts, i.e., the Maternity Benefit Act, 1939; the Mines Maternity Benefit Act, 1941; and the Maternity Benefit (Tea Estate) Act, 1950. The labor market of Bangladesh is one of the major attractions for foreign investors due to cheap wage rate and availability of skilled labor. To safeguard the interest of the laborer's, the Government has implemented several laws and regulations recently. The labor laws are governed by the Bangladesh Labor Act 2006 as amended in 2010 and 2013 and Labor Rules 2015.	Applicable during construction phase of the project. The PIU will ensure through its contractors that basic amenities are provided to the labors. Project proponent through its contractors should also ensure all vendors employed should have valid labor license, compensation to workers (own and vendors) should not be below daily wage rate as specified by Government. Employee ID card must be issued (own and vendors). In addition, safety, health and welfare measures of building and construction workers as mentioned in the act needs to be complied.
16	BEZA Act, 2010	Under this act, BEZA, economic zone developers, industrial units established in the economic zones shall be bound to comply with international commitments recognized by the Government of Bangladesh including compliance to all the existing laws on environment and environmental protection.	It is the own act of project proponent to regulate the social and environmental issues of this sub project.

17	Bangladesh National Building Code (BNBC), 2020	The Bangladesh National Building Code (BNBC) clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety. The BNBC also stipulates the general duties of the employer to the public as well as workers. According to this section, "All equipment and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, runway, barricade, chute, lift shall be substantially constructed and erected so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them". The Code also clarifies the issue of safety of workmen during construction and with relation to this, set out the details about the different safety tools of specified standard. In relation with the health hazards of the workers during construction, the nature of the different health hazards are also included.	This code is relevant, since valve stations will be constructed under this subproject.
18	Standing Order on Disaster, 2010 and Disaster Management Act, 2002	The Order (2010) and Act (2012) address activities related to disaster management in a coordinated, object-oriented manner and strengthened way and to formulate rules to build up infrastructure as part of effective disaster management to fight against all types of disasters.	Applicable, as the sub-project is located in a natural disaster-prone area such as cyclone, surge, storm etc.
19	Bangladesh EPZ/EZ Labor Law Ordinance No 01, 2019	This law has been designed to ensure occupational health & safety, cleanliness, safety and welfare management, no discrimination in term of wage and a well as human right at the working site.	All labor related issues including complaints will be addressed following this Ordinance.
20	The Fire Prevention and Fire Fighting Act, 2003	The Fire Prevention and Fire Fighting Act, 2003 in Bangladesh is a regulatory framework that mandates fire safety measures. Here are the key points: ▶ Purpose: The Act aims to prevent fires, ensure effective firefighting, and minimize damages caused by fire incidents. ▶ Coverage: It applies to all factories and establishments in Bangladesh. ▶ The Act sets out guidelines for fire prevention, extinguishing, and damage reduction. ▶ Requirements: The Act specifies safety measures related to fire prevention, firefighting equipment, and emergency procedures. ▶ It emphasizes continuity of operations, property protection, and minimizing danger to life. ▶ Fire License: All factories must obtain a fire license as per this Act. ▶ Compliance with fire safety regulations is mandatory. In summary, the Fire Prevention and Fire Fighting Act, 2003 ensures that factories adhere to fire safety standards, protecting lives and property from fire-related risks.	It's applicable to this subproject. Fire accidents may occur due to faulty connection, gas leakage in the working areas.
21	EIA Guidelines for Industry, 2021	The EIA Guidelines for Industry, 2021, introduced by the Department of Environment (DoE), Bangladesh, is the only guidelines for conducting Environmental Impact Assessment which is a formal study process used for impact identification, for casting and evaluation, environmental consequences and plans for mitigation measures, and monitoring programs of proposed development industries, projects and activities. This involves the study of the probable changes in the physical and biological as well as socio-economic environment which may result from the proposed development activities or projects, and a suitable environmental management plan to minimize adverse effects on the one hand to enhance positive effects on the other. In	The Guideline is applicable and should be followed developing the ESIA report for the Zone as well as Environmental Clearance from the DoE.

		Bangladesh, Initial Environmental Examination (IEE) and EIA study has been made regulatory need under certain categories of projects as specified in Environment Conservation Rule, 1997 for obtaining Environmental Clearance Certificate which is mandatory for any industrial and other development projects.	
22	Factories Act, 1965& Bangladesh Factory Rules, 1979	According to the Rules, labors require medical facilities, first aid, accident and emergency arrangements, and childcare services to be provided to the workers at the workplace.	It's relevant to the subproject. After establishment of gas pipeline networks, industrial growth will increase in NSEZ areas.
23	The Employee State Insurance Act, 1948	Health, injury, and sickness benefit should be paid.	It's relevant to the subproject. During construction and operation period, labor health and safety should ensure following this act.
24	The Employers' Liability Act, 1938	Covers accidents, risks, and damages with respect to employment injuries.	It's relevant to the subproject. During construction and operation period, labor health and safety should ensure following this act.
25	Child Labor Elimination Policy 2010	Children should withdraw working from different forms of occupations, e.g., hazardous work and the worst forms of child labor; Providing special emphasis for indigenous and physically challenged children to bring them back to the congenial environment; Planning and implementing different short-, medium-, and long-term strategies and programs to eliminate various forms of child labor.	It's relevant to the subproject. During construction period, labor influx will occur and there is a chance to recruit child labor.
26	Water Supply and Sewerage Authority Act, 1996	The act calls for ensuring water supply and sewerage system to the public, preservation of system, and other related health and environmental facilities for the community.	It's relevant to the subproject. During construction and operation period, water supply and sanitary facilities will require to the labor camp, construction sites and construction yard
27	Public Health (Emergency Provisions) Ordinance, 1944	Calls for special provision regarding public health. In case of emergency, it is necessary to make special provisions for preventing the spread of disease, safeguarding the public health, and providing adequate medical service, and other services essential to the health of respective communities and workers during construction related work.	It's relevant, during construction and operation period, community health and safety will be jeopardized if preventive measures are not undertaken properly.

Table 2-2: World Bank's ESSs, pertinent GoB's Environmental & Social Policies related to sub-project and Gaps analysis

Sl n	World Bank's ESF 2017			Equivalent National Environmental Policy and Regulations	Relevance/ non relevance to the sub- project	Gaps and its remedy redressal
	World Bank's Policy and ESSs	Objectives	Requirements			
1	World Bank Environment and Social Policy for Investment Project Financing	It sets out the mandatory requirements of the Bank in relation to the projects it supports through Investment Project Financing.	The types of E&S risk and impacts that should be considered in the environmental and social assessment. The use and strengthening of the environmental and social assessment, development and implementation of WB financed projects where appropriate.	-	Applicable to this proposed subproject as the sub-project is funded by the World Bank	-
2	ESS-1 Assessment and Management of Environmental and Social Risks and Impacts	Identify, assess, evaluate, and manage environment and social risks and impacts in a manner consistent with the ESF. Adopt differentiated measures so that adverse impacts do not fall disproportionately on the lands, disadvantaged or vulnerable, and they are not disadvantaged in sharing development benefits and opportunities.	The environmental and social assessment framework for World Bank-financed projects aims to: Promote workplace safety and health; Ensure fair treatment, non-discrimination, and equal opportunity for project workers; Protect vulnerable workers, including women, persons with disabilities, children (of working age), and supply workers; Prevent forced and child labor; Support freedom of association and collective bargaining, in line with national laws; Provide accessible channels for project workers to raise concerns.	National Environmental Policy, 1992; NEMAP 1995; ECR 2023; ECA 1995 and subsequent amendments until 2010; Noise Pollution (Control) Rules 2006; Air Pollution (Control) Rule 2022; Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009; BEZA Act, 2010	It's relevant to the subproject. The E&S risks and impacts have been identified based on baseline environmental and social surveys and consultations with primary stakeholders including communities, surrounding communities and project implementing unit. The subproject activities would affect the existing the land use pattern due to excavation, pipe laying and backfilling activities during the construction period.	By and large, the national policies and regulations are consistent with the requirements of ESS 1 with some gaps as mentioned below.
3	ESS-2 Labor and Working Conditions	Promote safety and health at work. Promote the fair treatment, non-discrimination, and equal opportunity of project workers. Protect project workers, with particular emphasis on vulnerable workers. Prevent the use of all forms of forced labor and child labor. Support the principles of	Requirements for the Borrower to prepare and adopt labor management procedures. Provisions on the treatment of direct, contracted, community and primary supply workers and government civil servants. Requirements on terms and conditions of work, non-	Bangladesh Labor Law, 2006, Bangladesh Labor Act, 2013 and Bangladesh Labor Rules, 2015 Bangladesh EPZ/EZ Labor Law Ordinance No 01, 2019	i) Direct workers such as project managers and supervisors from PIU, BEZA, deployed for PRIDE; ii) Contracted workers employed by contractors and the Project Management Unit, possibly involving	The national legal provisions almost cover all requirements of ESS2. Under the PRIDE project of the BEZA object's Labor management procedure has been prepared to regulate

		freedom of association and collective bargaining of project workers in a manner consistent with national law. Provide project workers with accessible means to raise workplace concerns.	discrimination and equal opportunity and worker's organizations. Provisions on child labor and forced labor management. Requirements on occupational health and safety, in keeping resemblance with the World Bank Group's Environmental, Health, and Safety Guidelines (EHSG).	Industrial Policy, 1999 Noise Pollution (Control) Rules 2006 Air Pollution (Control) Rule 2022	subcontractors; iii) Migrant workers, common in the area, are expected for construction; iv) Primary supplier workers providing goods and materials, such as construction supplies.	working conditions and management of worker relations including workers specific GRM, terms and conditions of employment, non-discriminations and equal opportunity, protection of work force, prohibition of child/forced labor and provision of OHS.
4	ESS-3 Resource Efficiency and Pollution Prevention and Management	Promote the sustainable use of resources including energy, water, and raw materials. Avoid or minimize adverse impacts on human health and the environment caused by pollution from project activities. Avoid or minimize project-related emissions of short and long-lived climate pollutants. Avoid or minimize generation of hazardous and non-hazardous waste. Minimize and manage the risks and impacts associated with pesticide use. Requires technically and financially feasible measures to improve efficient consumption of Energy, water, and raw materials and introduces specific requirements for water efficiency where a project has high water demand.	Requires estimating gross greenhouse gas emissions, managing wastes, chemicals, hazardous materials, and addressing historical pollution. Refers to national laws and World Bank EHSGs. Key goals include: Promoting sustainable use of resources (energy, water, raw materials). Minimizing adverse impacts on human health and the environment by reducing pollution. Reducing emissions of climate pollutants. Minimizing hazardous and non-hazardous waste generation.	National Fisheries Policy, 1998 Water Supply and Sanitation Act, 1996 Ground Water Management ordinance, 1985 National Water Bodies Protection Act, 2000 National Agriculture Policy, 2013 National Water Act, 2013 Noise Pollution (Control) Rules, 2006 The Sustainable and Renewable Energy Development Authority Act, 2012 (Act No. 48 of 2012) National Strategy for Waste Management Environment Court Act, 2000 and amendment in 2002 National 3R Strategy for Waste Management, 2010 Solid Waste Management	During the subproject implementation, both hazardous and non-hazardous solid wastes will be generated. Construction activities will cause air pollution, noise, and resource consumption, including fuel and groundwater. To minimize environmental impacts, measures will be taken to ensure efficient energy and water use, and the conservation of water during construction. Local and recycled materials will be used to reduce the project's environmental footprint. Pollution management strategies will address risks from dust, emissions, wastewater, chemical spills, hazardous materials, and non-hazardous waste disposal, in line with WBG EHSG guidelines.	GOB has rules and regulation those address the pollution prevention such as ECA 95, ECR 97/2023, Rules for hazardous waste management and strategies for adaptation and mitigation to climate change. While many ESS3 requirements are addressed by existing regulations, there are gaps in many cases such as lack of rules directly addressing the issues related to sourcing of construction material, resource efficiency etc.

				Rule 2021		
5	ESS-4 Community Health and Safety	Anticipate or avoid adverse impacts on the health and safety of project-affected communities during project life-cycle from routine and non-routine circumstances. Promote quality, safety and climate change considerations in infrastructure design and construction including dams. Avoid or minimize community exposure to project-related traffic and road safety risks, diseases and hazardous materials. Have in place effective measures to address Emergency events. Ensure that safeguarding of personnel and property is carried out in a manner that avoids or minimizes risks to the project-affected communities.	Infrastructure requirements must consider community health and safety by: Anticipating and avoiding adverse impacts on affected communities during the project life cycle. Promoting quality and safety in infrastructure design and construction. Minimizing community exposure to traffic, road safety risks, diseases, and hazardous materials. Implementing effective emergency measures. Ensuring personnel and property safeguarding minimizes risks to communities.	National Water Bodies Protection Act, 2000 Noise Pollution (Control) Rules 2006 National 3R Strategy for Waste Management, 2010 Solid Waste Management Rule 2021 Bangladesh National Building Code (BNBC), 2020 Bangladesh EPZ/EZ Labor Law Ordinance No 01, 2019	It is relevant to the subproject activities. Community health hazards will occur during the construction period. Gas pipeline construction works will be undertaken mostly in vacant lands The main impacts on drainage and internal road, use of vibratory equipment, construction debris handling and disposal etc. during construction; ii) high likelihood of direct exposure to increased construction related traffic and equipment, and sensitive receptors alongside national highways. iii) Dust levels from earthworks, high noise and emission level from traffic congestion and idling of vehicles; and iv) influx of migrant workers could potentially cause local discomfort or potential conflicts with local people.	In the existing GoB regulatory systems (laws, rules, policies and acts), there is no direct community health and safety. Hence, these policies fulfil the community health and safety partially. The gaps are addressed through suitable provisions in ESMP. In addition, contractor will be responsible to implement the ESMP regarding community health and safety which includes OHS plan, labor Influx management Plan, workers camp management plan, traffic and road safety management plan etc.
6	ESS-5 Land Acquisition Restrictions on Land Use and Involuntary Resettlement	Minimize involuntary resettlement by exploring design alternatives and avoiding forced eviction. Mitigate adverse impacts from land acquisition by providing compensation at replacement cost and assisting displaced persons in restoring	Applies to both permanent and temporary physical and economic displacement from land acquisition and access restrictions, excluding voluntary market transactions that affect third parties. Sets criteria for voluntary land donations and prohibits	The Acquisition and Requisition of Immovable Property Act, 2017 National Land Use Policy, 2001	It is not relevant to the subproject activities. No land acquisition will be required under this project, since entire owner of the NSEZ is BEZA.	Gap exists specifically related to aspects such as identification of non-titleholders as PAPs and cut off dates for non-titleholders. However, this ESS is not relevant for activities in zones 2A

		their livelihoods to pre-displacement levels or higher. Improve living conditions for vulnerable individuals through adequate housing, access to services, and security of tenure. Implement resettlement activities as sustainable development programs.	forced eviction without legal protection. Land and asset acquisition must occur only after compensation and resettlement. Requires community engagement, information disclosure, and a grievance mechanism.			and 2B.
7	ESS-6 Biodiversity Conservation	Protect and conserve biodiversity and habitats. Apply the mitigation hierarchy and the precautionary approach in the design and implementation of projects that could have an impact on biodiversity. To promote the sustainable management of living natural resources.	Requirements for projects affecting areas that are legally protected designated for protection or regionally/internationally recognized to be of high biodiversity value. Requirements on sustainable management of living natural resources, including primary production and harvesting, distinguishing between small-scale and commercial activities. Requirements relating to primary suppliers, where a project is purchasing natural resource commodities, including food, timber and fiber.	National Biodiversity Strategy and Action Plan (2004) The Forest Act,1927 and subsequent amendments in 1982 and 1989 National Forest Policy, 1994 Wildlife Conservation (Protection and Safety) Act, 2012 Bangladesh Biodiversity Act, 2017	It' is relevant to the subproject activities The Gas Pipeline construction works in Zone 2A and Zone 2B has potential to cause conversion of habitat and impair associated ecological functions by: altering aquatic habitat in low-lying areas and canals through discharging solid or liquid waste from construction camps and from the construction yard. Appropriate mitigation and/or control measures have been suggested in this ESIA.	Provisions from the acts meet the ESS requirements. ESMP will be prepared to address the wildlife presence and movement outside the protected area and in and around the project corridor.
8	ESS-7 Indigenous Peoples	Ensure the development process respects affected parties' human rights, dignity, culture, and livelihoods. Promote sustainable, inclusive benefits that are culturally appropriate. Improve project design by fostering ongoing, meaningful consultations and obtain Free, Prior, and Informed Consent (FPIC) in specific cases. Recognize and preserve	Applies when Indigenous Peoples have a collective attachment to the land, whether impacts are positive or negative. Allows for different terminologies if they meet World Bank criteria. Covers forest dwellers, hunter-gatherers, pastoralists, and nomadic groups. Requires meaningful consultation, a grievance mechanism, and Free, Prior, and Informed Consent in specific cases.		No relevance to the subproject activities. There are no Indigenous Peoples adjacent to the Zone 2A and Zone 2B. Not applicable for the project	There are no indigenous peoples in the project area

		Indigenous Peoples' culture, knowledge, and practices, allowing them to adapt to changing conditions on their terms.				
9	ESS-8 Cultural Heritage	Protect cultural heritage from the adverse impacts of project activities and support its preservation. Address cultural heritage as an integral aspect of sustainable development. Promote meaningful consultation with stakeholders regarding cultural heritage. Promote the equitable sharing of benefits from the use of cultural heritage.	Requires a chance finds procedure to be established. Recognition of the need to ensure peoples' continued access to culturally important sites, as well as the need for confidentiality when revealing information about cultural heritage assets that would compromise or jeopardize their safety or integrity. Requirement for fair and equitable sharing of benefits from commercial use of cultural resources. Provisions of archaeological sites and material, built heritage, natural features with cultural significance, and moveable cultural heritage.	Cultural Heritage Prevention Policy of Bangladesh, Ministry of Cultural Affairs	Not applicable. Cultural heritage will not be affected or adversely impacted by project activities, However, 'chance find' procedure is included in the EMPs for all work phases.	Currently no official cultural heritage policy is available in Bangladesh hence provisions from the act do not fully meet the ESS requirements. Chance find procedures is included in ESMP. Impacts on religious structures (not protected, but social and cultural value) will be mitigated or managed through provisions for restoration.
10	ESS-9 Financial Intermediaries	Sets out how Financial Intermediaries (FI) will assess and manage environmental and social risks and impacts associated with the subprojects it finances. Promote good environmental and social management practices in the subprojects the FI finance. Promote good environmental and sound human resources management within the FI.	Financial Intermediaries (FIs) to have an Environmental and Social Management System (ESMS) - a system for identifying, assessing, managing, and monitoring the environmental and social risks and impacts of FI subprojects on an ongoing basis. FI to develop a categorization system for all subprojects; with special provisions for subprojects categorized as high or substantial risk. FI borrowers to conduct stakeholder engagement in a manner proportionate to the risks and impacts of the FI subprojects	-	Not relevant as there is no financial intermediary involved.	Not applicable to the country system. Project proponents, regardless of funders, are subject to the same country's laws

11	ESS-10 Stakeholder Engagement and Information Disclosure	Establish a systematic approach to stakeholder engagement, helping Borrowers identify stakeholders and maintain constructive relationships. Assess stakeholder interest and incorporate their views into project design. Promote inclusive engagement with affected parties throughout the project, ensuring timely, accessible, and understandable information disclosure.	Stakeholder engagement is required throughout the project life cycle, including the preparation of a Stakeholder Engagement Plan (SEP). Early identification of both affected and interested parties is crucial. Engagement must be proportional to the project's nature, scale, risks, and impacts, and aligned with stakeholder interests. The plan ensures effective information disclosure and meaningful consultation. It aims to create a systematic approach for Borrowers to identify stakeholders and build constructive relationships, particularly with project-affected parties.	Environmental conservation Rules, 1997 and subsequent amendments in 2002, 2003 and 2010 Right to Information Act, 2009	The subproject aligns with the World Bank's approach to information disclosure, transparency, and knowledge sharing. The public will have access to detailed project information during preparation and implementation, with the ESIA disclosed on the BEZA and WB websites. Consultations and focus group discussions (FGDs) were held during the ESIA process to assess stakeholder interest and incorporate their views into project design and performance.	Environmental Impact Assessment Notification-1997 is not applicable to the EZ-project though it has provisions for public hearing as part of impact assessment process. The Project has prepared a Stakeholder Engagement Plan (SEP) to engage with all stakeholders relevant to the different components and sub-components of the project.
	World Bank Groups' EHSGs, IFC, 2007					
1	General EHS Guidelines, April, 2007, IFC	The General EHS Guidelines contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors	Requirements on environmental, health, and safety issues during construction of different intervention of EZ.		The project will comply where applicable	
2	EHS Guidelines for construction Materials Extraction, April, 2007, IFC	The EHS Guidelines contain the performance levels and measures that are considered to construction materials extraction activities such as aggregates, limestone, slates, sand, gravel, clay, gypsum, feldspar, silica sands, and quartzite	Requirements on the resource management of construction materials extraction activities such as aggregates, limestone, slates, sand, gravel, clay, gypsum, feldspar, silica sands, and quartzite		The, sub project will comply where applicable	

2.3. INTERNATIONAL POLICIES AND TREATIES

32. Most of the development projects have been implemented in Bangladesh by the financial help and technical guidance of some international donor agencies. These international agencies have their own environmental and social safeguard policies. Bangladesh Government has also agreed and signed some international treaties, conventions, protocols and agreements for environmental assessment, protection, and pollution Control. International Design Codes, Standards and Guidelines have also been implemented to conduct any development project here in Bangladesh.

33. Bangladesh is a party to many international conventions, treaties, and protocols (ICTPs) related to the project and is committed to ensure that these protocols are complied with during all development works. The main ICTPs are Rio Declaration (environment and development), 1992, Convention on Biological Diversity (Rio de Janeiro), 1992, World Heritage Convention, 2011, International Plant Protection Convention (IPPC), 1951, Plant Protection Agreement for the South East Asia and Pacific Region 1956, Convention on Biological Diversity (CBD) 1992, UN Framework Convention on Climate Change (UNFCCC) 1992, Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat) 1971 and Convention on Persistent Organic Pollutants (Stockholm) 2001. Noted that, all these international treaties are not directly applicable to the proposed sub project. Multilateral Environmental Agreements (MEAs) Bangladesh has so far signed, ratified and or accessed 35 international Conventions. The international conventions related to this project and signed by Government of Bangladesh are provided in **Table 2-3**.

Table 2-3: International Conventions singed by Bangladesh applicable to this sub project

Treaty or Convention	Year	Brief Description	Responsible Agency
Working Environment Convention (Geneva)	1977	Protect workers against occupational hazards in the working environment	Ministry of Health and Family Welfare
Occupational Safety and Health Convention (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment.	Ministry of Health and Family Welfare
Kyoto Protocol (Japan)	1997	Under UNFCCC, International treaty on Climate change and emission of greenhouse gases	DoE/ MoEFCC

2.4. GOB PROJECT CATEGORIZATION

34. The proposed subproject Gas Pipeline Network will be a total of 30 km length within Zone 2A- 2B and its adjacent areas of the NSEZ . According to recent published ECR 2023 of the DOE under the proposed subproject Gas Pipeline Network project falls Red Category as following Schedule 1, items Item No 67: Electricity, Oil and Gas Transmission Line above 25 Km is categorized as Red. Therefore, the proposed project, is deemed as 'Red Category' requires to obtain a Site Clearance Certificate (SCC) and An Environmental clearance Certificate (ECC) from the DOE under the Ministry of Environment, Forest and Climate Change (MoEFCC)

35. For getting the SCC of the sub-project an Environmental Impact assessment (EIA) study report needs to submit to the concerned DOE office in Chattogram with final design of project before commencement of the civil works. Therefore, to fulfill the national requirement, the BEZA intends to carry out an EIA report based on this comprehensive ESIA study to ensure that the project is economically viable, environmentally sound and socially acceptable during the various stages of implementation. The ECC of the sub-project will get from the DOE in operation stage after completion of the civil works.

36. The ESIA report covers the general environmental profile of the study area and includes an overview of the potential environmental impacts and their magnitude on physical, ecological, economic, and social and cultural resources within the project's influence area during design, construction, and operation stages. An Environmental and Social Management Plan (ESMP), which includes mitigation measures for significant environmental impacts during implementation of the project, environmental and Social Monitoring program (EMoP). The ESMP, will provide the guidance to BEZA and its project implementing unit (PIU), contractors and supervision consultants or project implementation consultants on how to plan, build/upgrade and operate the project road in an environmentally and socially safeguard manner.

37. It is noted that, in 2015 an approval of 'Environmental Impact Assessment (EIA) study for the Proposed Mirsharai Economic Zone Project' at Mirsharai Upazila under Chittagong district was obtained the DoE. A clearance has also been taken for the Water Treatment Plant (Phase-1) at NSEZ, Mirsharai in the year 2022. Thus, according to the official of the DOE in Chattogram stated that no NOC is required from the Forest Department,

(FD), Department of Inspection for Factories and Establishment (DIFE), Fire Service and Civil Defense, and Union Parishad. Whereas the NOC will be mandatory from the KGDCL for the Gas network construction.

38. No Objection Certificates (NOC) may be required from the following authorities before commencing the construction works of the proposed sub-project, (Table 2-4).

Table 2-4: NOC Requirements

Sl. No.	Name of Authority	Responsibility
1	Department of Fire Service and Civil Defense	Project Management Unit, BEZA
2	Roads and Highway Department	Project Management Unit, BEZA
3	Karnaphuli Gas Distribution Company Ltd.	Project Implementation Unit, KGDCL
4	Department of Explosives	Project Management Unit, BEZA
5	Department of Inspection for Factories and Establishments	Project Management Unit, BEZA

2.5. WORLD BANK PROJECT CATEGORIZATION

39. Based on project type and scale, project location, sensitivity of issues, nature of impacts and magnitude of risk impacts, the World Bank Environmental and Social Framework has classified all projects into four categories, viz: High risk, Substantial risk, Moderate risk and Low risk. According to Word Bank categorization, this proposed sub project is deemed as Substantial risk. The World Bank screens the Project in order to determine the nature and extent of the environmental and social assessment needed, based on the type, location, sensitivity, and scale of the activity, as well as the nature and magnitude of its potential impacts, the capacity and commitment of the Borrower to manage the environmental and social risks and impacts in line with the World Bank Environmental and Social Framework.

40. Considering the E&S Risk Rating of Gas Pipeline Network Development in Zone 2A and Zone 2B project may be deemed as “Substantial” category as it is expected that there will be impacts resulting on multiple E&S components or receptors over a varying time and spatial scale (e.g. activities such as trenching, excavation for gas pipeline installation, materials transportation and lifting of equipment and pipes, grading, stringing, wielding of pipes, coatings and wrapping, labor camps etc.), that can cause adverse impacts on local air quality, noise levels, water qualities, generation of wastewater, solid-waste, liquid and hazardous wastes, electrical shock and as well as nuisance to community, aquatic ecosystem, labor/workers); that can be managed by adopting appropriate mitigation measures and the potential health hazards are anticipated if proper safety preventive measures are not undertaken properly.

41. Also, it is unlikely to have ‘Irreversible impacts’ meaning impacts on E&S components that, in all practical terms are permanent in nature and cannot be reversed in spite of the removal of the causal stress factor.

3. DESCRIPTION OF THE GAS PIPELINE NETWORK SUB-PROJECT

3.1. GAS PIPELINE NETWORK IN ZONES 2A-2B AND ITS ADJACENT AREAS

3.1.1. LOCATION OF THE PROJECT

42. National Special Economic Zone located in Mirsharai Upazilla of Chattogram district and Sonagazi Upazilla of Feni district. It is only 10 Km west of the national highway (Dhaka-Chittagong highway) and 11.5 Km west of the nearby railway station. The proposed gas distribution pipeline will be constructed along the utility corridor of the approach and internal roads connecting the 2A (Zone-6, 8, 22,), 2B (zone-10, 19, 23) of the NSEZ development project. The project is situated in Mirsharai Upazila of Chattogram district near Abu Torab and Charsarat Village. It is located on the west side of the BWDB embankment, approximately 12 km west of the national highway (Dhaka-Chattogram Highway), with Chattogram City located 60 km south. Mirsharai Railway Station is about 10.0 km east of the site, and the Shah Amanat International Airport in Chattogram is approximately 79 km to the south. The Chattogram seaport is situated 67 km south of the site. The sluice gate of River Feni is around 9 km west/northwest of the site, and a rivulet from River Feni runs along the western boundary of the site at one location. Location Map of the project site is given in **Figure 3-1**. The location is positioned at the eastern end of the Bay of Bengal, and a super dike has been built along the western boundary of Zone 2A & 2B to safeguard the site from water ingress during high tide and surges.

Figure 3-1: Proposed Location Map of Gas Pipeline Network
Source: Construction of Gas Pipeline for. Mirsarai Economic Zone and KGDCL, Gas Distribution. Network Up-gradation Project by KGDCL. (Year Dec, 2019)

3.1.2. SITE DESCRIPTION OF SUB-PROJECT STUDY AREA

43. The study area is considered as a 10 km radius around the BEZA (Zone 2A and Zone 2B) site. Project activity areas are considered as core areas and the remaining study areas as buffer zones. A 10 km (buffer area) radius environment around the BEZA site and around the access road are given in **Table 3-1**.

Table 3-1: Environmental and Social setting within the study area

Particulars	Details
Location	Mirsharai Upazila, Chattogram district
Nearby Village	Abu Torab and Charsarat Village
Site Elevation	7m MSL
Nearest Railway Station	Sitakunda
Climatic conditions	Sub-tropical
Seismic Zone	Z=0.28 (Zone 3)
Forests / National Parks	Mangrove Forest
Archaeologically important places / monuments	None
The surroundings of the project site are characterized	**North:** Feni river, switch gate of Feni River, agricultural land, mangrove forest, etc. **East:** Dhaka-Chattogram Highway (10 km from the study area), EZ connecting road, Ichakhali khal switch gate, Mangrove Forest, CDSP Bund, etc. **South:** Bay of Bengal, super dyke, etc. **West:** Bay of Bengal, Super dyke of Economic zone, industry, etc.

3.1.3. MAJOR FEATURES OF PROPOSED SUB-PROJECT

44. BEZA has developed industrial plots in the NSEZ, Mirsharai, Chattogram and planned to construct utility facilities to the industrial plots. The facility includes the construction of gas pipeline networks to supply natural gas to 2A (Zone-6, 8, 22,), 2B (zone-10, 19, 23) and the adjacent industrial economic zones of NSEZ by the KGDCL, connecting the Bakhrabad-Chattogram Transmission line of GTCL along the Dhaka-Chattogram Highway via Sheikh Hasina Sarani. This will be implemented under the PRIDE project of the BEZA. Construction of Gas Pipeline at 2A, 2B and adjacent Zones of BEZA, Mirsharai Chattogram has been undertaken to expand the gas distribution network to meet customer demands. 350 psig and 150 psig pipe networks. The basic information gas pipeline works including major features are shown in **Table** 3-2 and depicted in **Figure 3-2.**

Table 3-2: Basic information and salient features of the proposed gas pipeline network

No	Item	Description
1	Name of the Project	Environmental and Social Impact Assessment of Gas Pipeline
2	Proponent	Bangladesh Economic Zones Authority (BEZA)
3	Contract	Contract[1] for Design, Supply, Installation, Testing & Commissioning of gas pipeline networks, DRS and ancillary works as Turnkey basis in 2A-2B Zone and adjacent areas at Mirsharai BEZA, Chattogram
4	Project Location	Zone 2A and Zone 2B, NSEZ, Mirsharai
5	Gas suppliers	Karnaphuli Gas Distribution Company Limited (KGDCL).
6	Pipeline size	8-to-24-inch diameter
7	Pipeline length	About 28 kilometer
		Construction of gas pipeline of 24-inch diameter and 350 psig pressure, 6 km
		Construction of gas pipeline of 16-inch diameter and 350 psig pressure. 6 km
		Construction of gas pipeline of 10-inch diameter and 150 psig pressure, 13 km
		Construction of gas pipeline of 8-inch diameter and 150 psig pressure, 7 km
8	Mainline Pipe Specification	24" & 16" OD, Wall Thickness 9.53 mm and 10" & 8" OD, Wall Thickness 7.80 & 7.04 respectively. Pipe Spec.: API 5LX52 (PSL-2), LSAW Carbon Steel, Coating 3LPE (3.5 mm) for 24" & 16" OD only End

[1] Bid Document: Design, Supply, Installation, Testing & Commissioning of gas pipeline networks, DRS and ancillary works as Turnkey basis in 2A-2B Zone and adjacent areas at Mirsharai BEZA, Chattogram, 2023. BEZA

No	Item	Description
		Plain Ends beveled approximately to an angle of 30º, +5º, -0º with a root face of 1.6mm +06mm -0mm.
9	Total Pipeline Length including khal & road crossing	Around 12 kilometer for 350 psig; and Around 20 kilometer for 150 psig.
10	Construction of Valve Stations	5 Valve Station area will be 40 Ft x 20 Ft.
11	Construction of High-Pressure District Regulating Stations (HP-DRS)	2 No. DRS area will be 200 Ft x 200 Ft
12	RMS inlet Pressure	150 to 350 PSIG pressure
13	Design Pressure	740 psig for NPS 24" and 16" pipe 285 psig for NPS 10" and 8" pipe
14	Maximum Allowable operating Pressure	740 psig for NPS 24" and 16" pipe 285 psig for NPS 10" and 8" pipe
15	Flowing Fluid though Pipeline	Natural Gas/Re-gasified Liquefied Natural Gas (R-LNG)
16	Operating Temperature	0 to 55 ^{0}C
17	Casing Pipe Specification	30", 20", 14" & 12", API 5L
18	Induction Bend Specification	Radius of Curvature: 8D, Wall Thickness 9.53 mm Pipe Spec. API 5LX52 (PSL-2), Coating: None. Tangent length 150 mm. End: Plain Ends beveled approximately to an angle of 30º, +5º, -0º with a root face of 1.6mm +06mm -0mm.
	Civil works for DRS and Valve Station by Contractor	
1	Temporary store	1 no.
2	Construction of 02 (Two) storied control building	224 sqm.
3	Boundary wall in RCC Frame	1.80m in height and 616 Rm
4	Installation of Deep tube well with water pump inside DRS area	02 nos.
5	Construction of RCC surface drain of 600 x 300mm clear width (top & bottom) and 600mm (av.) depth with of side slope 2:1 trapezoidal section	488 Rm
6	Spiral-type barbed wire in fencing work	of 600 mm dia, 616 Rm
7	Construction of shed building (40'-0" x 20'-0") with RCC column foundation with internal electrification	1 no. storied
8	Construction of (10'-0" x 10'-0") CP room with RCC column foundation with internal electrification	2 nos.
9	4000mm wide x 150mm thick RCC in plant road to be constructed within the station area to facilitate vehicle movement.	500 sqm
10	Related other Civil Works	2 storied Operator building, Boundary wall, Base for DRS, temporary store, lighting, drains etc.

Source: NSEZ-PRIDE Project PIU, Engineering Design of the Proposed Gas Pipeline Network

3.1.4. GAS PIPELINES CROSSING THE ROADS AND EXISING SERVICES

45. Technical Specifications of the sub project is shown in **Table 3-3**. The proposed gas distribution pipeline will be constructed along the utility corridor of the internal roads and metaled road networks within the 2A and 2B zones, which may require some trench work and the establishment of three (3) labor camps. The cross-section designs of the proposed gas pipeline crossing road ways and unmetalled roads within Zone 2A and Zone 2B, and its adjacent area are presented in **Figure 3-3** and **Figure 3-4**. The standard details for the gas pipelines crossing canals, pond river is shown as **Figure 3-5** The cross-sectional designs of slope protection and standards of DRS, boundary of the DRS, Valve station, surface drain, building etc. are depicted in **Annex-1 Data Book, Volume 2**.

Table 3-3: Technical Specifications of the sub-project

Sl No.	Name of Item	Details
1	Diameter of Pipe	24 inch.
2	Trench for Gas Pipeline	3 feet
3.	Depth of the trench	1.5 meter
4.	Digging trench/day	300-400 meter
5.	Amont of supplying Gas during operation	250 million cubic meter

Source: NSEZ-PRIDE project PIU-BEZA

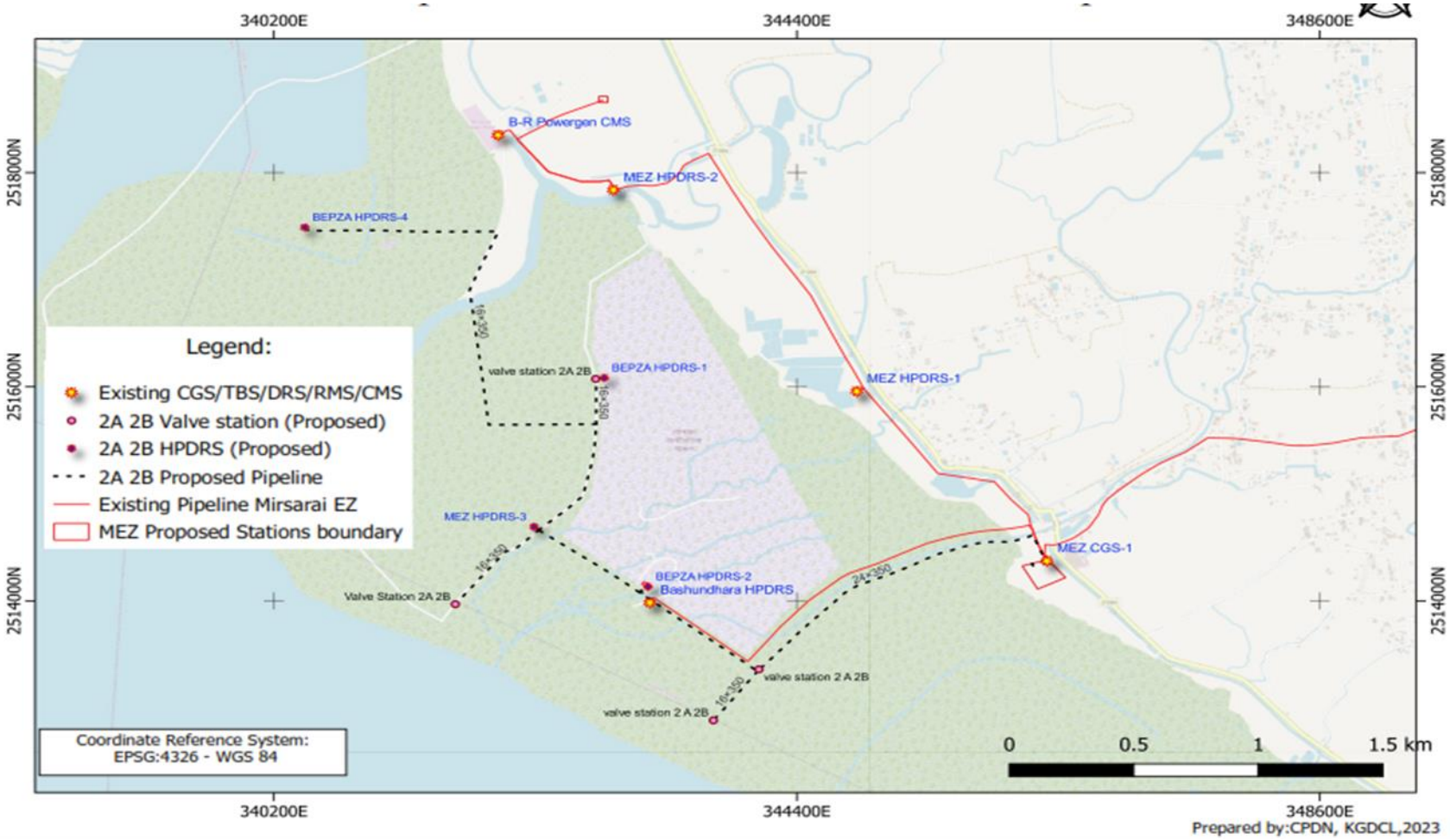


Figure 3-2: Main Features of Zone 2A and Zone 2B Gas Network

***Construction of Gas Pipeline for Mirsharai Economic Zone and KGDCL, Gas Distribution. Network Up-gradation* Project by KGDCL. (Year Dec, 2019)**

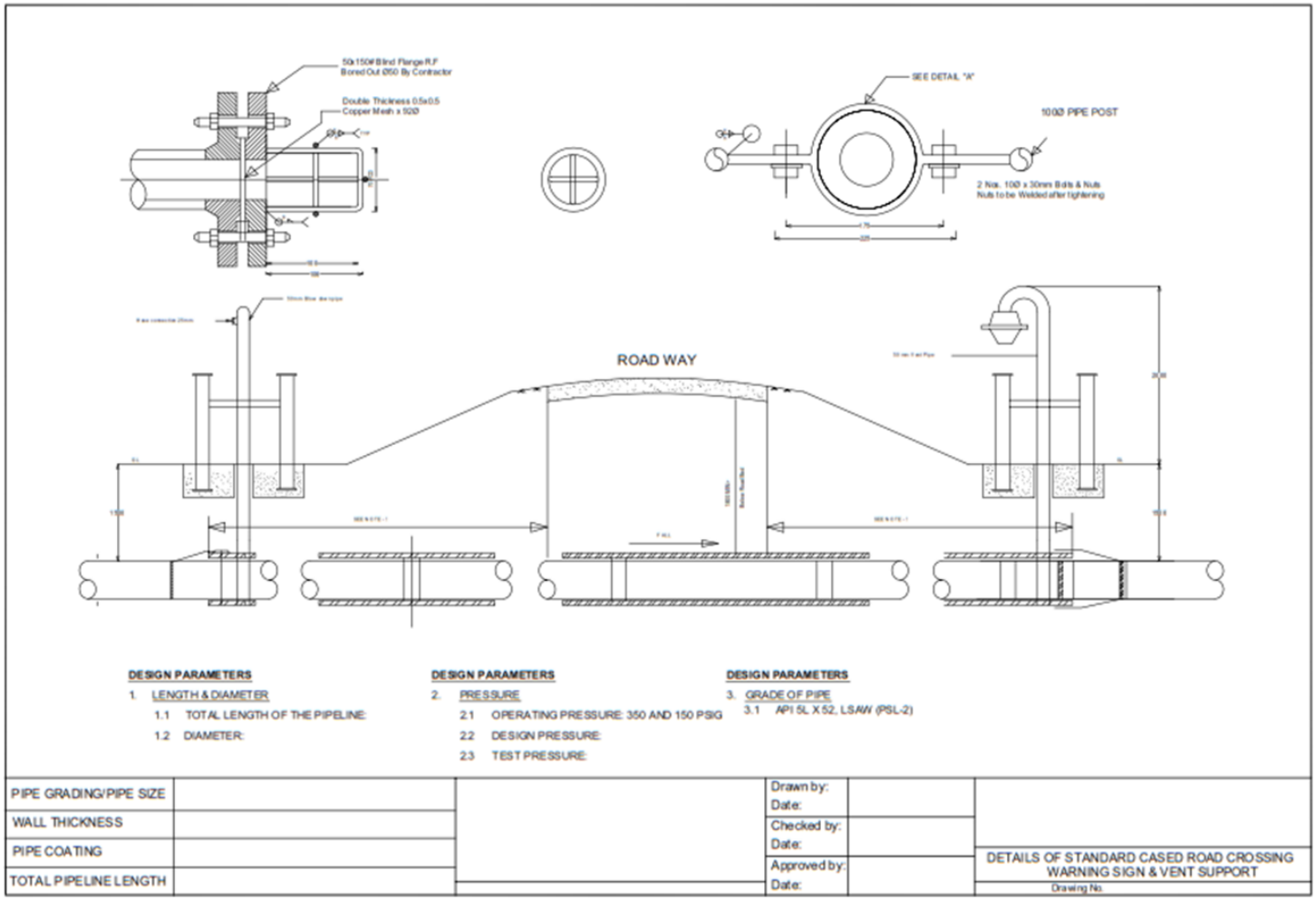


Figure 3-3: Cross-section of gas pipelines crossing the road ways within Zones 2A-2B, NSEZ

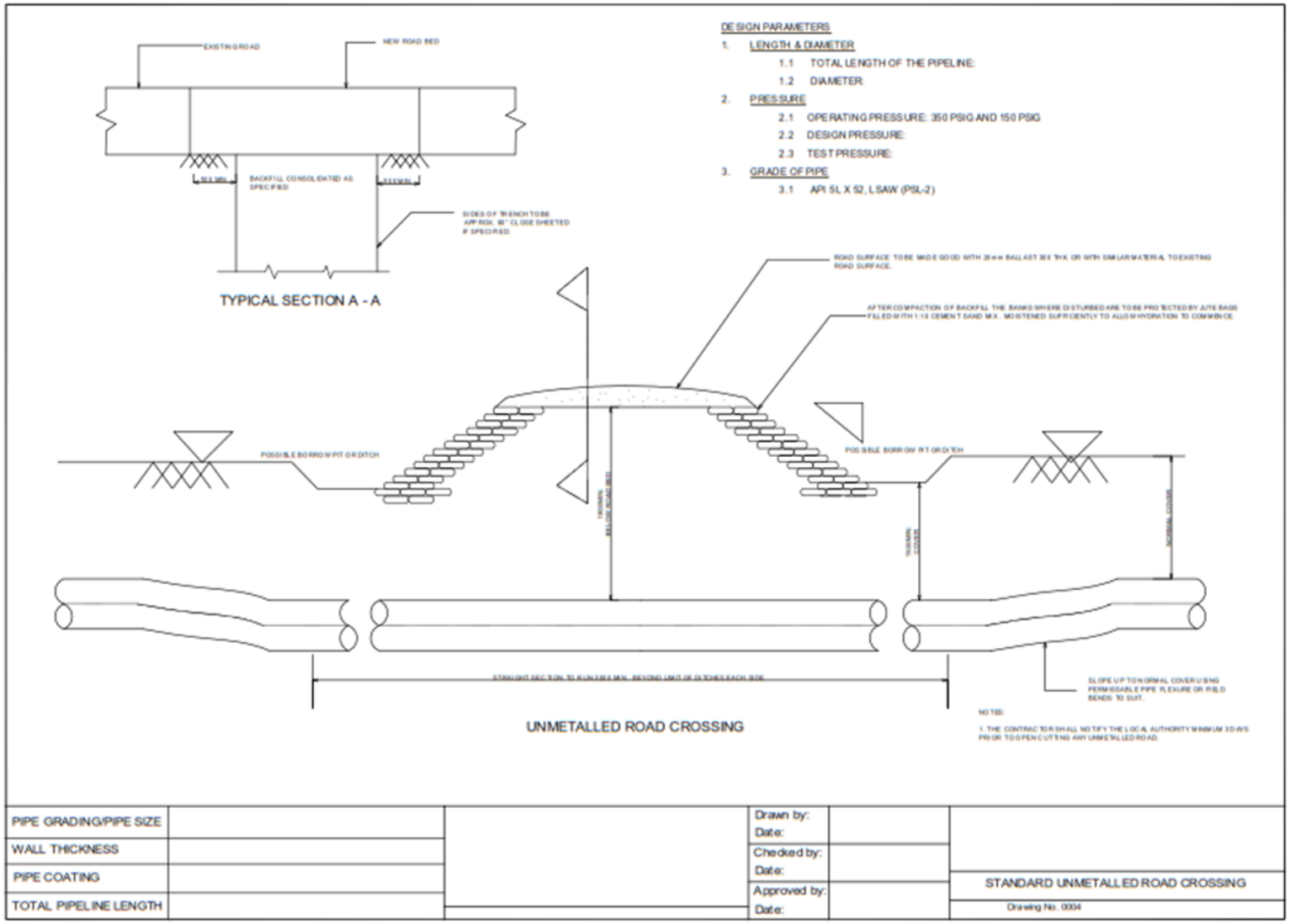


Figure 3-4: Cross sectional design of gas pipelines crossing the unmetalled road within Zone 2A-2B, NSEZ

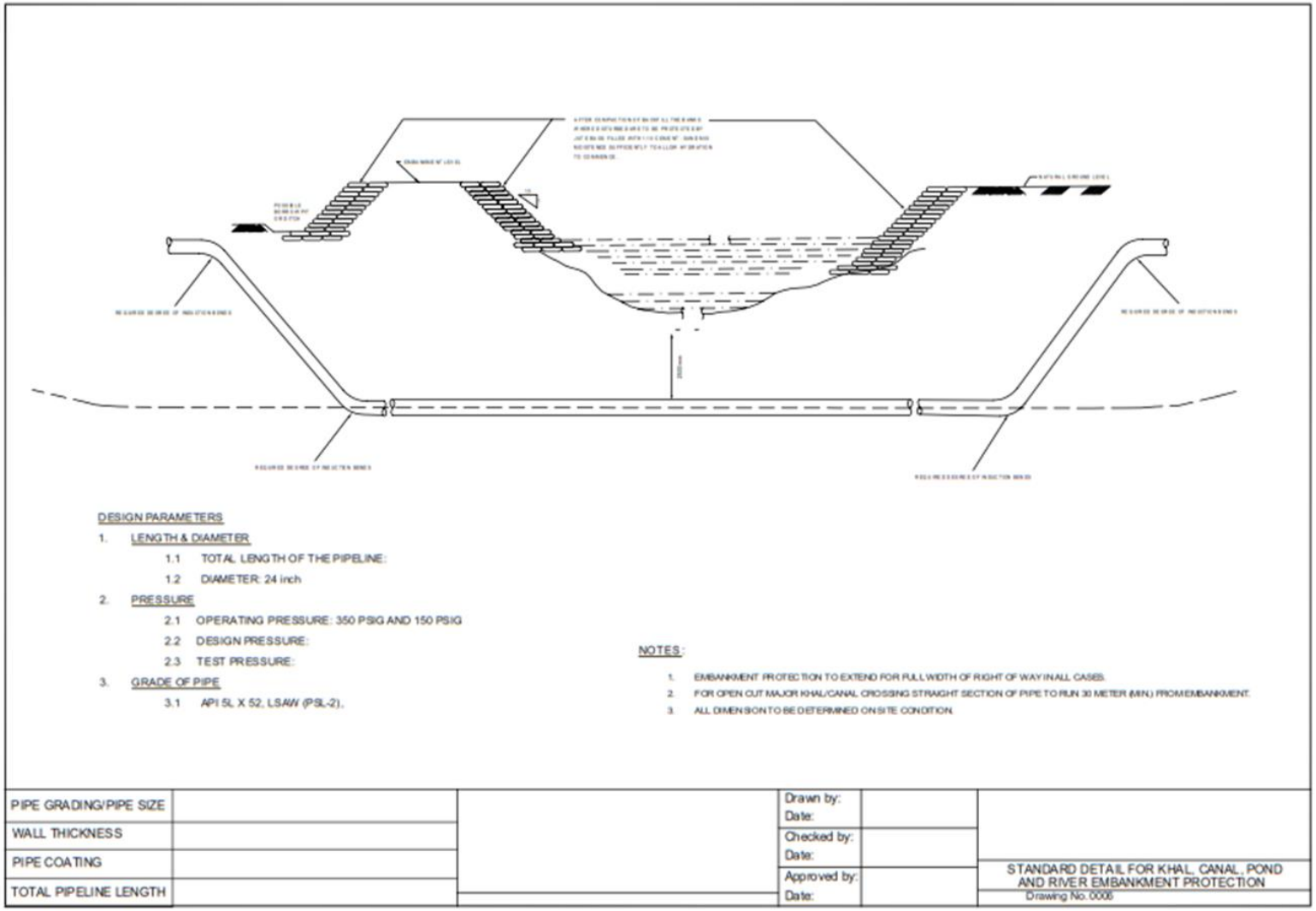


Figure 3-5: Standard for canal, pond and river embankment crossing protection within Zone 2A-2B, NSEZ

3.1.5. METHOD OF GAS PIPELINE INSTALLATION

46. The land for construction of the proposed gas pipeline is owned by BEZA and Right of Way (RoW) was selected by Karnaphuli Gas Distribution Company Limited (KGDCL). The gas pipeline will follow the Natural Gas Safety Rules, 1991. In case of the excavation, it should be designed properly to take care of existing buildings, utility lines and available techniques. Whenever any soil improvement measures are taken or pile is driven, at least one plate load test at column location where vertical load is maximum to ensure that the bearing capacity and settlement of in situ soil. The proposed gas pipeline will be built using the open cut approach, including road crossing, a railway crossing, a river/stream/khal crossing/ a canal/drainage/nala crossing, and a utility crossing, During the installation of the gas pipeline, public access will be restricted, and an alternative route should be open for the local community to use on a regular basis. All crossing work will be done in consultation with the community, and appropriate notice will be issued to ensure their understanding. The following activities will be carried for installation of the proposed gas pipeline networks (**Table 3-4**).

Table 3-4: Activities to be carried for installation of the proposed gas pipeline networks

Activities	Brief Description
Pipeline Route and Working Area selection.	To physically verify the identified roads and confirm its suitability for pipeline construction. To identify restrictive areas and suggest modifications/detouring to the identified routes. To establish the route on the ground.
Clearing and Grading of Right of Way	Collecting information required for obtaining clearance of RoW in the identified routes. Identify RoW, length, elevation, alignment of the proposed route.
Manpower Engagement.	Identify types, and periods of engagement of required manpower.
Preparation of Base camp, storage areas & Field camp for workers.	Identifying and select the suitable locations for construction of base camp, storage areas and labor camps
Installation of sanitary toilets and drinking water facilities to the labor camps.	Necessities of installation of submersible pump at the labor camp for drinking waters and other purposes like bathing, and household works. Identify and select the suitable locations for installation of sanitary toilets adjacent to the labor camps.
Site security (Fencing) etc.	Identify and select the points for installation of Fencing
Preparation of site development	Necessary preparation will undertake.
Transportation and hauling of pipes.	Identify and select the transportation ways to carrying out different materials at the site.
Temporary Storage in Stockyard –pipe fittings & other material.	Identify and select the stockyard locations.
Stringing of line pipe.	Necessary stringing of pipeline will be carried out.
Pipe bending using bending machine.	Necessary pipe bending will be undertaken.
Equipment and Vehicle Mobilization.	Equipment and vehicle mobilization will be carried out.
External cleaning of pipe.	Necessary external cleaning will take
Welding, Cleaning of welding area of mainline pipe by sand blasting.	Welding, cleaning will be undertaken.
Grading, Installation of Coating of Pipeline or Cathodic protection.	Grading, installation, coating or cathodic protection will take.
River, Road & Rail crossing by thrust boring versus open cutting, and Metering Stations etc.	Crossing sections will be conducted by thrust boring method to avoid negative effects.
Tightness and leak testing of pipelines (hydrostatic testing)	Hydrostatic testing will take.
Trenching, Lowering in Gas Pipe Laying, Tying up.	Trenching, and tiding up will take.
Backfilling, Re-instatement and Clean-up.	Backfilling, re-instatement and cleanup will take.
Pipeline Commissioning	Commissiong will take after installation.

Activities	Brief Description
Metering station and other permanent structures above-ground facilities.	Excavation, backfilling, concrete works, finishing works and painting will take during construction period.

3.2. LAND USE ALONG ROUTES

47. According to detailed topographic the land uses alongside the gas pipeline route are mainly vacant land with rising terrain, internal roads, earthen road, etc. Based on the terrain configuration, surface features and land use for both Spur line route has been considered as one section, as follows **Table 3-5**.

Table 3-5: Land use of the Gas pipeline Routes

Section	Terrain	Land use
(Total Pipeline Length: 30 km)	Gently Rising terrain. Surface soil is silty clay interspersed with marshy land & weathered rocks with seasonal	The proposed Pipeline route has been considered parallel to Internal Road, Asphalted, RCC, earthen, Metaled Road within RoW limit. However, the Communication network is very good in the selected routes

48. The pipeline route has been proposed parallel to existing roads from take-off to terminal point. The detail of pipeline alignment is presented in **Volume 3**. According to topo survey, a few structures and boundary walls different categories of structures were found within survey area with a number of major & minor crossings, is furnished in **Annex-2 Data Book, Volume 2**. At the left side 10 building structures and at right side 16 building are built up there. Similarly, six (6) and five (5) boundary walls are noted and left side and right side, respectively. A total five (5) ditches are located within survey area, of them one is at left side and the rest are in right side. In addition, pipelines crosses canal at seven (7) locations of same three (3) canals and ten (10) low-lying areas. About, 509 electricity poles, 74 electric light posts, and 9 water pipelines are located within surveyed ROW at different distances from the proposed alignments (**Details in Annex-2, Data book. Volume 2.).** The major canals crosses are shown in **Table 3-6.**

Table 3-6: Gas pipeline canal crossings

Sl. No	Canal Name	Location, GPS Reading
1	Ichakhali canal	Besides of BEZA Office, Zone-1, N 22.76075˚, E 091.47124˚
		Ziro point, N 22.76540˚, E 091.46287˚
		Near REB Substation, N 22.75126˚, E 091.45914˚
		Near the Super dyke , N 22˚ 44′33″, E 91˚ 27′02″
2	Susham	South Bank N 22.750948226, E 91.4591270681, North Bank N 22.7512402282 E 91.4591240655
3	Bashundhara Canal	South Bank N 22.73156008,E 91.4663240433, North Bank N 22.7321837275,E 91.4654432171
		South Bank N 22.7206489267,E 91.4818004432, North Bank N 22.7210055782,E 91.4813503277

Source: Topo-survey of the Gas pipelines networks, 2023

3.3. SOIL CHARACTERISTICS

49. About 30.0 m depth from the existing ground level in the study area indicate that .the overall soil formations are regular and the top layers of the investigated site have been encountered with comprising grey, very soft to stiff, silty clay & very loose to lose, silty sand. Whereas The deep layer grey to light grey, loose to very dense, silty sand, extending up to the final depth of borings. The position of Ground Water Table (GWT) was also determined during the geo-technical investigation at 10 borehole locations to know the current state of water table, however, bore log results show that the water table in the study areas is slightly varied from place to place.

3.4. LAND REQUIREMENTS

50. No land acquisition is required, since entire lands under Zones 2A-2B owned by the BEZA. However, the proposed gas distribution pipeline will be constructed along the utility corridor of the approach and internal roads connecting 2A and 2B zones outside the private land.

3.5. UTILITY DEMAND, MANPOWER AND MATERIALS REQUIREMENTS

3.5.1. UTILITY DEMANDS

51. Water, fuel, and electricity are necessary for the pipeline construction activities. The approximate utility demand for the pipeline construction is presented in **Table 3-7.**

Table 3-7: Consumption of utility during construction

Sl No	Name of utilities	Details	Utility sources
1	Water	60 liters per day per person. Approximate 2500 Liters /day for 40 individual /workers	Deep tube well
2	Electricity	5 KW/day	Local
3	HSD	Need based approach will apply.	Local
	Fuel: Gas	For cooking and welding, cylinder gas will be used	LPG and Fire wood
	Fuel: Octan	For 10 no. light vehicles	Supplier
	Fuel: Diesel	for 20 no. heavy vehicles, 5 no. diesel generator	
Source: KGDCL, 2024			

3.5.2. MANPOWER

52. The Project Implementing Unit (PIU), PRIDE project would require skilled manpower to preparing bid document, technical and safeguard specifications of contract document, float bid document during the pre-construction period, as well as supervision and monitoring during the construction period. The construction of Gas pipeline network in Zone 2A and Zone 2B would be developed by the contractor, the contractor will hire sufficient number of skilled manpower. Around 30-40 individuals will be required at the sites during the construction period. During the operation period, it is estimated that more than 200 workers, staff and other official will be recruited at the project sites for various industries and factories.

3.5.3. MATERIAL REQUIREMENTS

53. The main requirement of the materials is mostly safety relief valve, Transmitters, Flow Computer, Various types of Valves, (Ball, Globe, Plug & Check Valves), API 5L Line pipes, Various Types of Fittings, Insulating Joints, Industrial Uninterrupted Power Supply (UPS), Wrapping & Coating materials, CP materials, etc. These materials will be brought to the project sites from Chattogram Port by long carrier containers. The standards specification of gas pipelines installation are as follows

- ASME B31.8: Gas Transmission and Distribution Piping System
- ASME B31.3: Process Piping.
- ASME Section VIII: Unfired Pressure Vessels
- API Spec 5L:Specification for Line Pipe (Latest edition)
- API Std. 1104:Standard for Welding Pipelines and Related Facilities (Latest Edition)
- API RP 1102: Recommended Practice for Liquid Petroleum Lines Crossing Highways
- NACE RP0169:Control of External corrosion on Underground or Submerged Metallic Pipelines
- NACE RP0177:Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
- NEMA: National electrical Manufacturers Association, USA.
- API 2201:Procedures for Welding or Hot Tapping on Equipment Containing Flammables
- SSPC-SP-1:Solvent Cleaners
- SSPC-SP-11:Power Tool Cleaning
- SSPC-SP-10:Near-White Blast Cleaning
- BS 1722: Part 1:Chain Link Fences
- AGA Report #3: Standard Gas Fluids Measurement
- BIWTA/Railway/Highway/Waterway/DoE/BTRC/Forest/Other pipeline related Permit Requirements (Terms and condition applicable)
- Bangladesh National Building Code BNBC-2020

3.6. PROJECT COST AND IMPLEMENTATION WORKS SCHEDULE

54. The estimated cost of the proposed Gas pipeline Network sub-project is approx. 218.99 crore. According to the draft Bid Document, the implementation schedule of the project is 30 months period, which includes design, supply, installation testing and commissioning of gas pipeline networks, DRS and ancillary works as Turnkey basis in Zone 2A-2B and adjacent areas in NSEZ at Mirsharai in Chattogram. In addition, the contractor's liability period is 12 months.

Table 3-8: Project Civil Works Schedule (Indicative)

Sl. No.	Activities	Timeline									
		2024		2025				2026			
		Q-1	Q-3	Q-1	Q-2	Q-3	Q-4	Q-1	Q-2	Q-3	Q-4
1	Detailed Engineering Design (including cost estimates, technical specifications, tender documents)										
2	Tender calling, Contractor's selection, and issuing works order										
3	Site Development and Construction										
4	Project Operational start										

Note: This schedule has been prepared based on discussion with KGDCL personnel. It may be changeable based on actual conditions or unfavorable situations, natural disasters or any other reasons that could not be avoidable.

4. ENVIRONMENTAL AND SOCIAL BASELINE

4.1. INTRODUCTION

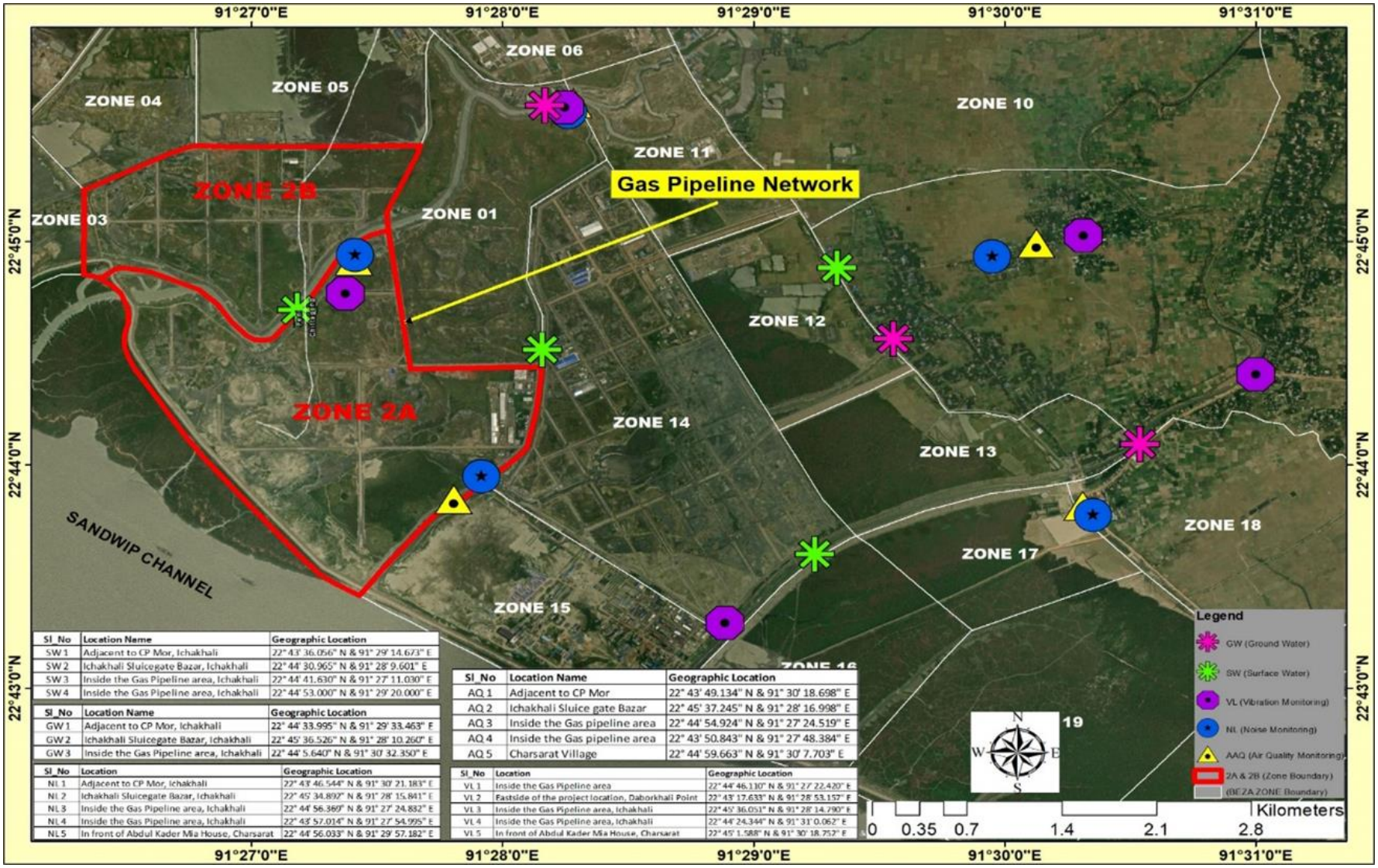
55. The construction of the gas pipeline will have environmental and socioeconomic impacts in the sup-project area including adjoining areas. The environmental and social baseline status, forming the foundation for identifying, predicting, and assessing impacts, was established through field studies covering various environmental components. The environmental and social baseline conditions includes physical resources, biological resources, and socio-economic aspects in the project areas. In this regards, the establishment of the baseline condition of sub-project area, the probable Valued Components (VCs) are identified based on nature and size of project activities, sub-project site and the potential anticipated impacts by the proposed inventions. The identified important valued environmental and social components for this sub- project are presented in **Table 4-1**

Table 4-1: VCs during pre-construction, construction and operation phases of the sub-project

Sl. No.	E&S parameters	Rationale
Pre- Construction and Construction Phases		
1	**Physical environment**	
1.1	Change of Land use, topography and land cover	▶ Change of Land use due to construction of gas pipelines and its supporting infrastructure facilities needs to study in compliance to WB's ESF-ESS1 and ESS 3. Existing plain land may be degraded landscaping due to improper open cut for trenching during gas pipelines installation;
1.2	Soil Characteristic	▶ due to construction of gas pipelines trenching, crossing the canals and disposal of solid and liquid waste may deteriorate the soil quality in the sub-project site, which needs to study in compliance to WB's ESF-ESS1 and ESS 3;.
1.3	Water logging and Drainage	▶ Water logging and drainage congestion may occur during construction works during. In compliance to WB's ESF-ESS1 needs to study;
1.4	Surface water Quality	▶ Surface water quality may be deteriorated due to wastewater from the labor camp, construction yard discharges into canals and ponds in the study area
1.5	Ground water Quality	▶ Groundwater quality may be deteriorated due to wastewater from the labor camp, construction yard discharges into the ground (ESS3)
1.6	Canals (khal) water flow	▶ Bamonsundor and Ichakhali canal water flow may be disrupted temporarily during construction works in compliance to WB's ESF- ESS 3;
1.7	Air Quality	▶ Establishment of baseline air quality. Release of air pollutants from various emission sources during construction/operation activities, use of equipment and movement of vehicles may occur such as dust and PM10 from construction/operation activities and road traffic. In compliance to WB's ESF-ESS1 and ESS 3 needs to address;
1.8	Noise Quality	▶ Establishment baseline noise level because increase in ambient noise levels from construction/operation activities, equipment, and vehicles, pipeline construction etc. may be occurred. In compliance with WB's ESF-ESS1 and ESS 3 needs to study;
2.	**Ecological Environment**	
2.1	Terrestrial Flora and Fauna	▶ A few Terrestrial flora and fauna may be affected by the construction works of the gas pipelines (ESS6);
2.2	Aquatic Flora and Fauna	▶ Aquatic flora and fauna maybe affected by the construction gas pipelines (ESS6) during crossing the canals and low-lying areas;
3.	**Social Aspect**	
3.1	Disturbance of agricultural land and produce	▶ Existing lands may be affected due to construction works;
3.2	Disruption of local access due to construction materials transportation (pipelines)	▶ Congestion of local roads sometime creates problems for smooth movement of vehicles and pedestrians. (ESS4);

Sl. No.	E&S parameters	Rationale
3.3	Occupational Health Safety and Community Health Safety	▶ Accident of the Workers and project personnel may occur, as well as to local community; ▶ Health and safety are also a concern during construction activities. OHS and CHS needs for compliance of WB's ESF-ESS 2 and ESS4 requirements;
3.4	Local Economy, Livelihood, Fishing, Buffalow Grazing etc.	▶ Disturbances and limited access to the local people into the Zones 2A and 2B may create Livelihood disruption who are based on Fishing, Buffalow Grazing etc. in Zone 2A and 2B. Needs to address in compliance of WB's ESF- ESS 5;
3.5	Traffic movement Disruption	▶ Movement of heavy vehicles for carrying the construction material may create problem for smooth movement of vehicles and pedestrian needs to be studied in compliance of WB's ESF-ESS2;
3.6	Labor Influx	▶ Labor Influx will create negative impacts due to employment of workers/ workforce from different places. Conflict may occur between local workers and far-off workers and the local community. Unhygienic conditions resulting from day-to-day activities of workers during construction stage may spread various diseases and other adverse impacts, in compliance WB's ESF-ESS2 needs to study for this project;
3.7	Gender-based Violence	▶ Gender-based violence (GBV), including sexual harassment and abuse (SHA), may occur at project sites throughout construction and operation due to workforce influx, local recruitment, and other factors. in compliance WB's ESF-ESS4, communities safety needs to study for this project;
3.8	Storage and handling Hazardous and non-hazardous waste	▶ Hazardous waste (used batteries, chemicals, used oils, lubricants, mobil, welding and metal scrap, etc.) and non-hazardous waste (All household and kitchen garbage, packaging waste (plastics, paper, cardboard, wood, etc.), and building waste (concrete, brick, rubble, iron scrap, etc.) will be produced from labor camps and storage areas during the construction period will require to address in compliance with ESS-4;
Operation and Maintenance Phase		
Physical Environment		
1.1	Noise level	During operation of valve stations and RDS center, excessive noise will be generated;
Social Aspects		
2.1	Occupational health and safety	Occupational health and safety will be at risk due to operation and maintenance of gas pipeline if accidental or incidental events like fire, explosion will occur at the sites;
2.2	Community health and safety	Community health and safety will be also at risks if accidental or incidental events like fire, explosion will occur at the sites;
2.3	Storage and handling of hazardous and non-hazardous waste	Hazardous waste and non-hazardous waste during the operation phase will require to address in compliance with ESS-4;

56. The AOI for environmental studies was considered for the information the potential VCs viz; land type , soil characteristic, drainage, hydrology, water quality the air quality, noise, etc.as well as determination of present status of the biodiversity impacts both on terrestrial and aquatic flora and fauna , while social considerations were determined based on-site visits, socioeconomic survey, and discussions with the local community. The measurements of the surface water and groundwater quality air quality, noise level and vibration level are carried within AOI area is shown in **Figure 4-1.**



Sl_No	Location Name	Geographic Location
SW 1	Adjacent to CP Mor, Ichakhali	22° 43' 36.056" N & 91° 29' 14.673" E
SW 2	Ichakhali Sluicegate Bazar, Ichakhali	22° 44' 30.965" N & 91° 28' 9.601" E
SW 3	Inside the Gas Pipeline area, Ichakhali	22° 44' 41.630" N & 91° 27' 11.030" E
SW 4	Inside the Gas Pipeline area, Ichakhali	22° 44' 53.000" N & 91° 29' 20.000" E

Sl_No	Location Name	Geographic Location
GW 1	Adjacent to CP Mor, Ichakhali	22° 44' 33.995" N & 91° 29' 33.463" E
GW 2	Ichakhali Sluicegate Bazar, Ichakhali	22° 45' 36.526" N & 91° 28' 10.260" E
GW 3	Inside the Gas Pipeline area, Ichakhali	22° 44' 5.640" N & 91° 30' 32.350" E

Sl_No	Location	Geographic Location
NL 1	Adjacent to CP Mor, Ichakhali	22° 43' 46.544" N & 91° 30' 21.183" E
NL 2	Ichakhali Sluicegate Bazar, Ichakhali	22° 45' 34.892" N & 91° 28' 15.841" E
NL 3	Inside the Gas Pipeline area, Ichakhali	22° 44' 56.369" N & 91° 27' 24.832" E
NL 4	Inside the Gas Pipeline area, Ichakhali	22° 43' 57.014" N & 91° 27' 54.995" E
NL 5	In front of Abdul Kader Mia House, Charsarat	22° 44' 56.033" N & 91° 29' 57.182" E

Sl_No	Location Name	Geographic Location
AQ 1	Adjacent to CP Mor	22° 43' 49.134" N & 91° 30' 18.698" E
AQ 2	Ichakhali Sluice gate Bazar	22° 45' 37.245" N & 91° 28' 16.998" E
AQ 3	Inside the Gas pipeline area	22° 44' 54.924" N & 91° 27' 24.519" E
AQ 4	Inside the Gas pipeline area	22° 43' 50.843" N & 91° 27' 48.384" E
AQ 5	Charsarat Village	22° 44' 59.663" N & 91° 30' 7.703" E

Sl_No	Location	Geographic Location
VL 1	Inside the Gas Pipeline area	22° 44' 46.110" N & 91° 27' 22.420" E
VL 2	Eastside of the project location, Daborkhali Point	22° 43' 17.633" N & 91° 28' 53.157" E
VL 3	Inside the Gas Pipeline area, Ichakhali	22° 45' 36.051" N & 91° 28' 14.790" E
VL 4	Inside the Gas Pipeline area, Ichakhali	22° 44' 24.344" N & 91° 31' 0.062" E
VL 5	In front of Abdul Kader Mia House, Charsarat	22° 45' 1.588" N & 91° 30' 18.752" E

Figure 4-1: Monitoring locations for surface & groundwater, airquality, noise and vibration levels testing

57. The subsequent section categorizes the baseline environment into three major dimensions:

- Physical Environment: Encompassing physiography, land-use, soil and, meteorology and hydrology including Environmental Quality such as evaluating air, water, noise quality, vibration level, soil, and sediment. etc.;
- Biological Environment: Addressing factors related to life, including habitats, aquatic life, fisheries, terrestrial and aquatic habitats, flora, and fauna;
- Socio-economic Environment: Focusing on anthropological factors such as demography, income, and infrastructure etc.

4.2. PHYSICAL ENVIRONMENT

58. Environmental Data Collection and Analysis: To establish a baseline biophysical condition, the primary data collected from analytical testing of samples from site and secondary data from various sources such as Bangladesh Meteorological Department (BMD), Geological Survey of Bangladesh (GSB), and other governmental departments, reports, and journals were collected and analyzed. Secondary data on climate (weather), , disaster risks and ecological diversity were also analyzed.

4.2.1. PHYSIOGRAPHY

59. Bangladesh is the world's largest deltaic region with most of its parts located at low altitudes. It is a riverine country crossed by numerous rivers, streams, and their tributaries. It is divided into five physical regions – the Ganges Delta proper to the southwest, the Paradelta to the northeast and the Chittagong region in the southeast. The total flood plain of the Ganges has a low ridge and a basin relief crossed by many tidal rivers and creeks. EZ sites are generally flat, low-lying, and poorly drained. The land use of the project site is 'wetland'. The Ichakhali Canal and the tributaries of the Ichakhali Canal are located here, which are flooded during monsoons and high tides. Site development work is underway and most of the land has already been developed. The average elevation of the site at present is about 7m MSL. According to the physiography of Bangladesh, the proposed sub-project area falls under the physiographic unit “Delta (Tidal), Coastal plain”. Chittagong Coastal Plain is exposed to cyclones and low-lying coastal areas are subject to saline storm surges. According to the UNDP and FAO (1988), young tidal floodplains are occupying a narrow strip along the study area. It comprises saline mud flats and marshes exposed at low tide. The landscape is almost level and is crisscrossed by numerous tidal creeks. Heavy silts and clay predominate. Many soils are actually or potentially extremely acid in reaction due to the presence of acid sulphate conditions, but acid sulphate layers inland have generally been buried by 50 cm or more of less Acid River or piedmont alluvium. Seasonal flooding is found in the higher parts and in embanked areas is mainly by rainwater. On lower land and near the coast, the land is tidally flooded with saline water. The physiography map of the study area is presented in **Annex-3 Baseline Details. Map-1, Data Book, Vol.2.**

4.2.2. LAND RESOURCES AND LAND USE PATTERN

60. The sub-project area has mixed features comprised of plain land, high lands, ponds, canals roads, etc. The land use map of the project area is presented in **Annex-3, Map-2, Data Book, Vol.2.** The overall project's area is approximately 19.65 sq km, of which 1.04 sq km are highland and 6.14 sq km are low land (or 4% of the total). Most of the project's area about 26% of the total area is flat ground. A proposed road would make up 1.75 sq km, or 4% of the total area; a pond would make up less than 1% of the space about 0.01 sq km, and canal would make up 0.62 sq km, or 1%. The landscape status of the project area is presented in **Figure 4-2.**

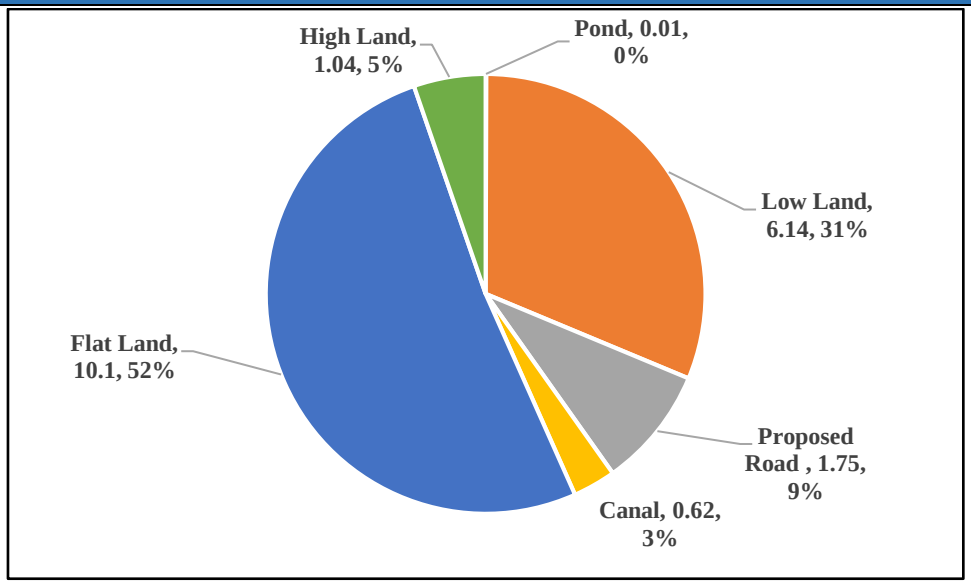


Figure 4-2: Landscape status of the project area
Source: Satellite Imaginary

4.2.3. GEOLOGY AND SOIL CHARACTERISTICS

61. The geology of the project area can generally be classified as sedimentary with limestone including metamorphic rocks such as travertine. Occurs as any of the following: quartzite, graphitic schist, chlorite, amphibole, mica and kyalite schist, hornblende, biotite and garnet, gneiss, acid gneiss, granular or charconite. The site is close to the sea and Feni River and covered with clay and sand deposits. According to the Geological Map of Bangladesh, the site is covered by beach and dune sand and water and is classified as low and intertidal plains according to the geomorphic map of Chattogram. The geological and soil maps showing the sub-project area in **Map-3,** and **Map-4, Data Book,Vol.2.** The soil of the project area mainly formed from recent alluvial sediments. The major types of soils reported from the study area includes :

- Grey Piedmont soils Occur extensively on the northern and eastern Piedmont Plains and locally on the Chittagong coastal plain. They have been formed in the out-wash alluvium at the foot of hills, having a cambic B-horizon which has a grey matrix and is medium or very strongly acid in reaction. They are mainly included in Dystric or Eutric Gleysols.
- Calcareous Alluvium Soils are stratified or raw alluvium throughout or below the cultivated layer. They are calcareous throughout or part of it and lack in having diagnostic subsoil horizon. This alluvium on the active Ganges floodplain mainly comprises brownish grey to pale brown sandy and silty deposits, which are moderately calcareous. Soils on the Lower Meghna estuarine floodplain is slightly calcareous grey to olive, finely stratified silts. They are mainly Calcaric Fluvisols.

62. Shear wave (S-wave) velocity, Vs, of soils is a small-strain parameter that is widely used to evaluate the dynamic response of soils, including seismic site response and liquefaction potential of soils. Soil type identification from shear wave velocity[2] is shown in **Table 4-2.** The AVS 30 based engineering soil map of Mirsharai Upazila is given **Figure 4-3.**

Table 4-2: Identification of soil type from shear wave velocity

Ground Class	AVS 30 (m/s)	Soil Type
C	360-760	Very Dense/ Hard Soil and Soft rock
D1	300-360	Stiff / Dense to very tense/Hard Soil
D2	250-300	Stiff / Dense Soil
D3	220-250	Medium Stiff to Stiff / Medium Dense to Dense Soil
D4	200-220	Medium Stiff / Medium Dense Soil
D5	180-200	Soft/Loose to Medium Stiff /Medium Dense Soil
E	<180	Soft / Loose Soil

[2] Geological study and seismic hazard assessment, Mirsharai Upazila Development Plan (MUDP)

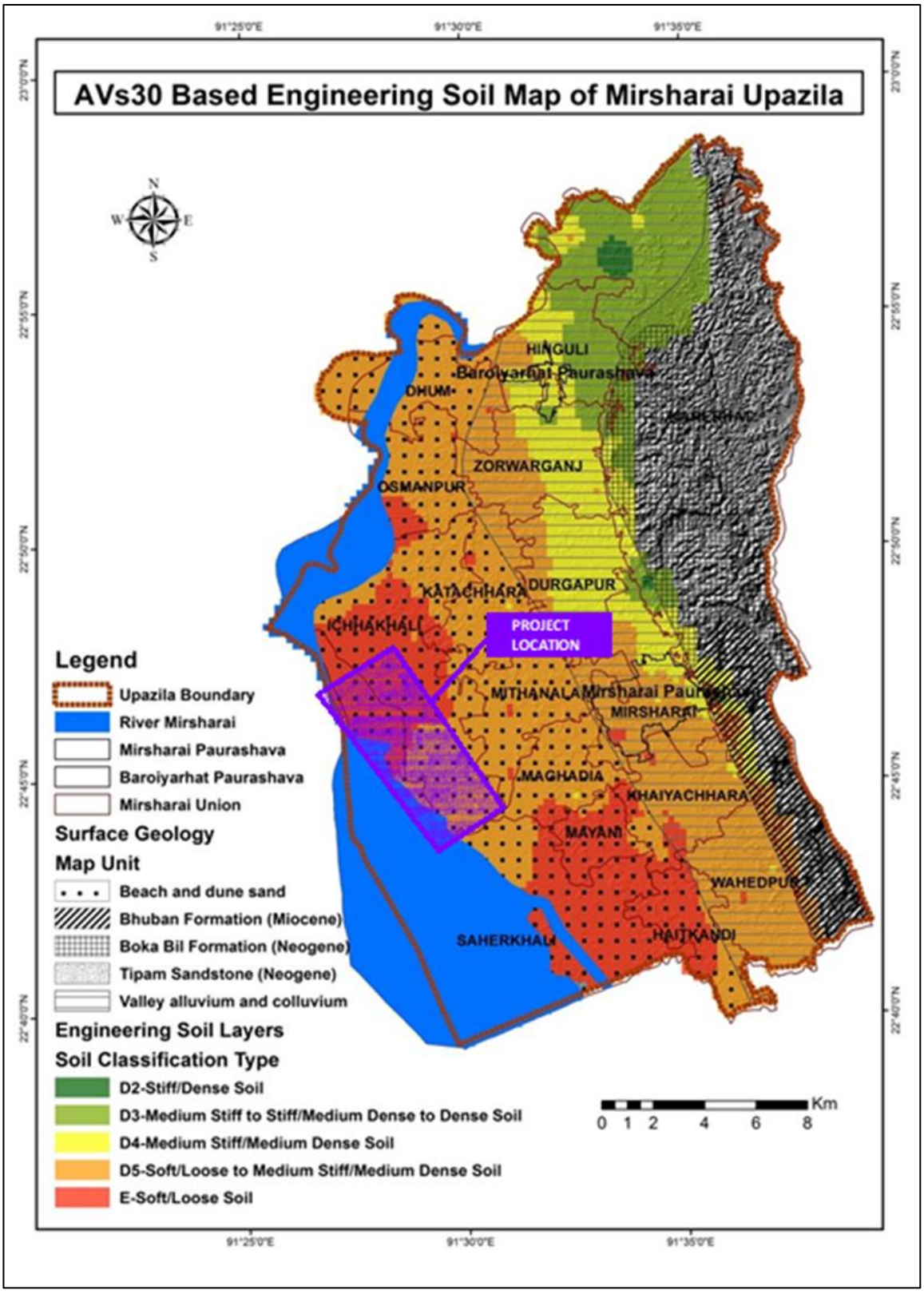


Figure 4-3: AVS 30 based engineering soil map of Mirsharai Upazila

Source: Geological study and seismic hazard assessment, Mirsharai Upazila Development Plan (MUDP), 2020

4.2.3.1. SOIL CHARACTERISTICS OF SUB-PROJECT AREA

Geotechnical Investigation was carried out to let be informed on strength and compressibility characteristics of the sub - soil to the design engineer for selection of Suitable depth and type of foundation for the proposed structure. The investigation works including execution of 10 (ten) boreholes up to 30.0 m depth from the existing ground level. The locations of the boreholes (BHs) are presented in **Figure 4-4**. Subsurface conditions at the site were explored through (i) drilling boreholes, (ii) conducting standard penetration tests,

disturbed and undisturbed sampling for laboratory testing and analysis (**Soil Investigation Report, Volume-4**). All of these items of the field investigation have subsequently been followed by the performance of laboratory tests. Report of geotechnical investigation is included in **Annex-2 Data Book, Volume 2.**

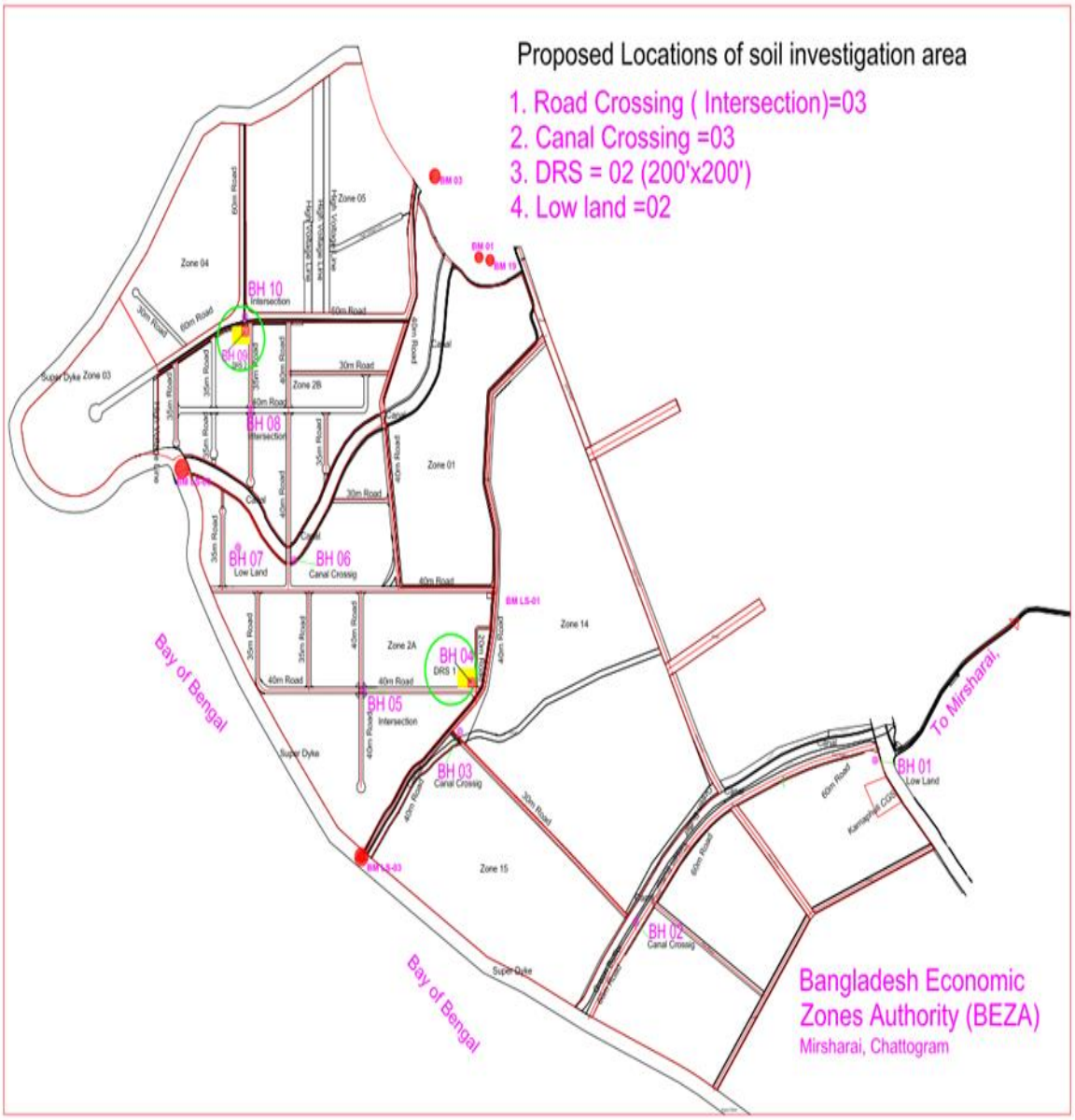


Figure 4-4: Location of Soil Investigation Areas

Source: Urban Development Directorate (UDD), Center for Geoservices & Research, August, 2018

63. The results of investigation of 10 (ten) boreholes up to 30.0 m depth from the existing ground level in the study area indicate that .the overall soil formations are regular and the top layers of the investigated site have been encountered with comprising grey, very soft to stiff, silty clay & very loose to lose, silty sand. The deep layer grey to light grey, loose to very dense, silty sand, extending up to the final depth of borings. The data on the soil size fractions at different 10 boreholes are presented in **Annex-2, Data Book, Vol-2** .The results of soil characteristic of 10 different boreholes are presented in **Table 4-3**.

- The overall soil formations of the investigated site are regular in between the Borehole locations.
- The top layers of the investigated site have been encountered with comprising grey, very soft to stiff, silty clay & very loose to lose, silty sand. (Ref. Bore logs).
- The deep layer's grey to light grey, loose to very dense, silty sand, extending up to the final depth of borings

Table 4-3: Soil investigation results of 10 different boreholes (BH)

Particle Size fractions & Other Analysis	Soil Investigation of 10 different Boreholes (BH)									
	BH 1 (%)	BH 2 (%)	BH 3 (%)	BH 4 (%)	BH 5 (%)	BH 6 (%)	BH 7 (%)	BH 8 (%)	BH 9 (%)	BH 10 (%)
Gravel : 75.00 mm to 4.75 mm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse sand :4.75 mm to 2.00 mm (Passing #4 and retained on #10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium sand : 2.00 mm to 0.425 mm (Passing #10 and retained on #40)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine sand : 0.425 mm to 0.075 mm (Passing #40 and retained on #200)	2.92	3.78	4.82	4.50	4.64	4.28	3.34	4.18	2.74	3.10
Silt size : 0.075 to 0.005 mm	74.97	75.72	74.10	72.35	71.66	74.07	75.11	74.17	77.67	74.69
Clay size : Smaller than 0.005	22.11	20.50	21.08	23.15	23.70	21.65	21.55	21.65	19.59	22.21
Colloid : Smaller than 0.001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100	100	100	100	100	100	100	100	100	100
Depth (m)	3.0	4.5	4.5	6.0	4.5	4.5	3.0	6.0	4.5	6.0
Sand (%)	2.92	3.87	4.82	4.50	4.64	4.28	3.342	4.18	2.74	3.10
Fine (%)	97.08	96.22	95.18	95.508	95.36	95.72	96.66	95.82	97.26	96.9008
LL	41.0	38.0	38.0	39.0	41.0	40.0	38.00	40.0	38.00	38.0
PL	25.0	24.0	25.0	22.0	25.0	22.0	23.0	24.0	24.0	23.0
PI	16.0	14.0	13.0	17.0	16.0	18.0	15.0	16.0	14.0	15.0
Specific Gravity	2.69	2.69	2.69	2.70	2.71	2.70	2.69	2.70	2.70	2.69

Source: Soil Investigation Report, 2023: (Ref. Bore logs sheet, Data Book).

4.2.4. GENERAL HYDROLOGY AND DRAINAGE SYSTEM IN STUDY AREA

64. The general hydrology of the study area comprised the Feni river, three canals (*khal*) such as Ichakhali khal, Daborkhali khal and Bamon Sundar khal. located in project study area, lies in the flood plain of Feni river. The Sandwip channel passes along the western boundary of Zone 2A & 2B. The Ichakhali khal passes within the project area Zone 2A and Zone 2B. and the shallow aquifer of about 20-50m thickness exists near the surface. Aquifers are semi-confined to confine in nature. Transmissivity of the Chattogram district varies from 114-600 sqm/day. Storage coefficient varies from 0.0007 to 0.03. Permeability of the aquifer varies from 3-10 sqm/day. There is no man-made drainage system at the project site. However, there are natural drainage systems within the project site such as Daborkhali and Ichakhali canal. The water in Ichakhali canal is controlled by means of sluice gate, which is located at the entry point of the channel on SW side of the project site. The upstream area of Ichakhali Canal is crisscrossed by natural drains. The flow direction is towards the Ichakhali channel and the water from the Ichakhali channel eventually flows into the Sandwip Channel. According to Physical Infrastructure survey under Mirsharai Upazila Development Plan (MUDP), 2018, in Mirsharai Paurashava, the drainage system with 75% of the drains covered and the remaining 25% left uncovered. Notably, 82% of the drains are Pucca[3] while 18% are Katcha[4]. The drainage patterns in neighboring areas of 2A and 2B zones.is shown in **Annex 3, Map-5, Data Book, Vol 2.**

65. **Canals:** Gas pipeline network crosses the Ichakhali, Daborkhali and Bamonsundar khal. All canal is more or less dried up and no water for Agricultural practices. Besides, the Daborkhali khal already blocked by BEPZA for their infrastructure development works, which is maybe for the temporary basis.

66. There is no man-made drainage system at the project site. However, the project location has natural drainage systems, such as the Ichakhali Canal. The water in the Ichakhali canal is controlled by a sluice gate

[3] In Bengali, "pucca'' generally means 'solid,' 'permanent,' or 'firm.' It is often used to describe something that is well-constructed or established.

[4] in Bengali, "katcha" is often used to refer to something that is made of muddy, or not well-developed.

positioned in the SW direction of the project site near the Sandwip Channel's entry point. The natural drains run throughout the upstream portion of Ichakhali Khal. The flow is directed towards the Ichakhali waterway, which drains into the Sandwip channel through sluice gates of the Super Dyke constructed by the Bangladesh Water Development Board (BWDB).

4.2.5. SURFACE WATER QUALITY

67. Four sampling sites for surface water were selected based on the convergence points of stream courses, areas with high-water velocity, and permanent waterbodies/ponds. Surface Amongst them three samples from the canals and one from the pond.

68. Sampling Method: The sampling process involved careful collection, composite sample mixing, and proper preservation, labeling, and storage to ensure accurate record-keeping labeled with the date, time, name of the sampling point, and their coordinates during the sampling process. Sample was collected by USEPA standard for storage, preservation, transportation and testing purposes. During surface water collection USEPA surface water sampling guideline (https://www.epa.gov/quality/surface-water-sampling) was followed. Water samples were collected as grab samples in a pre-washed 5-litre plastic can and a 1-litre sterilized clean PET bottle for complete Physico-chemical tests respectively. Samples wear labeled properly. After that, the samples were sent to the recommended laboratories i.e., BCSIR for analysis of parameters.

69. Amongst the samples, three are from the canals; Bamonsundor canal (SW1), Daborkhali canal (SW2) and Ichakhali canal (SW3), and one from the pond collected as shown in **Figure 4-1**. The location map, laboratory analysis report and Mphotographs are given in **Annex-3, Map-6**, **Data Book, Vol-2.**

70. [5]Result of Analysis: The surface water samples of the project area were analyzed on the biological and chemical parameters. The tested water quality parameters were compared against the Environment Conservation Rules (ECR), 2023, ECR Schedule 3 2 (A). (a) following the best standard practices in Bangladesh. The results showed that most of the parameters complied with the national standard, while some parameters do not comply with the standard limits. Physical and chemical properties of water except TDS of SW1 and SW 2 are within the standard of Environmental Conservation Rules (ECR), 2023. The concentration of salinity is found in all surface water samples but highest was in Bamonsundor canal about 2.1. Results of inland surface water analysis are presented in **Table 4-4.**

Table 4-4: Surface Water Analysis Result

Parameters	Unit	SW1	SW2	SW3	SW4	Bangladesh Standard[6]	Test Method (APHA)
DO	mg/L	5.39	7.56	7.51	6.47	≥5	4500-O-G
TDS	mg/L	` 2168	1332	166	304	1000	2540.C
TSS	mg/L	84	34.0	6.0	5.0	-	2540.C
EC	µS/cm	3910	2750	327	540	-	2510.B
Turbidity	NTU	42.8	81.2	65.6	46.9	-	Turbidimeter
pH	-	7.32	8.02	7.09	7.08	6-9	4500-H^+. B
Salinity	ppt	2.1	1.4	<0.1	0.2	-	-
COD	mg/L	5.64	1.88	2.82	3.76	50	5220.B
BOD	mg/L	2.32	<0.2	<0.2	0.58	≤6	5210.B
Mercury	mg/L	< 0.001	<0.001	<0.001	<0.001	-	3112.B
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	0.1	3111.B
Cadmium	mg/L	<0.001	<0.001	<0.001	<0.001	-	3111.B
Oil and Grease	mg/L	<2.0	<2.0	<2.0	<2.0	-	5520.B

[5] 20th edition of the "Standard Method for Examination of Water and Wastewater," published by the American Public Health Association (APHA). United States Environmental Protection Agency (USEPA)

[6] Bangladesh Environment Conservation Rules, 2023- Schedule 2 (Standards for Inland Surface Water, Water Usable for Fisheries).

Parameters	Unit	SW1	SW2	SW3	SW4	Bangladesh Standard[6]	Test Method (APHA)
Fecal Coliform	MPN/100ml	2.0	<1.8	2.0	<1.8[7]	2.0*	9221B-C
Total Coliform	MPN/100ml	2.0	2.0	2.0	<1.8	2.0*	9221B-C
Note: * indicates (Absent) as per BDS Standard 1240:2021							

Source: Laboratory Analysis by BCSIR, December 2023 and January 2024

4.2.6. GROUNDWATER RESOURCE AND QUALITY

71. Groundwater is heavily used for irrigation to compensate for the insufficient surface water in the project area. Shallow groundwater, located 2 to 4 meters below the ground surface, is accessible but of variable quality. Shallow tube wells are employed for irrigation, while deep tube wells with hand pumps are utilized for drinking water. Groundwater recharge happens through slow vertical percolation of rain and irrigation water, as well as seepage from rivers, canals, streams, and stored water. There is a net groundwater inflow from the north, serving as a primary source of recharge. However, the percolation rate is hindered by the thickness and impermeability of the upper clay layer. Recharge begins in May, peaks in August, but much potential recharge is lost due to quick saturation of the upper water-bearing layers and rejection by heavy surface soil.[8] Approximately 88% of the population in Mirsharai relies on tube well water, ensuring that the majority do not encounter any issues with their drinking water supply. Merely 1% of the residents utilize Chara water in this region[9].

72. **Groundwater Quality:** The selection of groundwater three (3) sampling locations aimed to capture representative water samples from different locations within the project area as shown in Figure 4-1. After being collected, the samples were placed into an appropriate and labeled black bottle and kept in an ice cooler. Then the samples were submitted to the recommended laboratory i.e., BCSIR for analysis of parameters.

73. Result Analysis: The result of groundwater analysis is given in **Table 4-5** and **the** location map, laboratory analysis report and photographs are given in **Annex-3, Baseline Section, Map-6, Data Book, Vol-2.** Groundwater results have been compared with national standard [ECR, 2023-Schedule 2 (B)].

74. Groundwater parameters of the collected samples have been compared to the best practices tools in Bangladesh called Environmental Conservation Rules (ECR), 2023, Schedule 2 (B) for understanding the baseline status of the parameter's quality. Following the national standards, it was found that the Total Dissolved Solids (TDS) in GW3 exceeded the national ECR 2023 standard, and Turbidity of GW3 also surpassed the limit. Furthermore, the Iron (Fe) concentration in all samples slightly exceeds the standard set by the Environmental Conservation Rules (ECR), 2023, Schedule 2 (B). Nevertheless, other parameters indicate water quality suitable for drinking.

Table 4-5: Groundwater Analysis Results

Parameters	Unit	GW1	GW2	GW3	Bangladesh Standard[10]	Test Method (APHA)
TDS	mg/L	374	332	2544	1000	2540.C
EC	µS/cm	590	587	5580	-	2510.B
Turbidity	NTU	1.1	0.83	90.8	5.0	Turbidimeters
pH		7.52	7.30	7.31	6.5-8.5	4500-H+.B
Salinity	ppt	0.3	0.3	2.4	-	
Total Hardness as $CaCO_3$	mg/L	82.0	118	944	-	2340.C
Iron	mg/L	1.14	1.82	7.18	0.3-1.0	3111.B
Arsenic	mg/L	< 0.005	< 0.005	< 0.005	0.05	3114.C
Manganese	mg/L	< 0.05	< 0.05	0.38	0.4	3111.B
Odor	-	Agreeable	Agreeable	Agreeable	-	In-house

[7] As per MPN (most probable number) chart (APHA-22nd edition), MPN <1.8 indicates absence of test organism in the supplied sample.
[8] Environmental and Social Assessment (ESA) Report, BEZA, 2020
[9] Physical Infrastructure survey, Mirsharai Upazila Development Plan (MUDP), 2018
[10] Bangladesh Environment Conservation Rules, 2023, Schedule-2(B).

Parameters	Unit	GW1	GW2	GW3	Bangladesh Standard[10]	Test Method (APHA)
Fecal Coliform	MPN/100ml	<1.8[11]	<1.8	<1.8	2.0*	9221B-C
Total Coliform	MPN/100ml	<1.8	<1.8	<1.8	2.0*	9221B-C
Note: * indicates (Absent) as per BDS Standard 1240:2021						
Source: Laboratory Analysis by BCSIR, December 2023 and January 2024						

4.2.7. WATER SUPPLY NETWORK

75. According to the ESA study for the PRIDE project, a surface water treatment plant with a capacity of 50 MLD (Phase-1) will be built at Poshchim Ichakhali Mouza on the east side of the CDSP embankment, the surface water will be collected from the Feni River, 2.5 kilometers upstream of the Feni Regulator. To carry river water to the treatment facility, a raw water transmission line of approximately 9.5 kilometers will be installed. After treatment, the water will be supplied by a treated water transmission main to about 12.4 kilometers in Zones 2A and Zone 2B and distributed to all industrial plots (Ref Mirsharai Master Plan 2020). Groundwater is another potential source of water supply in economic zones for industrial and other purposes, depending on the features of the existing subterranean aquifers. In total, 15 PTWs (producing tube wells) were suggested for installation in the study regions, with 10 in zone 2A and 6 in zone 2B. The average thickness of the deeper aquifer ranges from 120m to 205m, and each PTW will have a capacity of 1 cusec (28.3 liter/sec). The PRIDE project sought to create a water delivery network of roughly 25 kilometers for 2A and 2B.

4.2.8. METEOROLOGY

76. The sub-project of NSEZ is located Mirsharai Upazila of the Chittogram district in south-eastern part of Bangladesh, which is situated in the central part of the Asiatic monsoon region, characterized by a tropical climate. Like other parts of Bangladesh, the study area experiences the significant temporal variations of climatic condition due to the influence of moisture-laden monsoon winds from the southwest in summer and drier, colder north-western winds in winter. The variation of climatic situation, the meteorological station at Sitakunda is at distance of app. 25.0 kms respectively from the study site is considered for the analysis for 10 years recorded data for the period from 2013 to 2022 and details in **Annex-3. Baseline study, Data Book, Vol-2**. The summarized records are as follows.

77. **Temperature:** The average minimum and maximum temperature in Sitakunda station is 12.28°C & 32.94 °C. In Mirsharai area temperatures vary from 6-9°C in winters and 37-41°C in summers. The average minimum temperature varies between 12.28 to 25.91 °C whereas maximum temperature ranges from 27.16 to 32.94 °C. Monthly average minimum and monthly average maximum temperatures for the period 2013-2022 for Sitakunda Station, detail in Data Book (*Source BMD & BBS-Statistical Yearbook 2013 to 2022 Met. Station: Sitakunda)*

78. **Rainfall:** Like other coastal regions of the country, the monsoon season is very important in this region. The average annual rainfall of the Mirsharai region is 2540 mm. June July and August are the months of maximum rainfall in the project area. Average monthly rainfall varies from 0.0 to 898.5 mm. The maximum rainfall in 2019 was 1589.0 mm in the month of July. The average monthly rainfall data (obtained from BMD) in graph for the Sitakunda station is given in Data Book, shows that the rainy season in the project area prevails mainly from May to September. Like other coastal regions of the country, monsoon season is very important in this region.

79. **Humidity:** Humidity in Chattogram district varies from 40% during the day in February to 90% in July and August. The spatial and temporal variation of relative humidity is very low in Bangladesh throughout the year. Monthly normal relative humidity in the project area varies between 72% in February and 87% in July (in Sitakunda). The data show that monthly normal humidity does not vary much with seasonal changes and is relatively high.

80. **Evaporation**: Evaporation in the project area reaches its maximum during April-May when temperature, sunshine and wind are at or near their maximum levels for the year. Evapo-transpiration peaks in April.

81. **Wind Speed:** The Project area is characterized by southerly wind from the Bay of Bengal during monsoon and north-westerly wind from Himalaya during winter, very similar to the national pattern. The windiest months are April – July mostly. Highest wind speed was observed at Sitakunda station since this station is located at the nearest seashore. The seasonally variation of Wind Rose for over the ten years (2013-2022) are given in baseline condition of the Data. **Book Annex** .The Project area experiences by natural calamities such as cyclone tornados and surge by the coastal wind and high-risk zones of cyclones.

[11] As per MPN (most probable number) chart (APHA-22nd edition), MPN <1.8 indicates absence of test organism in the supplied sample.

82. **Sunshine Hours:** The monthly average sunshine hours in Sitakunda vary from 4 to 9 hours/day. Maximum sunshine hours are recorded in April, May, and June. In general, April, May and June have a maximum of 12 hours of sunlight per day.

4.2.9. NATURAL HAZARD

83. Cyclone: The country is one of the worst sufferers of all cyclonic casualties in the world. Numerous cyclones have hit Chittagong in the past and caused extensive damage several times. According to the Cyclone Risk Zone Map of coastal areas of Bangladesh, the project site is located in the high-risk area of Bangladesh. Wind Speed and Rainfall during Cyclone in Chittagong District from the above collected historical data, on May 19, 1997, the maximum height of the cyclone in Sitakunda area of the coastal region was 15 feet, the wind speed was 232 km/h and during the cyclone on April 29, 1991, the wind speed in Chittagong was about 225 kmph. Both these cyclones caused havoc. The cyclone of 12 November 1970 killed 30000 people and the cyclone of 29 April 1991 caused 1,38,882 people, 70,000 cattle and a lot of crops and property were damaged. Due to widespread damage, the price of construction materials has gone up drastically. Cyclone risk map showing the project area is high risk area **(Annex-3, Map-7**, **Data Book Vol-2).** The highest inundation depth, having a range between 5 m and 6 m lies in the Mirsharai area.

84. The project area is in the coastal area and highly vulnerable to cyclone and its associated disaster like storm surges. Storm surge levels during cyclones are highly variable and range from 0->6 m. A super dike is constructed along the NSEZ area by the BWDB considering the maximum storm surge, it is expected that this super dike will protect the NSEZ area from future storm surges. In the last 60 years, 26 of the 37 cyclones recorded in Bangladesh hit Chittagong district. List of major cyclonic storms from 1960 to 2022 is given in **Annex-3, Table -5, Data Book, Vol-2**. The high number of casualties is because cyclones are always associated with storm surges.

85. **Tidal Action**: The NSEZ project area affected by tidal action from Sandwip Channel during severe Cyclonic Storm SIDR (2007) and Severe Cyclonic Storm Aila (2009), which was a tropical cyclone that resulted in one of the worst natural disasters in Bangladesh. Previously the project area inundated by tidal action but presently, there is no possibility to inundate the NSEZ because the construction of the Super dyke along northern side. In addition, the dense mangrove tree plantation at Super Dyke embankment has special positive impact like protection of the coastal area from natural calamities like cyclonic storm and tidal surges.

4.2.9.1. FLOODS

86. Bangladesh is a flood-prone country; Along with coastal flooding, riverbank bursting is a common phenomenon in Bangladesh and severely affects the topography of the country. 75% of Bangladesh is less than 10 meters above sea level and 80% is floodplain, thus presenting Bangladesh as a nation at risk of more extensive degradation. Serious flood, caused by heavy rainfall, damaged crops, and valuable property for Chattogram district. Flooding usually occurs during the rainy season from June to September. Monsoon convective rainfall is associated with relief rains generated by the Himalayas. Meltwater from the Himalayas is also a significant input and causes flooding every year and the project site is within flood zone and lies within a coastal tidal surge prone area.

4.2.9.2. EROSION

87. Site visits and literature reviews show that there are erosion problems in the project site area. However, super dikes and embankments will protect the EZ from erosion and inundation. Thus, the possibility of erosion problems in the project area will be reduced.

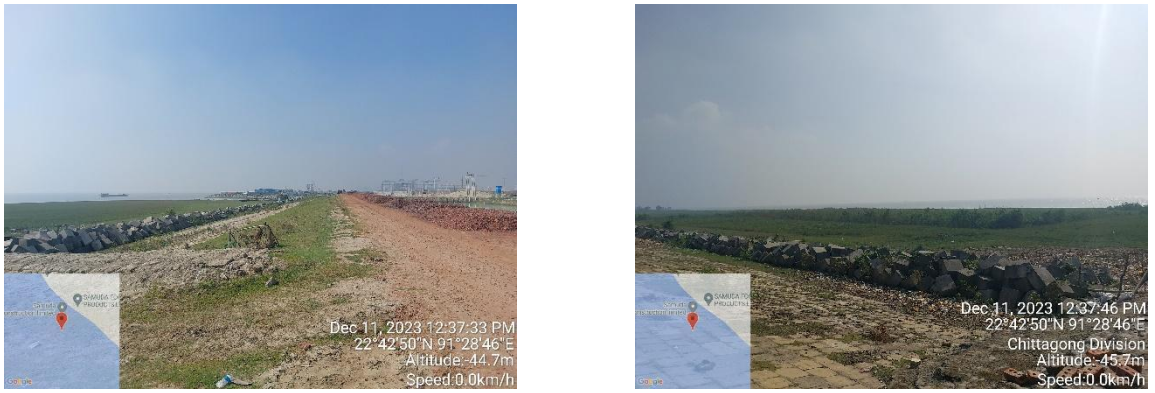


Figure 4-5: Super dikes and embankments to protect the erosion and inundation.

Source: Environment Team of BCL, 2023

4.2.10. SEISMICITY

88. Bangladesh can be affected by moderate to strong earthquake events due to its proximity to the collision boundary of the Northeast moving Indian plate and Eurasian Plate. Strong historical earthquakes with magnitude greater than 7.0 have affected parts of Bangladesh in the last 150 years, some of their epicenters within the country. According to Bangladesh National Building Code BNBC 2020 the country has been divided into four seismic zones with different levels of ground motion as shown in **Map-8, Data Book, Vol 2**.

89. Each zone has a seismic zone coefficient (Z) which represents the maximum considered peak ground acceleration (PGA) on very stiff soil/rock (Site class SD) in units of g (acceleration due to gravity). The zone coefficients (Z) of the four zones are: Z=0.12 (Zone 1), Z=0.20 (Zone 2), Z=0.28 (Zone 3), Z=0.36 (Zone 4). The most severe earthquake prone zone, Zone 4 is in the northeast which includes Sylhet and has a maximum PGA value of 0.36g. Dhaka city falls in the moderate seismic intensity zone with Z=0.2, while Cox's bazar city falls in a severe intensity zone with Z=0.28. However, according to Bangladesh National Building Code, BNBC 2015 the basic seismic coefficient of the study area is belonged under partly Z= 0.20 and partly under Z = 0.28g, where g is gravitational acceleration.

90. This project includes the installation of gas pipeline networks, five valve stations, and two HP-DRS, all of which will pose seismic concerns. The project area Zone 2A, Zone 2B and its adjacent areas in BNSEZ falls mostly in moderate seismic intensity zone Z=0.2. To mitigate this predicted risk, it is critical to consider the impact of earthquakes while constructing these structures and pipeline networks. To ensure structural safety, the civil structures in this seismic region will be built in accordance with the Bangladesh National Building Code of 2020 as well as following engineering best solution.

4.2.11. AMBIENT AIR QUALITY

91. The main objectives of the ambient air quality monitoring program were to establish the baseline air quality in the study area. The selection of air quality measuring locations took into consideration the site of settlements and receptors within the project area as shown in **Figure 4-1** as well as **Map-9 in Annex-3, Data Book, Vol-2.**

92. **Measurement Methodology:** Sampling locations were selected considering the area's background, accounting for potential point sources and other interferences. The height of sampling points was determined based on the presence of walls and other obstructions around the project location. Before installing the machine, environmental factors such as free-flowing air, wind direction, and well-mixed air were observed. Elevation angles of nearby buildings and obstructions were taken into account during site selection. All steps were executed in accordance with the ECR 2023 and IFC guidelines for the Ambient Air Quality Monitoring Program. Air quality data was gathered at five (05) locations within the project area over a 4-hour duration. Subsequently, the collected data was converted to represent a 24-hour period using an approved methodology, with the conversion details provided in the methodology section of this report. Ambient air quality measurements were conducted from December 8, 2023, to December 14, 2023.The photographs and laboratory test reports of ambient air quality monitoring are shown in Data Book , Vol -2. Analysis is carried out based on the measurement data with the standard time frame with application of a conversion equation Pasqual's (1961) air mass dispersion data and six air mass stability classes and corresponding meteorological conditions. Schroeder and Jugloff (2012) outlined a conversion approach using the simple power law to transform eight-hour readings into 24-hour/annual values. Details of the air quality calculation is presented in **Annex-3, Data Book, Vol-2.** The results of the air pollutants are as follows;

93. **Particulate Matter 10 Micron or Less (PM_{10}):** The PM_{10} concentration was monitored in the same locations as SPM. The same machine was used to monitor the PM_{10} concentration over a standard period. From the monitoring data, it is observed that PM_{10} concentrations were found within the standard value of Air Pollution (Control) Rules, 2022 (Figure 4-6**).**

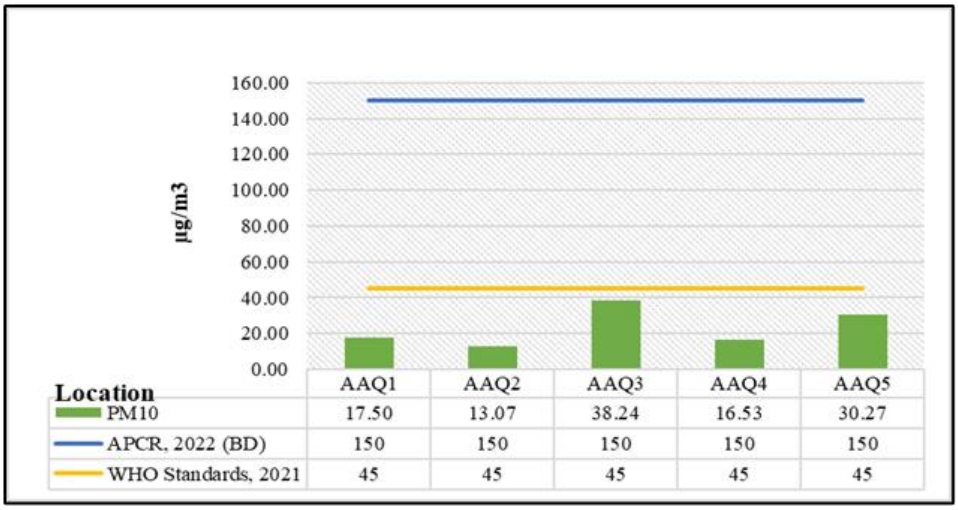


Figure 4-6: Concentration of Particulate Matter 10 Micron or Less (PM10)

94. **Particulate Matter 2.5 Micron or Less ($PM_{2.5}$):** $PM_{2.5}$ was monitored in the same areas by the same machine and the data has been represented for 24 hours as shown in Figure 4-7**.**

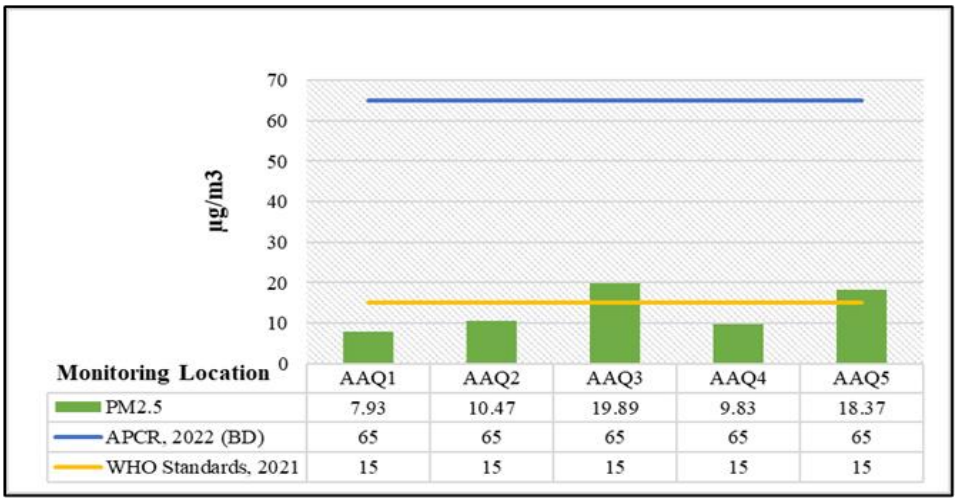
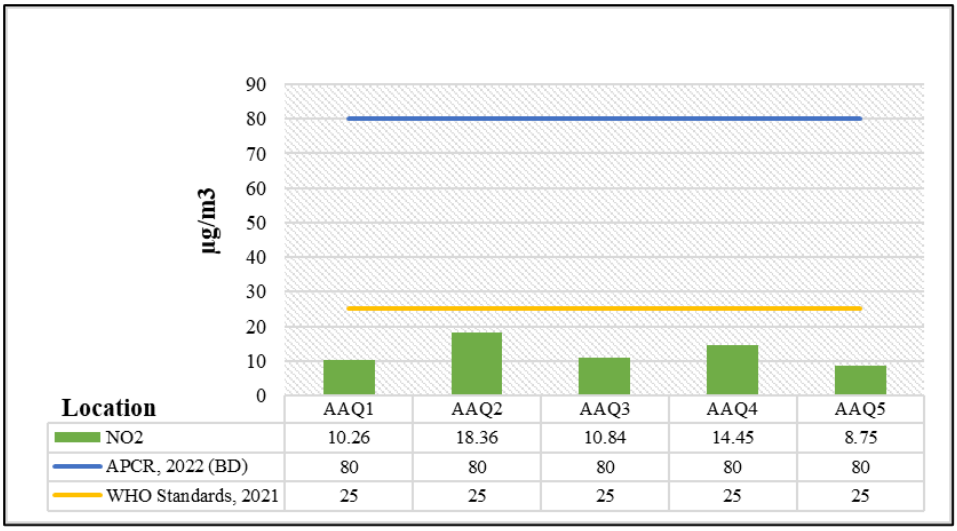


Figure 4-7: Concentration of Particulate Matter 2.5 Micron or Less (PM 2.5)

95. Monitoring data at all the locations were found within the standard value of Air Pollution (Control) Rules, 2022. But $PM_{2.5}$ data for the location of AQ3 and AQ5 exceeded the IFC/WB standards**.**

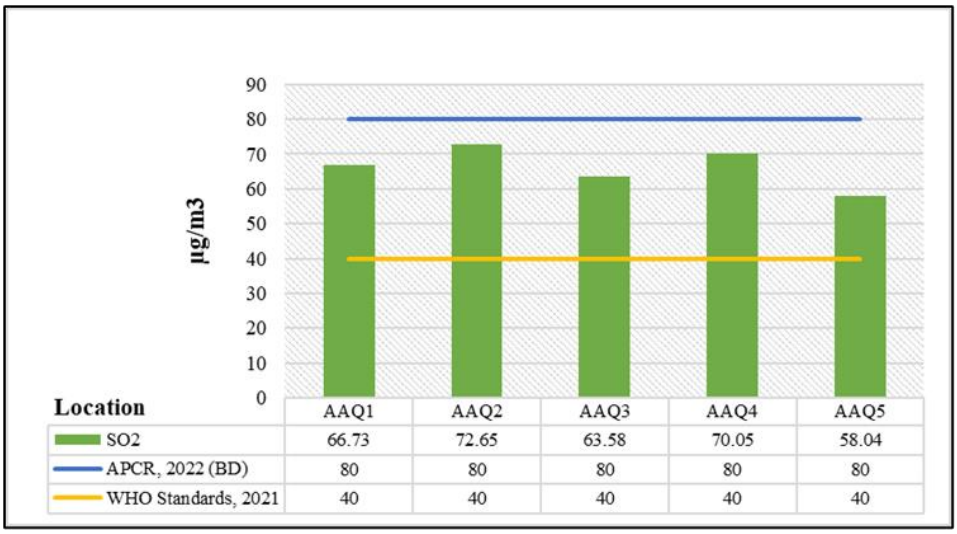
96. **Nitrogen Dioxide (NO_2):** From the monitoring data, it is observed that NO_2 concentrations were found within the standard value of Air Pollution (Control) Rules, 2022 and IFC/WB, Figure 4-8**.**



Location	AAQ1	AAQ2	AAQ3	AAQ4	AAQ5
NO2	10.26	18.36	10.84	14.45	8.75
APCR, 2022 (BD)	80	80	80	80	80
WHO Standards, 2021	25	25	25	25	25

Figure 4-8: Concentration of Nitrogen Dioxide (NO_2)

97. **Sulfur Dioxide (SO_2):** The 24-hour SO_2 concentration at all the monitoring locations was reported well below the standard value of Air Pollution (Control) Rules, 2022 but above the WHO standard, as shown as Figure 4-9



Location	AAQ1	AAQ2	AAQ3	AAQ4	AAQ5
SO2	66.73	72.65	63.58	70.05	58.04
APCR, 2022 (BD)	80	80	80	80	80
WHO Standards, 2021	40	40	40	40	40

Figure 4-9: Concentration of Sulphur Dioxide (SO_2)

98. **Ozone (O_3):** Ozone was monitored by an ozone meter and the data has been represented for 8 hours. The concentrations are significantly lower than the standard value of Air Pollution (Control) Rules, 2022, and IFC/WB, Figure 4-10

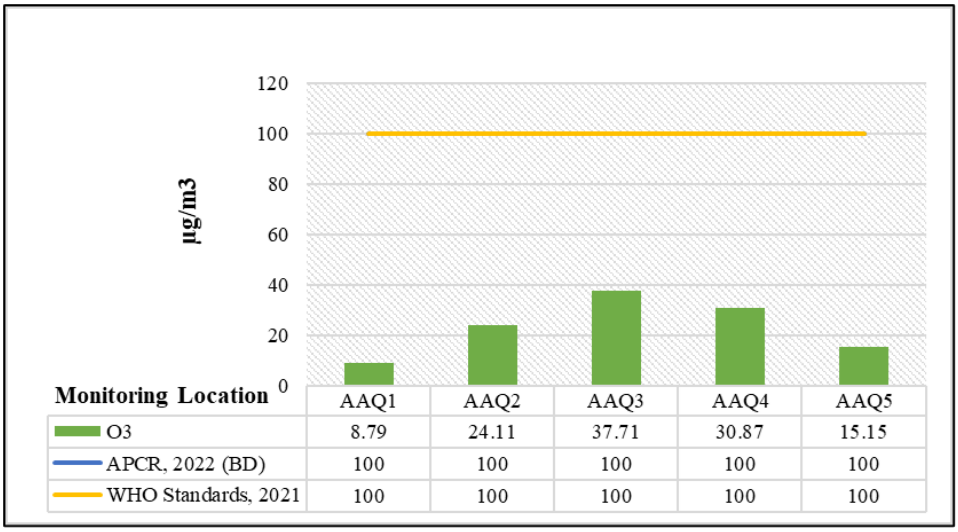


Figure 4-10: Concentration of Ozone (O_3)

99. **Carbon Mono-oxide (CO):** Eight hourly CO concentrations are reportedly low at the monitoring locations while comparing with the standard value of Air Pollution (Control) Rules, 2022 on 8-hour basis (5 mg/m^3), as shown in Figure 4-11**.**

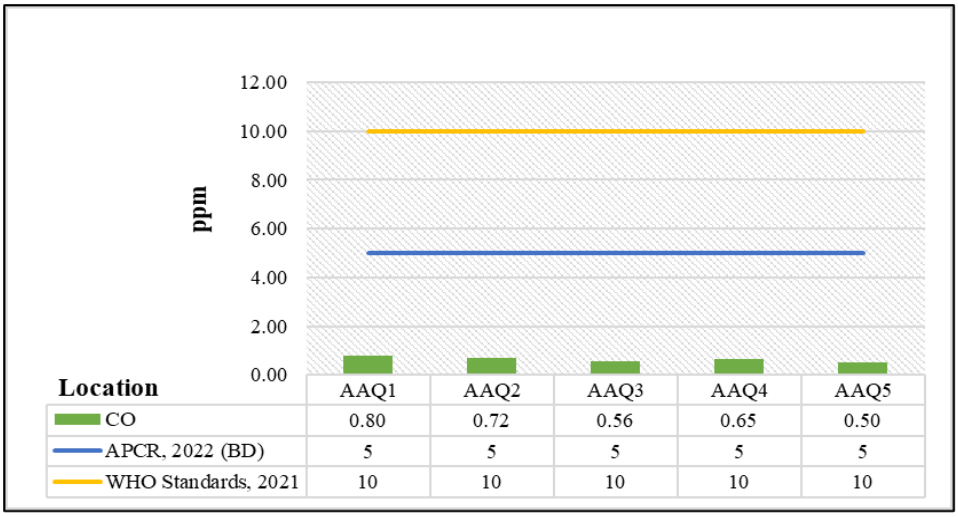


Figure 4-11: Concentration of Carbon Mono-oxide (CO)

100. **Micro-meteorological Monitoring Results:** During the environmental baseline monitoring in the study area the air temperature, relative humidity, air pressure, wind speed, and direction have also been monitored to understand the current climatic situation of the study area. there is no such kind of standard in Bangladesh for climatic variables. however, study showed that the air temperature states between 23.98.4-32.66 °c. the relative humidity is mostly dependent on the temperature and air vapor where the monitoring data showed reasonable relative humidity on the summer days. air pressure in the study area has been showing from 1001.56 to 1014.65 hap which is most agreeable to the previously recorded air pressure (bmd database 2013-2022) of the respected locations on summer days. real-time recorded wind speed and wind direction of the study area have been demonstrated in the plot to clarification of the real-time wind speed and direction aspects (**Table 4-6)**

Table 4-6: Micro-meteorological Monitoring Results

Sl. No.	Code	Air Temperature (°C)	Relative Humidity (%)	Air Pressure (hPa)	Wind Speed (ms^{-1})	Wind Direction (Degree)
1	AQ1	29.94	46.72	1013.98	2.28	106.57 (ESE)
2	AQ2	32.66	63.84	1001.56	0.47	47.05 (NNE)
3	AQ3	27.92	59.25	1012.81	2.79	70.20 (E)
4	AQ4	25.00	69.66	1014.65	3.85	218.77 (SW)
5	AQ5	23.98	61.68	1012.01	0.21	236.78 (WSW)

Source: Field Measurement and Laboratory Analysis by BCL Associates Limited, 2023

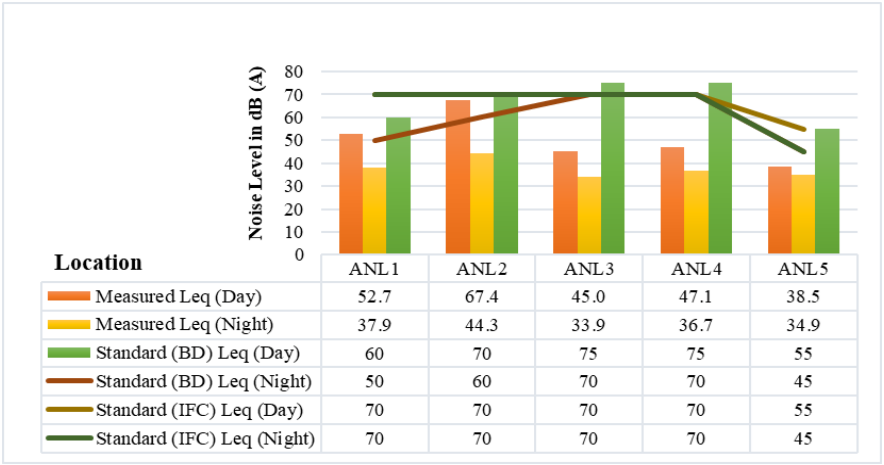
101. According to the WR plot, most of the air flows from the North-North-East, North-East, East- North -East and East directions. The wind speed also showed from 0.21 to 3.85 m/s in the study locations quite good for summer days in the study area on depending the BMD Database 2022 were 17.5% wind directed from the North -East direction. Besides, 55.1% of winds flow at a net speed of about 0.0-1.5 m/s in the study area that presented the diagram in Annex-3, Data Book, Vol-**2.**

4.2.12. AMBIENT NOISE QUALITY

102. The primary goal of monitoring ambient noise levels was to establish a baseline in the project area. The objective was to assess sound intensity at various monitoring locations across the project site, carefully chosen to capture representative data. Selection criteria for these locations considered potential sources of construction activities and proximity to important receptors such as residential areas and educational institutions. The chosen sites fall into distinct categories like industrial, residential, commercial, mixed, and silent areas according to DOE/IFC classifications. Detailed information about noise level measurement sampling locations is provided **Figure 4-1.**

103. **Measurement methodology**: The sound levels were recorded as A-weighted equivalent continuous sound pressure level values, employing A-weighting filters in the noise measuring instrument.

104. **Results of Analysis**: Ambient daytime noise levels, denoted as Leq_{day}, exhibited a range of 38.5 to 67.4 dB(A) within the study area. In contrast, ambient nighttime noise levels (Leq_{night}) displayed variations ranging from 33.9 to 44.3 dB(A). Maximum daytime noise levels (Lmax) recorded at monitoring locations spanned from 59.6 to 84.2 dB(A), while minimum daytime noise levels (Lmin) ranged from 33.1 to 38.6 dB(A). At nighttime measurements, maximum noise levels (Lmax) were documented in the range of 41.5 to 57.0 dB(A), and minimum noise levels (Lmin) ranged from 32.0 to 33.8 dB(A). Notably, the highest daytime noise level was recorded at 67.4 dB(A) at NL2, while the lowest was 38.5 dB(A) at NL5. Graphical representations illustrating noise levels at various monitoring locations are provided in Figure 4-12. Location map, laboratory test result sheets and photographs are shown in **Annex-3, Result Data Sheet, Data Book, Vol-2.**



Location	ANL1	ANL2	ANL3	ANL4	ANL5
Measured Leq (Day)	52.7	67.4	45.0	47.1	38.5
Measured Leq (Night)	37.9	44.3	33.9	36.7	34.9
Standard (BD) Leq (Day)	60	70	75	75	55
Standard (BD) Leq (Night)	50	60	70	70	45
Standard (IFC) Leq (Day)	70	70	70	70	55
Standard (IFC) Leq (Night)	70	70	70	70	45

Figure 4-12: Results of Ambient Noise Level

Source: Field Survey and Laboratory analysis by BCL Associates Limited, December 2023

105. On the other hand, during the monitoring period, nl2 recorded the highest than nighttime noise level at 44.3 db(a), while nl3 recorded the lowest at 33.9 db(a). The noise level measurements indicate that nl3 exceeded the bangladesh standard for both daytime and nighttime. In the case of nl3, both daytime and nighttime noise levels surpassed the stipulated standards outlined in the noise pollution control rules of 2006 in bangladesh. This proximity serves as a prominent factor contributing to the elevated noise levels. However, noise levels at other locations, both during the day and night, conform to the standards outlined in the noise pollution control rules of 2006 in bangladesh and the international finance corporation (IFC) guidelines.

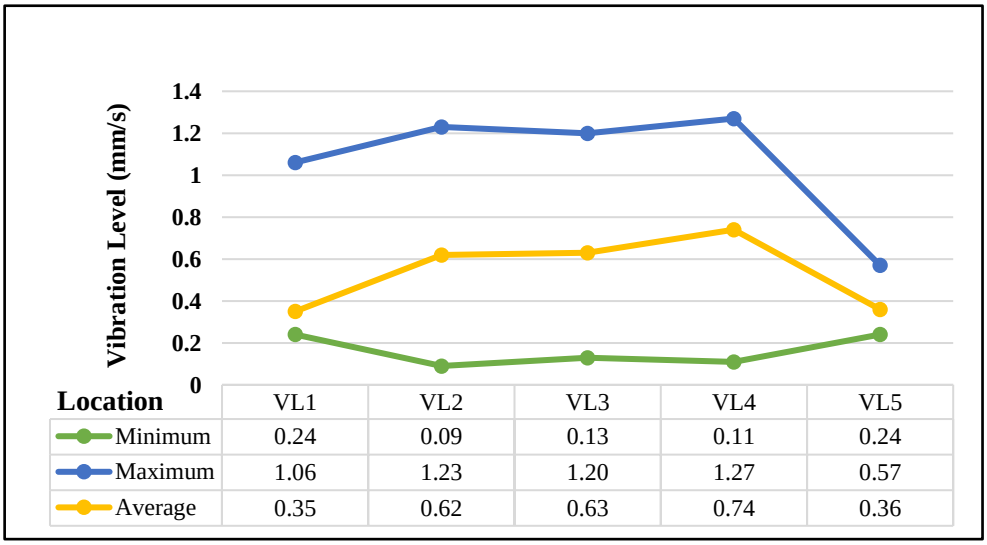
4.2.13. VIBRATION LEVEL

106. The project area's vibration intensity is negligible. The vibration from traffic on a neighboring road, on the other hand, is insignificant. On focusing on the vehicle movement and construction activities, vibration levels were measured at close to five locations where air and noise monitoring were carried out. An electronic and auto-

recorded vibration meter has been used to conduct the measurement at five locations. The vibration level has been recorded in the study area using a digital vibration level meter.

107. Locations and Frequency: The sampling locations have been considered based on the potential sources of the project activities and its nearest receptors. Details of the vibration measurement locations sampling photographs and results sheet of vibration level have been given in **Annex-3, Map-11, Data Book, Vol-2**.

108. **Results Analysis**: Vibration results are given in Figure 4-13. The vibration level in the project area has been observed as a negligible state. The government of Bangladesh has not set any standard for vibration level in the perspective of construction or other activities. Therefore, the average vibration level is captured from 0.35 to 0.74 mm/s. VL4 is the highest recorded sampling point due to the frequent movement of vehicles on the highway.



Location	VL1	VL2	VL3	VL4	VL5
Minimum	0.24	0.09	0.13	0.11	0.24
Maximum	1.06	1.23	1.20	1.27	0.57
Average	0.35	0.62	0.63	0.74	0.36

Figure 4-13: Minimum, Maximum and Average Vibrations
Source: Field Survey and Laboratory analysis by BCL Associates Limited, December 2023

4.3. BIOLOGICAL ENVIRONMENT

4.3.1. BIO-ECOLOGICAL ZONES OF THE STUDY AREA

109. The Ecological component of the study focused on flora, (terrestrials and aquatic), fauna/ wildlife (amphibians, reptiles, mammals, and birds) and fishes (fresh and saline water), as well as the surrounding ecosystems. The IUCN, The World Conservation Union, has divided Bangladesh into 25 Bio-ecological Zones (Nishat et al, 2002) in the context of physiographic and biological diversity. The study area has fallen under two bio-ecological zones of coastal floodplain and coastal marine water. The area (both directly and indirectly impacted area) occupies terrestrial as well as aquatic ecosystems. Each of the bio-ecological zones represents the overall ecological situation of an area of the country. A map of the Bio-ecological zone is presented in the **Annex 3**, **Map 12, Data Book, Vol -2**, which indicates that sub-project area mostly saline tidal floodplain and coastal plain. Additionally, the study area's bio-ecological zoning was done using the Bio-Ecological Zone (BEZ) categorization of Bangladesh by IUCN-Bangladesh (2002).

110. According to Agro-ecological zoning , the physiographic unit of the project is Chittagong Coastal Plain (**AEZ# 6**, **Agro-ecological Map 13, Data Book, Vol-2**), sub-regions are Piedmont Plains and River Flood plain (23a) and Young Tidal Floodplain (23b) with general soil type Non- Calcareous Grey Flood Plain Soils (non-saline) in both sub-region soils (Map). The soil texture in both sub-region soils is loamy. The landscape of the area is comprised of mainly medium high land to high land. The soil type also pre-dominates with Young Meghna Estuarine flood plain (AEZ # 34)as shown in Annex. The farmers practices on agriculture in the IOA area are for 2 seasons, i.e., Kharif I and Kharif II. Sources of irrigation in this region are canals, pond, etc. no irrigation program is in operation . Major crops of the region are Kharif-1: Aus, Amon, BR 28,29, Shornochuri, 41,29, BR-12, Hira-2 and Kharif-2 are chill ladies finger, Cabbage, Maize, Pulse (Baula), beans, lentils, cucumber and other vegetables. However, there is no any type of cultivation within Zone 2A - Zone 2B and its surrounding areas observed during field survey.

111. The Ecological component of the study focused on a few groups of biological components. These were flora, (Terrestrials and aquatic), wildlife (amphibians, reptiles, mammals, and birds), fishes (Fresh and Saline water) as well as the surrounding ecosystems. Most of the fieldwork within the project has been addressed with these groups although each group had different approaches and methodologies. The study area (10 Km buffer area

from the project site) occupied various types of ecosystems such as rural settlements, roadside vegetation, croplands, woodland vegetation, and wetlands. The study of ecosystems of the study area included primary and secondary data collection on local habitats, habitation areas, plantations, ecological critical areas, protected areas, game reserves, Hilsha breeding grounds, transit routes, and sensitive settings. The ecological study was conducted through survey, direct observations and interviews with local people.

112. The surveys included transects within the study area covering all major habitat types. During the transect survey, other members of the team having expertise on respective fields accompanied the ecologist. Secondary ecological data of the study area have been explored from different publications and reports like IUCN-Red List Local and Global, Bangladesh National Herbarium, World life Conservation Security Act, (WCSA, 2012), and CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora. The Bangladesh Asiatic Society's Encyclopedia of Flora and Fauna of Bangladesh, the Forest Department, the International Union for Conservation of Nature (IUCN), and other pertinent sources considered through a literature study served as secondary sources of information.

4.3.2. TERRESTRIAL ECOLOGY

4.3.2.1. TERRESTERIALS PLANTS STATUS WITHIN ZONE 2A AND ZONE 2B

113. Terrestrial flora (terrestrial plants) has been investigated using Random Meander method (Cropper, 1993) and or Quadrat method random basis in the AoI to determine the status of floral presence in the study area. Conducted study on habitat wise by using quadrat (100ftX100ft, 30ftX30ft, and 10ftX10ft) dated on 8-12 December, 2023, in this method the Consultant explored plant data and information throughout the study through opportunistic basis. Different habitats (roadsides, homesteads, canal, ponds, mangrove, and cultivated lands) are investigated to find out diversity of terrestrial plants. Special efforts were also given to record species of conservation importance according to IUCN Red List of Threatened Species (Online Version 2021-3)' (IUCN, 2021), Wildlife (Conservation and Security) Act, 2012 and CITES. Local people have been interviewed during the investigation. Red Data Book of Vascular Plants of Bangladesh yet not published from Bangladesh National Herbarium. For gathering present conservation and distribution status recorded plants compare with IUCN-Global status. Local people have been interviewed during the investigation. Maximum plant species have been identified at field, however, for confusion in identification, close photographs of flowers, leaves and stems and/or fertile specimens of leaves, stems and roots were collected.

Photo 1: Samplings of Quadrat at Chorsorot Mangrove Area,

114. Terrestrial plants have been investigated in the entire Area of Influence to determine the status floral presence in the study area. List of sampling no, Habitat, Location, Latitude, longitude is shown in **Table 4-7** and the Quadrat samplings location map are shown in **Annex-3 Map 14, Data Book, Vol-2**

Table 4-7: List of sampling no, habitat, location, latitude, longitude as quadrat

S/N	Sampling no	Habitat	Locations	Latitude, E	Longitude, N
1	Quadrat 1: 10ft X 10ft	Pond	CP mor	22° 43' 52"	91° 30' 17"
2	Quadrat 2: 10ft X 10ft	Mangrove	2B	22° 45'46"	91° 27' 41"
3	Quadrat 3: 10ft X 10ft	Grazing Land	2A zone	22° 45' 46"	91° 27' 44"
4	Quadrat 4: 10ft X 10ft	Roadside	Ichakhali, Sluicegate Road	22° 46' 40"	91° 28' 35"
5	Quadrat 5: 10ft X 10ft	Road site	Sorsorot	22° 44'10"	91° 30'40"
6	Quadrat 6: 10ft X 10ft	Mangrove	Charsoroti	22° 44' 20"	91° 29' 90"
7	Quadrat 7: 10ft X 10ft	Homestead	Sorchorot and Mogadia	22° 44' 44"	91° 29' 02"
8	Quadrat 8: 10ft X 10ft	Water body	Office pond, South Mogadia, Super dyke site	22° 45' 40"	91° 28' 12"
9	Quadrat 9: 10ft X 10ft	Mangrove	South Mogadia Super dyke site	22° 42' 39"	91° 29' 15"
10	Quadrat 10: 10ft X 10ft	Coastal belt	Bashundhara Jetty	22° 42' 49"	91° 28' 45"
11	Quadrat 11: 10ft X 10ft	Bamon Sundar Canal	Bamon Sundar Khal, 3 No sluice gate	22° 44' 44"	91° 29' 02"
12	Quadrat 12: 10ft X 10ft	Daborkhali Khal	Daborkhali Khal	22° 43' 50"	91° 27' 55"

S/N	Sampling no	Habitat	Locations	Latitude, E	Longitude, N
13	Quadrat 13: 10ft X 10ft	Ichakhali Khal	Charsoroti, Mogadia 6 no. Union Ichakhali	22.737364	91.496899

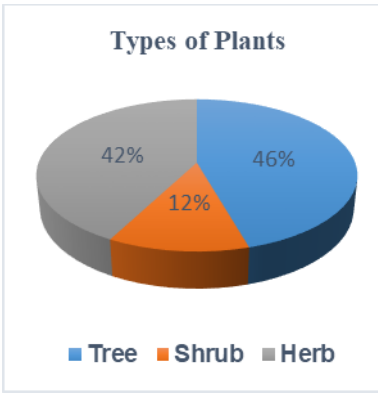
Source: Field survey, 2023

115. **Findings:** A total of 123 species of important terrestrial plants under genera of 116 of family 61 have been recorded in the project area. Among them 44% tree, 41% herb and the rest are shrub. However, no one is threatened according to red data book on Vascular plants of Bangladesh (Bangladesh National Herbarium). Important terrestrial and aquatic plants observed and noted. Out of 123 species of terrestrial plants mostly uses as medicinal and which is 56 in number and use as timber 27, fruit bearing 28, ornament 08 and fuel 04. 23 species of aquatic plants have also been identified. IUCN-Global status of terrestrial plans is DD=03, Least Concern=41, Unknown-76 and near threatened=03. The global status of aquatic plants is Least Concern=10 and Unknown=13. Some Important timber trees are Acacia Nilotica, Albizia lebbeck, Albizia procera, Ficus benghalensis, Ficus hispida, Ficus racemose, Ficus religiosa, Eucalyptus camaldulensis, Syzygium cumini, Neolamarckia cadamba, Swietenia mahagoni, Samaneae saman and Acacia auriculiformis.

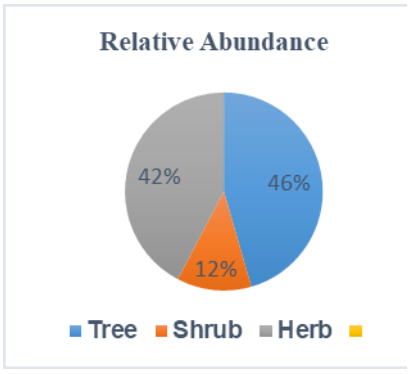
116. Important Fruit bearing trees are Elaeocarpus robustus, Psidium guajava, Musa paradisiaca, Citrus grandis, Mangifera indica, Spondias piñata, Annona reticulate, Annona squamosal, Cococs nucifera, Areca catechu, Avarrhoa carambola, Moringa olefera, Phyllanthus emblica, Punica granatum, Angle marmelos, Citrus aurantifolia, Limonia acidissima, Litchi chinensis, Manilkara sapota, Phoenix sylvestris, Dillenia indica, and etc. Important Medicinal plants are Achyrenthes aspera, Centella asiatica, Vinca rosea, Enhydra fluctuans, Eupatorium odoratum, Mikania scandens, Diplazium esculantum, Heliotropium indicum, Chenopodium album, Commelia benghalensis, Eclipta alba, Tridax procumbens, Coccinia cordifolia, Acalypha indica, Croton bonplandinus, Euphorba hirta, Jatropha gossipifolia, Ocimum sanctum, Aloe vera, Marsilea quadrifolia, Mimosa pudica, Argemone Mexicana, Cynodon dactylon, Spilenthes acmela, Persicaria hydropiper, Scoparia dulcis, Smilax macrophylla, Datura metel, Datura stramonium, Physalis minima, Solanum nigram, Solanum xanthocarpum, Clerodendrum viscosum, Lippia geminate, Vitex negundo, Amiranthus viridis, Carica papaya, and etc.,

- No threatened species identified from the project area.
- Relative abundance of the identified plants area Common=51,
- Very Common-36, Rare=31 and
- Few=05.

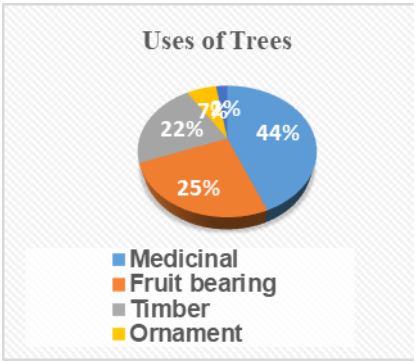
117. The List of terrestrial plants with Local name, English name, scientific name, family, uses is presented in **Annex-3,Table -9, Data Book**, **Vol-2** . The percentage of type of Plants, their abundance and uses are shown in Figure 4-14. In the study area about 46% are trees, 42% herbs and only 12 % are shrub and their relative abundance are same.



Types of plants with % in the project area



Relative abundance of plants



Uses of plants in the project area

Figure 4-14: Type of Plants, their Abundance and Uses as Percentage

4.3.2.2. TERRESTERIALS FAUNA

118. In general, terrestrial fauna includes all wildlife under the classes of the Amphibians, Reptilian, Mammalia and Aves. Terrestrial fauna, particularly Wildlife survey has been done using direct observation method and interview with local people. Observations are done throughout the day, with emphasis on the morning (06:00 to 10:00 hr.) and evening (16:00 to 19:00 hr.) when wildlife was most active in nature. During field observation, the team identified the presence of wildlife based on tracks, footprints, feeding signs and animal/bird calls. Special habitats, like nesting and roosting habitats of birds, bats etc. were also identified. Local people were interviewed during field observations for determination of cryptic mammals and reptiles and seasonal variation of migratory

wildlife. Several field guides were used for identification of wildlife; among them, 'Amphibians and Reptiles of Bangladesh' (Hasan *et al.* 2014; Whitaker *et al.* 2004), 'Birds of the Indian Subcontinent' (Grimmet *et al.* 2013) and 'A Field Guide to Indian Mammals' (Menon, V. 2003). 'Red List of Bangladesh Volume 2 – 4: Amphibians, Reptiles, Birds and Mammals' (IUCN Bangladesh, 2015) and 'IUCN Red List of Threatened Species (Online Version 2021-3)' (IUCN, 2021) are used for determination of global threatened categories of wildlife. Wildlife (Conservation and Security) Act 2012 and CITES List 2021 are reviewed for determination of protection status of wildlife in local and global contexts. Species richness has been measured using a widely used method.

AMPHIBIANS

119. A total of 29 species of amphibians were observed in the project area. Out of them one endangered, one vulnerable and 2 data deficient according to IUCN red list(2015,v.2). A checklist of amphibians and Relative Abundance with IUCN's Local & Global Status within Project AOI is presented in **Annex-3, Table10, Data Book. Vol-2.**

REPTILES

120. In total 17 species of reptiles were recorded. Of the reptilian species, 9 were lizards and 3 species of snakes. Out of these Girgiti, Chameleo (*Chamaeleo chamaeleon)* House Gecko (*Hemidactylus brookii*), Rat Snake (*Coluber mucosus*) and Checkered Keelback (*Xenochropis piscator*) were observed by survey team during field survey. The rest of the reptilian fauna were reported to be observed by locals during field consultations in the villages of AOI. Many of the fauna are listed here by consultation of the local people. Among the 17 species recorded, Grey Indian Monitor (*Varanus benghalensis*) and Ganges Soft Shell Turtle (*Nilssonia gangetica*) are reported to be listed in Bangladesh Wildlife Prevention Order,1973 as Sch-III which protects them from hunting, killing, and capturing. Two turtles and one terrapin, the Ganges Soft Shell Turtle (*Nilssonia gangetica*) are listed as Vulnerable, River Terrapin (*Batagur baska*) as Critically Endangeredand Striped Roof Turtle (*Kachuga dhongoka*) as Endangered as per IUCN (2015, v.2) category. A checklist of the reptiles in project AOI and their IUCN local status, distribution and habitat is presented in **Annex-3, Table11, Data Book. Vol-2.**

MAMMALS

121. As per discussion with local people Deer and Fox are found in planted mangrove forests (Chorsorot mangrove area but none were spotted during visit. In Ramgarh reserve forest wild animals like Fox, Monkeys, Langoor, Ulluk, Wild Cats, Wild Boar, Deer, Otter/Udbiral (LontraCanadensis), Kat Biral, Elephant, Bonrui, Rabbits, Deers, & wild goats. However, Ramgarh forest does not fall within a 10 km radius area. In total 26 species of mammals were recorded through investigation, consultation with community people, according to IUCN-Global Ussuri dhole (Cuon alpinus) and Western hoolock gibbon (Hoolock hoolock) are endangered. Hog badger (Arctonyx collaris), Fishing cat (Prionailurus viverinus) and Capped langur (Trachypithecus pileatus) are Vulnerable . Mammals found in the project AOI and their local IUCN status is given in **Annex-3 Table12 Data Book. Vol-2.**

The greater short-nosed fruit bat (*Cynopterus sphinx*), or short-nosed Indian fruit bat, is a species of megabat in the family *Pteropodidae*.

Bats are lying mammals of the order Chiroptera with their forelimbs adapted as wings, they are the only mammals capable of true and sustained flight. Bats are more agile in flight than most birds, flying with their very long spread-out digits covered with a thin membrane or patagium. Bat taking juice of date palm. Nipa virus transmitted by Bat.

AVIFAUNA

122. In total 109 birds were identified in the project area. Some Avifauna like Black crow, House crow, Baya Weaver, Baali, Asian Pied Starling, Ruddy shelduck, Dove, Houses parrot, Kokil, Machranga/Kingfisher, Magpie Ribbon, Oriental Magpie Robin, Rock dove, Black Dhorongo/Finge, Water cock, Black crowned night Heron, Common Tailor Bird, Little Cormorent, Palash fish Eagle, Common Myna, White brested waterhen, Indian Pond Heron, Cattle egret, Little Egret, Great Egret, Pond Heron are found in the study area. During the visit at the project

did not investigate any migratory bird. A detailed list is provided in **Annex-3. Table13, Data Book. Vol-2.** Commonly observed Avifauna in the project site (Figure 4-15).

Great egret (*Ardea alba*)

Cormorant (*Phalacrocoraxniger)*

Jungle Myna (*Acridotheres fuscus*)

Black drongo (*Dicrurus macrocercus*)

Common Pigeon, Jalali Kobutor (*Columba livia*)

Black crow/Dar kak *Corvus brachyrhynchos*
House crow /Patikak *Corvus splendens*

Figure 4-15: Commonly Observed Avifauna in the project site

123. Overall Present Status: In total of 181 species of wildlife recorded in the study area; among them 29 are amphibians, 17 reptiles, 109 birds and 26 mammals (**Table 4-8).**

Table 4-8: Common Wildlife in the study area

Group of Animal	Total, Number	Local Status				Global Status			
		CR	EN	VU	Total	CR	EN	VU	Total
Amphibia	29	-	1	2	3	-	-	-	-
Reptilia	17	1	2	5	8	2	2	-	4
Aves	109	-	-	-		-	1	-	-
Mammalia	26	2	2	04	8	-	2	3	5
Total (Wildlife)	**181**	**3**	**6**	**11**	**20**	**-**	**4**	**3**	**9**

Data source: Field Survey data, 2023

4.3.3. AQUATIC ECOSYSTEM

4.3.3.1. AQUATIC PLANTS

124. Aquatic plants have been investigated using Random Meander method (Cropper,1993) using quadrat method. Local people have been interviewed during the survey. Aquatic habitats in the project area are ponds, canals, and wetlands. The aquatic flora is mainly named in Bangla Mushak Dana, Malanchai, Brahmisak, Kanaidoga, Kachuripana, Topapana, Helencha, Arail, Khudipana, Kalmishak, Dholkolmi, Keshordam, Sushnishak, Pani Biskhatali, etc. The list of local name, common name, and scientific name and family with their IUCN Global Status is presented in in **Annex-3. Table14, Data Book. Vol-2.**

4.3.3.2. FRESH WATER FISHES

125. Fisheries Survey Method: Fish survey is based on direct observation and interview with local people, especially fishers. A pictorial data collection format used for identification of fishes at field by the local people. IUCN Red List of Threatened Species (Online Version 2020-1) (IUCN, 2020) will also review for determination of globally threatened categories of fishes. Consultation was carried with the fishermen in study area to gain

knowledge about the fish species in canals, River Feni and ponds etc. For fish species investigation visited some fish markets like Abu Torab Bazar, Jolodas para, Sarker para, Ichakhali Bazar, Bamon Sundar Dorgar Hat and other markets and landing center. Fishermen fishing at the Ichakhali, Shaherkhali and Bamonsundor Khal, and fish farms.

126. Fisheries resources of the study area are rich and diversified. Fish habitats of the study area are creeks, khal, rivers, aquacultureponds, and natural ponds. Both natural and aquaculture fisheries exist in the study area Whereas the proposed Gas line network crosses the Ichakhali, Daborkhali and Bamonsundar khals. Presently no fish resource exits there. The Gas line network did not cross any other cultured fish ponds in Zones 2A and 2B and its adjacent areas.

127. Saline water of Sandwip channel entrance into the canals that control by the regulators, Due to lack of proper maintenance the sea water entrenches into the canals and mix with fresh water . As a results, the water in these canals varies from fresh to brackish. The tested results show the salinity of the Bamonsundor , Daborkhali, and Ichakhali were 2.1 ppt, 1.4ppt, and less than 0.1 ppt, respectively (Table 5-3). Even the salinity concentration of the pond water was 0.2 ppt. The khals that drain-out into the Sandwip Channel have moderate species diversity. Fish species diversity is higher in the estuarine mouth compared to that of its upstream direction, while the fresh water fish resources are limited, particularly in .the Ichakhali, Daborkhali and Bamonsundar khals no fish available, since surface water in these canals changes from fresh to brackish.

128. . **Fish Resources**: Both natural and aquaculture fisheries exist in the study area. The sone khals that drain-out into the Sandwip Channel have limited species diversity. Species diversity is higher in the estuarine mouth compared to that of its upstream direction. For fish species investigation visited some fish market like Abu Torab Bazar, Jolodas para, Sarker para, Ichakhali Bazar, Bamon Sundar Dorgar Hat and other markets and landing center. Consultation was carried with the fishermen in study area to gain knowledge about the fish species in Feni River, khals, beels, ponds etc. Fish species in canals and catches by fishermen are: Golda chingri, Bagda chingri, Chiring, Pangash fish, Coral fish, Promphet fish, South Asian carp/Catla, Ruhi, Hilsa,Bata fish, Gulla, Pua, Riksha/Taposhi, Lorka, Senuwa, Loitta, Nylotika, Mud Crabs, Holona, Mrigal, Silver Carp, Gras Carp, Karpo, Barbs (Putis), Chitol, Folai, catfish (Tengra, Singi, Magur, Boal, Pungus), Snakehead (Shol,Taki), Bele etc.). There are 37 fish ponds in the NSEZ project area where community people fish cultures for commercial and own consumption. Mainly white fish culture like Pabda, Poa, Chringri, Tilapia, Rui, Tengra, Katla, Mrigel, Carp, , Pangus etc. (**Figure 4-16**). In the AoI most of the fishermen are catching fish from Feni river, Sandwip channel and canals. In total 59 species of fish belong to 30 families identified. The Fish species recorded within the project AOI with their IUCN status as Local & Global are presented in **Annex-3. Table15, Data Book. Vol-2.**

4.3.3.3. AQUACULTURE

129. Aquaculture is practiced extensively in the Project area by community people. Large pond observed close to NSEZ zone. Mostly white fish culture species are Ruhi, Catla and carps etc. A variety of feeds such as cooked rice, fishmeal, and oil cake are used in the farm. Mudcrabs are collected by people from the Ichakhali, Shaerkhali Khal and sell in the Abu Torab Market.

		
Pabda, Gaura fish	**Poa and Chingri**	**Tilapia fish and Chingri**

Tengra, Bata fishes

Tilapia, Pabda, Gaura fishes

Crab (*Carcinus maenas*

Figure 4-16: Common Fishes in the study area

4.3.4. LIVESTOCK AND POULTRY

130. Livestock and poultry, being an essential sector of integrated farming system, play an important role in the economy of the study area. Livestock provide significant draft power for cultivation, threshing and crushing of oil seeds. 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 funds. Most of the household's rear poultry and livestock, a practice that significantly reduces poverty by generating employment and income.

131. During visit the site observed three types of domestic animal grazing surrounding the 2A-2B zones mainly buffolow, cow and sheep (Figure 4-17). The owners of the livestock population are facing problems in respect of availability of fodder and feeds land development activities are ongoing and as well as infrastructure development in the sub project areas.

Figure 4-17: Buffalo grazing in sub-project area

4.3.4.1. ECOSYSTEM SERVICES AND FUNCTION

132. The ecosystem of the study area is mainly terrestrial and aquatic. Ecosystem services and functions help local people and vice versa. Major benefits of the ecosystem services of the study area are given below:

- Ecosystem services have tremendous benefits to Agricultural activities for food production, economic growth and environmental benefits for sustainable agricultural practices can enhance soil fertility, biodiversity, and water conservation, contributing to overall environmental health,
- Fisheries provide a crucial source of protein and essential nutrients for many populations, especially in coastal communities to support enhance the livelihood options and maintain marine biodiversity to strengthen the ecosystem health, supporting by sustainable fishing practices,
- Forests are habitats for a vast array of plant and animal species, contributing to global biodiversity, mitigating the climate change impacts by absorbing CO2 and releasing O2.
- Tidal actions can help mitigate coastal erosion by distributing sediments and influencing shoreline stability, supporting diverse ecosystems, including mangroves, salt marshes, and estuaries, which are critical habitats for many species as well as tidal movements facilitate nutrient exchange between marine and terrestrial ecosystems
- The photosynthetic processes remove carbon dioxide in the air and supply oxygen to the environment.
- Trees serve as sources of timber for housing construction etc.
- Animals supply the protein needs of humans, serve as pets or animal skin for making shoes, bags, and other derivatives.
- The watershed provides fresh, clean water for human consumption.
- Trees serve as a buffer against storms preventing the destruction of houses by strong winds.
- Some species of plants can cure human ailments.
- Humus from the decomposition of organic matter serves as a natural fertilizer in areas cleared for agriculture.
- Fisheries resources was once all canals enriched. But due to development activities in these area fish's scarcity occurred.
- Forest Department started plantation in the super dyke area from 2021, still now around 50 lacs of saplings of mangrove species like Keora, Baen and Geoa planted and in high land planted saplings of Jhau. In around

800 acres of land afforested are going on by FD of their own fund. Every year replantation done in around 30%. BWDB funding for mangrove plantation in and around 100 acres of land. Planted saplings size 2-3ft. FD planted sapling of their own nursery.

- Protected Area (PA)

A Protected Area (PA) refers to an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means, i.e., PA is predominantly a natural area established and managed in perpetuity, through legal or customary regimes, primarily to conserve their natural resources (IUCN, 1990). No PA exists at or near the project site (within 10 km radius).

4.4. SOCIAL BASELINE

133. The ESIA study made extensive use of socioeconomic data obtained for determining social baseline condition of the project area through structured questionnaires survey of the sample households (HHs) residing adjacent to the sub-project areas. However, during the survey, some interviews with local residents were held on social conditions as well as gender violence perspective , etc.

134. Methodology: The social baseline surveys and investigations entailed both conventional and non-conventional approaches and methods of data collection –such as:

- Review of relevant project documents including the TOR for the BEZA Gas Pipeline project;
- Following the desk-studies of project documents and available secondary data, the field investigations started with a reconnaissance survey of the project area, taking note of the settlement patterns and the major structures and community properties and public utilities infrastructures (gas, electricity, water supply etc.) located along the proposed alignment
- Collection and analysis of relevant studies and available secondary data from various national and local sources;
- Sample Surveys-carried out to ensure a reasonable representation of all categories of people, the samples have been selected from the Mirsharai area, 'multi-stage sampling' method was followed to have a balanced representation of the project area. A total of 125 HHs were selected from different areas of Mirsharai Upazila
- covering households, business enterprises, institutions and organizations located along the proposed alignment and outside sub-project site;
- Focus Group Discussions (FGD) and KII and Public Consultation Meetings with elected representatives of local govt. bodies, NGOs, civil society organizations and public;
- To gain an initial idea of the socio-economic features and key indicators of local poverty situation to confirm the representativeness of the sample plans.
- To gather necessary information on existing socio-economic and cultural conditions in the project area and develop a baseline.

4.4.1. ADMINISTRATIVE STRUCTURE

135. **Mirsharai Upazila**: The gas pipeline network study area is 2A and 2B zones in NSEZ located at Mirsharai Upazila of Chattogram district that will impact Ichakhali Union and Shaerkhali union in Mirsharai Upazila. Mirsharai Upazila in Chattogram district is bounded by Tripura state of India, Chhagalnaiya and Feni Sadarr Upazila on the north, Shaunda Upazila and Bay of Bengal on the south, Fatikchari Upazila on the east, Sona Gazi and Campaniganj (Noakhali) Upazila on the west (Figure 5-39). Mirsharai Upazila area 482.88 sq km. According to BBS data of 2022, total population 1,11,009; male 4,72,777, female 2,28,303; . In Mirsharai Upazila, Municipality 2, Union 16, Mouza 109, Village 216, Urban population 31206, Rural population 387510., Population density 826 per Sq.Km. Main sources of income Agriculture 38.93%, non-agricultural laborer 3.61%, industry 0.57%, commerce 13.26%, transport and communication 2.93%, service 18%, construction 1.19%, religious service 0.34%, rent and remittance 8.84% and others 12.33%. Literacy rate average 55.1%; male 57.1%%, female 53.3%. Access to electricity all the wards and unions of the Upazila are under rural electrification network. However, 56.0% of the dwelling households have access to electricity. Sources of drinking water Tube-well 93.9%, tap 1.6% and others 4.5%. The presence of arsenic has been detected in 39% of the shallow tube-well water of the Upazila. Sanitation 76.2% of dwelling households of the Upazila use sanitary latrines and 21.7% of dwelling households use non-sanitary latrines; 2.1% of households do not have latrine facilities. Health centers in Upazila health complex 1, family planning center 16, satellite clinic 11. BRAC, Proshika, Seba, ASA, CARE, Hunger Project working in this Upazila.

Figure 4-18: Mirsharai Upazila Map Please remove the map

4.4.2. PROFILE OF SAMPLED HH CHARACTERISTICS

136. To ensure all relevant information and representation of all categories of people within project study area, a sample survey of 112 male headed households (HHs) and field investigations were carried out focused on collection and analysis of information from the samples of:

- Households, business enterprises, institutions and organizations located along the proposed project area and likely to be permanently and/or temporarily affected during construction.
- Households located within 1 KM on each side of the project.
- Poorer community people of different trades and occupations.

137. The sampling of probable close to project area are to be considered those can be affected by the project activities indirectly, since no person is living in 2A and 2B zone areas and its close proximity. Findings presented hereunder represent an assimilation of sample surveys of households, located along the proposed project area. However, the household level survey findings form the foundation; while the findings from analysis of data from other sources supplement the household level survey findings to reconfirm the validity, where it was thought necessary. The details of socioeconomic survey analysis is presented **in Annex- 3, Social Baseline, Data Book, Vol 2.**

4.4.3. HHS CHARACTERISTIC

4.4.3.1. NUMBER OF HH AND AVERAGE HOUSEHOLD SIZE

138. The average family size of 112 HHs in BEZA area is 4.38 persons. While 56.25% of total sample HHs have 4-5 members, 24.11% HHs have 3 members or less and the rest 19.64% have 5 or more members in their HHs, (Table 4-9).

Table 4-9: Number of HHs, average family size and percentage distribution of size

Total Number of samples HHs	Total number of HH members	Average HH Size	Distribution of HHs by different family sizes		
			HHs with 1-3 members	HHs with 4-5 members	HHs with 5 or more members
112	491	4.38	27 (24.11%)	63 (56.25%)	22 (19.64%)

4.4.3.2. AGE STRUCTURE OF HH POPULATION

139. The distribution of total population of the sampled households by age structure; showing that population aged between 16 and 60 years constitute 62.32% of total population of the sampled HHs – indicating the predominance of economically active members in the HHs. Male population within economically active age range is 33.20%; while female population of the same age is 29.12%. The reason for such difference between male and female is that male over 60 years of age is 2.04%, compared to 1.63% of female of that age group. Notable that the children (aged up to 14) constitute 32.18%; while the adolescents (aged 15-17) represent 5.30% of the total population. Noteworthy that the juvenile work force within the age range 18-34 years constitute 29.53 of total HH population.

4.4.3.3. MARITAL STATUS OF POPULATION AGED >14 YEARS

140. About 26.88% of male and 26.68% of total female population are being within marriageable age range, (aged above 14), 73.74% of male and 85.06% of female within that age range are already married.

4.4.3.4. DEPENDENCY RATIO[12]

141. The **t**otal population aged in between 0-14 and aged above 65 years constitute about 34.22% of the total family members of the interviewed HHs who apparently are dependent on the rest 65.78% members of the same HHs. Thus, the dependency ratio comes around 52.01%.

4.4.3.5. EDUCATIONAL STATUS OF HHS POPULATION

142. **A**bout 73.52% of the total population have a certain level education as against 9.37% illiterate. Among the literate ones, nearly 20.98% of male and 19.35% of female have only primary level of education and 1.43% of male and only 0.20% of female received graduation/post-graduation level of education. 28.31% of people received Secondary Education and a total of 3.26% received Higher Secondary education.

4.4.4. OCCUPATION AND EMPLOYMENT STATUS OF THE SURVEYED HH POPULATION

4.4.4.1. MAIN OCCUPATION OF SURVEYED HH POPULATION

143. Considering only the population within the age range 15-65 years, who constitute about 65.78% of the total population of the sampled HHs, the distribution of the 15-65 years aged population by main occupations. It appears that absolute unemployment rate in the BEZA influence zone is around 3.10%; absolute housewives who constitute about 39.32% of the total population of the considered age group. Students aged above 14 years comprise about 10.84% of population within the same age group Small and petty business being the single most common occupation for about 5.88% of the total population of the considered age group, service holders constitute 3.72%. Agriculture and day laboring being the main occupation for about 25.07%, agricultural labor is the main income source.

4.4.4.2. MAIN OCCUPATION OF SURVEYED HH HEADS

144. The distribution of household head by occupation, and it shows that business, day labor and driver category dominate the project area as it accounts for 75.89 percent of the total HH head occupation. No other occupation dominates here. Farming is the main occupation of only 9.82 percent. 6.25 percent of them are service holders as shown in **Table 4-10**.

Table 4-10:Distribution of population by occupation

Occupations	Primary Occupations of the Household Heads			
	Primary Occupations			
	Male	Female	Total	%

[12]The dependency ratio has been defined as follows:
Population Age group 0-14 yrs.+ Population aged>65
Dependency Ratio= -X100
Population age group 15-65

Agricultural farming	11	0	11	9.82
Business	16	0	16	14.29
Service	7	0	7	6.25
Housewife	0	0	0	0
Day laboring	51	0	51	45.54
Expatriate	2	0	2	1.79
Driver	18	0	18	16.07
Electrician	1	0	1	0.89
Old/ Disable	4	0	4	3.57
Fisherman	2	0	2	1.79
Total	**112**	**0**	**112**	**100.00**

4.4.4.3. EMPLOYMENT STATUS OF HH POPULATION

145. As it is evident from the survey data, while children (total 60) aged below 6 combined with students (131) constitute about 29.63% of total population (excluding housewives) of the surveyed HHs. While about 56.70%of total male and 34.43% of female are fully employed, 15.36% of male and 33.70% of female members are unemployed. Taken male and female together (excluding the housewife), the overall unemployment rate in the district 23.30% (**Table 4-11**).

Table 4-11: Distribution of population by employment status

Employment Status	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Aged blow 6 year	27	10.59	33	13.98	60	12.22
Students	71	27.84	60	25.42	131	26.68
Day labor	66	25.88	2	0.85	68	13.85
Agriculture and Fisheries	15	5.88	0	0	15	3.05
Service	39	15.29	3	1.27	42	8.55
Housewife	0	0	128	54.24	128	26.07
Unemployed	18	7.06	10	4.24	28	5.70
Business	19	7.45	0	0	19	3.87
Total	255	100	236	100	491	100

4.4.5. HOUSEHOLD ASSETS AND CAPITAL RESOURCES

4.4.5.1. LAND

146. About 81.25 % of the interviewed HHs is being land less 8.93% HHs reported to have less than 10 acres of one or other type of land and, 4% has land in between 1 to 1.5 acres, while only 1% has land above 3.5 acres. The rest 4% have land in between 1.51-2.50 acres. The average land owned per HH is an acre; of which 6.97 acres is homestead land and 18.71acre is cultivable land.

4.4.5.2. VALUE OF LAND OWNED BY THE SAMPLED HHS

147. Estimated at the average present market rate, the total value of land owned by the sampled HHs is shown in **Table 4-12**.

Table 4-12: Value of land owned by the sampled HHs

Land Type	Average amount of own land (Decimal/HH	Average Value (TK/Decimal)	Total Value (TK/HH)	Remarks
Agriculture	89.10	130400	243978400	Value of land has been estimated based on the average present market rates given by the FGD participants and respondent
Homestead	10.72	210570	146767290	
Pond /Ditch	12.5	95580	14337000	
Commercial	None of the sample HH reported possibility of any commercial land			

4.4.5.3. LIVESTOCK, POULTRY AND OTHER HOUSEHOLD ASSETS

148. About 58.93% interviewed HHs reported having one or other type of livestock, while another 47.32% of HHs reported have any poultry birds. The average number of livestock heads under the management of the sampled

HHs is 2.42 per HH, including 7 HH having 18 bullocks. The estimated average value of livestock and poultry birds per household of the sampled households. The average value per unit of buffalo TK54890 cow per unit is Chickens TK 450 and duck TK 450. The total value of all livestock and poultry stands at BDT 7481970. About 0.89% of interviewed HHs reported to have any type of agricultural equipment like tractor/power tiller and 32.14% have any type of transport like motorcycle and bicycle; while 28.57% households have TV/Radio, 90.18% household has mobile phones, 15.18% has fridges, 55.36%household has electric fan. The total value of various HHs assets amount to TK /-6911313

4.4.6. LIVING STANDARD

4.4.6.1. OWNERSHIP, STRUCTURAL CONDITIONS AND AMENITIES IN RESIDENTIAL HOUSES

149. To understand the standard of living of the sample HHs, the survey examined the ownership, structural condition, and availability of basic amenities in their residential houses. Table 4-40 shows that 58.04% of the interviewed HHs are residing in their own houses, 38.39 residing in rented house/Kash land and the rest 3.57% live in other houses. Notable that out of total 65 HHs residing in self-owned houses, only 23.08% are living in buildings, 21.54% live in semi-pucca, 32.30% live in tin-maid house and all others (23.08%) are living in Katcha houses.

4.4.6.2. AMENITIES IN THE RESIDENTIAL HOUSES OF THE SAMPLE HHS

150. As may be seen in the **Table 5-32** below, only 5.36% of the HHs are connected to piped water supply system; while the 90.18% depends on hand tube wells and for 4.46% HHs collect water from other HH. Sanitary latrines only 17.86% HH have sanitary latrine and 82.14% HH have ring slab/Non-Sanitary Latrine. 84.82% of HHs have electric connection, 1.79% have no electric connection, 4.46% depend on other houses and 8.93% use other sources,

4.4.6.3. ACCESSIBILITY TO HEALTH CARE FACILITIES

151. As it is evident from the survey**,** about 69.64% of people of the surveyed area mainly goes to the govt. hospitals and 2.68% HHs goes to private doctors/clinics for health care services, 99.11% HH goes to village doctor and 40.18% HH goes to pharmacy when any of their members are sick. Whereas 2.67% of HHs reported that the qualified doctor is available.

4.4.7. INCOME AND EXPENDITURE[13]

152. Estimated the income and expenditure of the sample HHs to have an idea of their overall economic conditions and standard of living, income estimate embraced: (i) Farm Income, (ii) Off-farm Income and (iii) Farm & Off-Farm Income of the HHs. Estimate of 'Farm Income' covered all agricultural income including the sales proceeds of crops, vegetable, fruits, livestock, poultry, fish culture and the like; while the 'Off-farm Income' included Wage/Salary/Pension etc. as well as the income from Trade/Business, Transport operation and/or transport related business, Remittance, Rent, Interest (Bank, FDR etc.) and Sale of any Capital Asset. On the other hand, expenditure is the summation of agricultural farming costs, household consumption cost (covering healthcare, clothing, and education costs), transportations cost and purchase value of any capital asset during the same reference period.

153. Out of total 112 HHs interviewed, agricultural farming (including livestock, poultry, fishery) is the only income source for 24.11% HHs and98.21 % depends exclusively on off-farm income, while the rest 14.29% HHs depend both on farm and non-farm income sources. The average monthly income of surveyed HHs is TK 18016.07/- HH and annual average expenditure per HHs.

154. The average monthly household expenditures on the major accounts - including agricultural farming cost, HH consumption expenditures, transportation cost and others etc. The overall area average of monthly expenditure is Tk 17.177.59/HH; leaving a balance of Tk 838.48/ HH.

4.4.8. OVERALL ECONOMIC CONDITION SAMPLE HHS

155. Based on poverty rate in Bangladesh the overall economic status of the sampled HHs about 69.64% of total HHs have faced deficit and 14.29% fell deficit at times or medium income family. On the other hand, 16.07% of HHs have surpluses.

[13] Analysis is based on figures collected from 100l HHs sampled from both sides within 1KM of the proposed road alignment.

4.4.8.1. PREVALENCE OF BORROWER HOUSEHOLDS

156. About 50.89% of total HHs took any loan during last one year for different purposes and from different sources. All the borrowing 27.68& HHs commonly took loans from NGOs and 10.71% HHs got loan from Banks and financial institutions, 4.46% from the Cooperatives.

4.4.8.2. AVERAGE LOAN FOR DIFFERENT PURPOSES

157. The purpose-wise percentage of loan recipients and 54.39% of borrowing HHs took loan for meeting the food expenses and other family consumption purposes; For business purpose, 3.51% of HHs took loan. 28.07% HHs borrowed for buying agricultural inputs/equipment and another 14.4% for other purposes.

4.4.9. ASSOCIATION WITH NGOS

158. Out of total 112 sampled HHs, 48.21% reportedly associated with any NGOs; Grameen Bank, ASA and BRAC are being the NGOs these HHs are associated with.

4.4.10. MAJOR LOCAL SOCIAL PROBLEMS

159. Considered the existing poor road condition is the first problem by 100% of respondents and unemployment is the second most common problem reported by 52.68% of respondents. Local conflicts and poverty issues were mentioned by 50.89% HHs.

160. Among the proposed measures against poverty assistance from Govt. and general demand for industrial establishment; While it is recommended to develop new industries and create employment opportunities to alleviate unemployment and poverty. Those who mentioned unemployment as a problem wanted govt. assistance towards establishing a new factory.

4.4.11. STATUS OF WOMEN IN THE PROJECT AREA

Education

161. Even though women constitute half of the population, analysis of survey findings reveal that women in many aspects fall behind men. The female literacy rate is still a bit high in the survey areas – about 19.82% female compared to 18.92% of male. Although the male students and recipients of secondary and higher secondary levels education are higher than female, the scenario at graduation levels is just opposite. Male students and recipients of graduate level education is 2.10% as against 0.30% of female, whereas female at graduation/post-graduation level are far behind their male counterparts.

Occupation and Employment

162. Excluding the absolute housewives and students aged above 14 years, 63.75% of the sampled HH members aged in between 15-65 years reported to be fully employed in any income earning occupation; about 43.03% of male and 39.94% of female are fully employed. Absolute unemployment rate for male is 2.9% and 0.31%; absolute housewives being considered employed.

Participation in Social Organizations and NGOs

Whereas 48.21% of total sampled HHs reported to have any family member associated with NGOs like ASA, BRAC, Grameen Bank.

Women's Mobility and Accessibility to Markets

163. To be taken with caution that 24.11% of sampled HHs heads do not support women working outside home, 91.96% women members of interviewed HHs reported to have visited any place outside home during a year before interview and 38.46% of total women interviewed reported to have visited any marketplace

Women's Participation in Decision Making

164. The Table 4-55 presents the survey findings about women participation in important family matters like children's education, children's marriage, and own health care; wherefrom it appears that women are very good position in regard to deciding about their children's education. About 94.64% of women taking part in deciding about their children's education about5.36% cannot at all play any role in this regard or was not applicable as they do not have any children yet to go to school.

165. Only 89.29% of women having children of that age group reported full freedom to participation in any decision about their children's marriage, while 5.36% reported possibility of participation in decision making only on limited issues concerning their children's marriage. About their own health, 97.32% of women reported to have absolute freedom of taking decision, while about 2.68% cannot take decision.

Women Awareness of STDs

166. Although HIV/AIDS infected people in Bangladesh is still at relatively low level, there is, however, a concentrated HIV epidemic among the injecting drug users (IDU), primarily due to sharing of unclean syringes and needles. As a result, the rate of new infections is still on the rise and Bangladesh is the only country in the South Asia Region where new infections are rising[14]. Risk arises mainly from unprotected paid sex, sharing of used needles and syringes by IDU, and unprotected sex between men who have sex with men. There is also a risk of epidemic among female sex workers (FSW) in towns bordering with India.

167. Having that in view, the study has investigated the knowledge level of the respondents about HIV/AIDS. In response to a question whether they know about Sexually Transmitted Diseases (STD), 23.08% women reported to have heard of HIV/AIDS and about 7.69% claimed to be aware of the reasons for spreading HIV/AIDS.

4.5. ARCHAEOLOGICAL/ HISTORICAL MONUMENTS

168. Archaeological heritage and relics are existing at the Mirsarai Upazila jurisdiction like Dhum Shila Pathar (Shantir Hat), Chhuti Khan Mosque, Paragal Khan Dighi, Nai Duari Mosque, Jagannath Dham (Abu Torab), Kali Mandir (Karerhat), Shantiniketan Vihara, Abhay Charan Vihara. All the archaeological sites are preserved by the Antiquities Act, 1968 (Under Section 12). All sites will not be affected by the sub-project. No any archaeological heritage and relics are located within the sub-project site.

4.6. ACCESS TO THE PROJECT SITE

169. The shorter, cost-effective and safe road between the NSEZ Economic Zone and the capital Dhaka, as well as the port city Chittagong, the existing road is via the Dhaka-Chittagong National Highway. It is a dedicated route for transporting commodities to and from the economic zone, as well as conveying finished products from this zone to domestic and international markets. The GCL's Bakhrabad-Chattogram Transmission Line connects the proposed project sites to the Dhaka-Chittagong Highway via Sheikh Hasina Sarani.

170. To determine baseline condition of traffic, two days traffic counting are conducted during 30 minutes period to assess the present scenario of the movement of motorized and non-motorized traffic within the NSEZ. The locations of traffic counting were at Shekh Hasina Sharak to CP More and Shekh Hasina Sharak to BEZA Check Post. Surveyed data indicated that 154 motorized vehicles movement in both directions of Shekh Hasina Sharak to CP More up and 121 motorized vehicles movement in both directions of Shekh Hasina Sharak to BEZA Check Post road in the morning time. Whereas, during the evening time total movement vehicles was higher on Shekh Hasina Sharak to CP More than to BEZA Check Post. Amongst the different mode of traffic highest number of vehicles are motorized 3-wheel/ CNG/ Mishuk/ Auto Rickshaw followed by micro bus, and so on. Most of the Micro buses were using by the tourist visitors. No Rickshaw, Van and Animal/Push Cart were observed. Road traffic count tally sheet is attached in **Annex-5, Data Book, Vol-2**. Different modes of road traffic are found heavy, medium and small tracks, large and minibus, micro bus, 4 Wheel Drive/ Jeep/ SUV / NOAH, car, Motorized 3 wheel/ CNG/ Mishuk/ Auto Rickshaw and motor cycle.

171. In addition to road network, another access to the project site is waterway, the Sandwip channel locate at western side of the project area. Usually in this route only a few trawlers and fishing boats movement found bur during two days survey, no sort of water vessel was plying on Sandeep Channel near the Economic Zone. It should be noted that fishing was closed due to government restrictions.

[14] *FEATURE STORY; HIV/AIDS in Bangladesh, July 10, 2012, World Bank*

5. ANALYSIS OF ALTERNATIVE ALIGNMENTS

5.1. INTRODUCTION

172. The alternatives analysis is carried out, considering the different alignments of the gas pipeline network, its length construction obstacles, crossing existing canals, and water course, etc. The technological issues are also considered, such as methods of pipeline installation as open cut method and horizontal directional drilling method (HDD) method, etc. Three options studied for this analysis are; i) proposed designed gas pipeline network; ii) new alignment as Alternative-1, and iii) another new alignment as Alternative-2. The impacts in terms of the physical environment, ecological, including social environments, and construction cost for each option have been evaluated. As of right now, the sub project site is unoccupied by private dwellers and there is no sensitive ecological habitation within the sub-project areas. There are no protected areas (PAs) or forest areas inside the sub-project boundaries, and an access road connecting it to the Dhaka-Chittagong National Highways is already exists.

173. Evaluating alternatives for Gas pipeline network in Zones 2A-2B and its adjacent areas involves a comprehensive assessment of various factors to identify the most suitable alignment for the gas supply in the sub-prpject area. The description of the three options are briefly described below.

5.2. PROPOSED GAS PIPELINE NETWORK

174. This route of the sub-project has been selected based on the requirement of Govt. level and planned in the Master Plan of BEZA. The major constraints along the route are always avoiding the developments to the extent possible. In addition to above, pipeline route has been selected to avoid the forest areas, ecological sensitivities areas, protected areas, undulated or rugged areas, in terms of economics, safety, constructability and availability of sufficient ROW for further development. Due to a super dike that eliminates flood and waterlogging threats, the pipeline route was chosen with minimal impact on the natural and social environments in zones (2A) and (2B), and its adjacent areas.

175. The proposed designed gas pipeline network is about 30 km length, starting from the Central Gas Station (CGS) as shown in **Figure 5-1**Error! Reference source not found. The number of major road crossing-at 3 points at 22°45'25"N 91°28'40"E, 22°45'02"N 91°27'32"E, and 22°43'54"N 91°30'10"E. and the water body crossing at 4 points; 22°44'25"N 91°27'02"E, 22°45'23"N 91°26'22"E, and 22°45'45"N 91°27'07"E' and 22°45'04"N 91°27'33"E. These canals are Itchakali, Bamunshandur and Susham /Daborkhali. No building steuctures will be affected since the gas pipeline will pass alognside the existing and proposed future roads network. The sub-project scenarios considered the following engineering factors as well:

Table 5-1: Design parameters of Gas pipeline network

Maximum road gradients:	Along the pipeline alignment- 1:5 (excluding hills) Across the pipeline alignment- 1:10
Pipeline distance between turning point (TP):	100 meters
Maximum deflection angle at TP:	90^0
Width of Right of Way (RoW):	12 meters
Minimum distance from residents	15 meters
Minimum distance from building/structure/monument:	50 meters

5.3. ALTERNATIVE-1

176. The Alternative -I is considered another new alignment for the installation of gas pipelines, which will pass through the existing road networks as well other sides within the Zone 2A-2B and its adjacent areas as zig-zag to connect a wide areas of coverage as shown in **Figure 5-2.** The new gas pipelines will pass from the CGS of a tentative length 42.70 km, along road side or middle of roads with crossing the canals at least nine (9) locations.

The number water body crossing- at 9 points at 22.7425587N, 91.4510999E, 22.7509447N, 91.4592012E, 22.7342654N, 91.4758789E, 22.7493938N, 91.4396783E, 22.7584367N, 91.4385892E, 22.7350636N, 91.4467007E, 22°44'25"N 91°27'02"E, 22°45'23"N 91°26'22"E, and 22°45'45"N 91°27'07"E' and 22°45'04"N 91°27'33"E etc. In addition, this unplanned alignment may create many obstacles and interferances with the industrial infrastructures and other building development stage, in future.

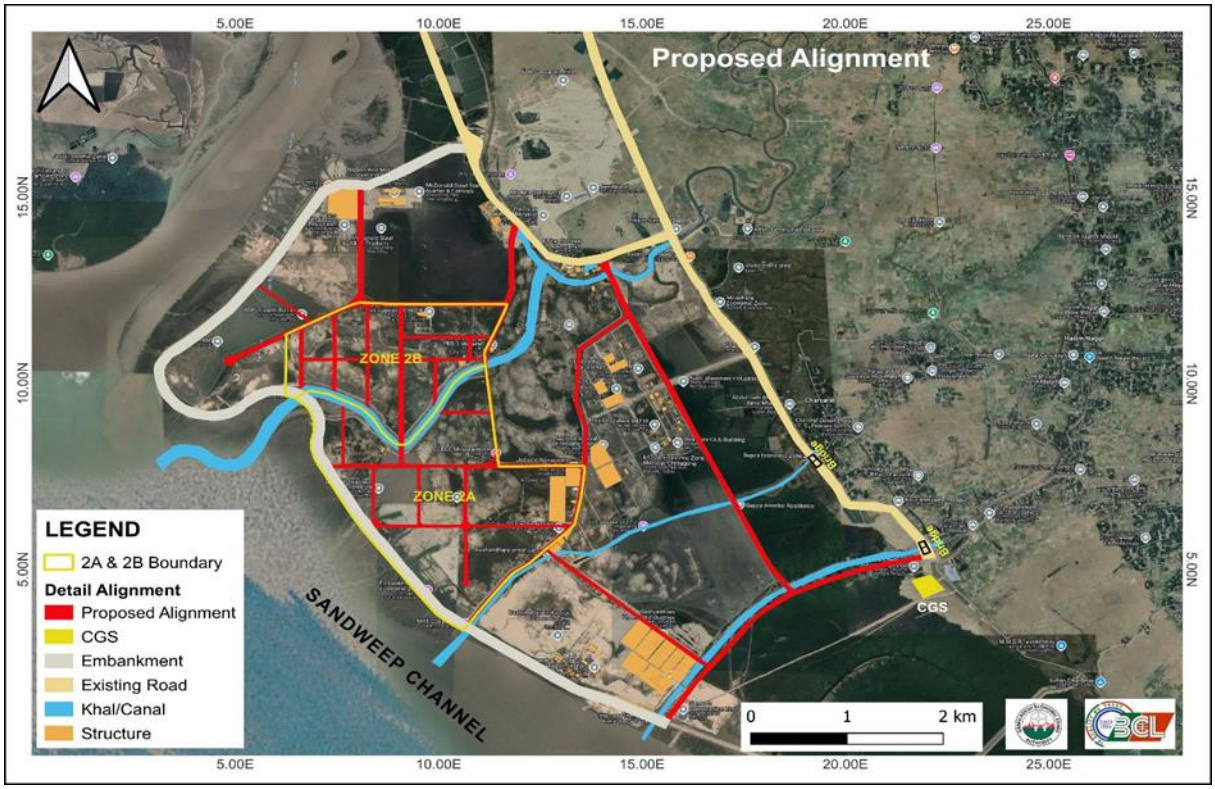


Figure 5-1: Proposed Gas pipeline network within Zone 2A-2B and its adjacent area

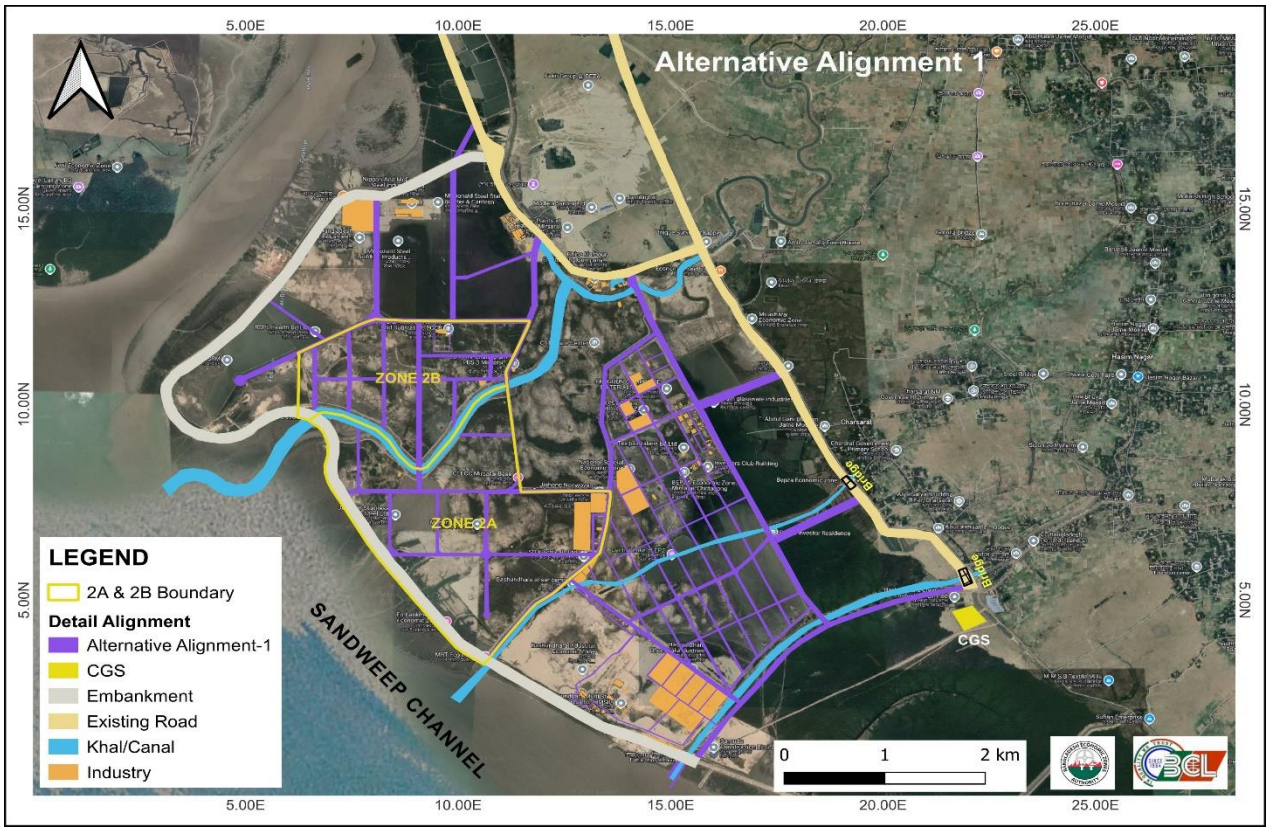


Figure 5-2: New Gas Pipeline network within Zone 2A-2B and adjacent area - Alternative-1

5.4. ALTERNATIVE-2

177. The alignment of alternative 2 starts at same location of proposed designed alignment and passes alongside another main road (Figure 5-3). The length of this gas pipeline networks will about 35km. The new gas pipelines will pass along road side or middle of roads and also crossing the canal at least six (6) locations. In addition to four (4) canals within proposed alignment, another two canals are at 22°43'57.50"N, 91°30'15.94"E and 22°44'30.99"N, 91°29'32.54"E. Over these canals two bridges are constructed. The number of major road crossing-at 3 points.

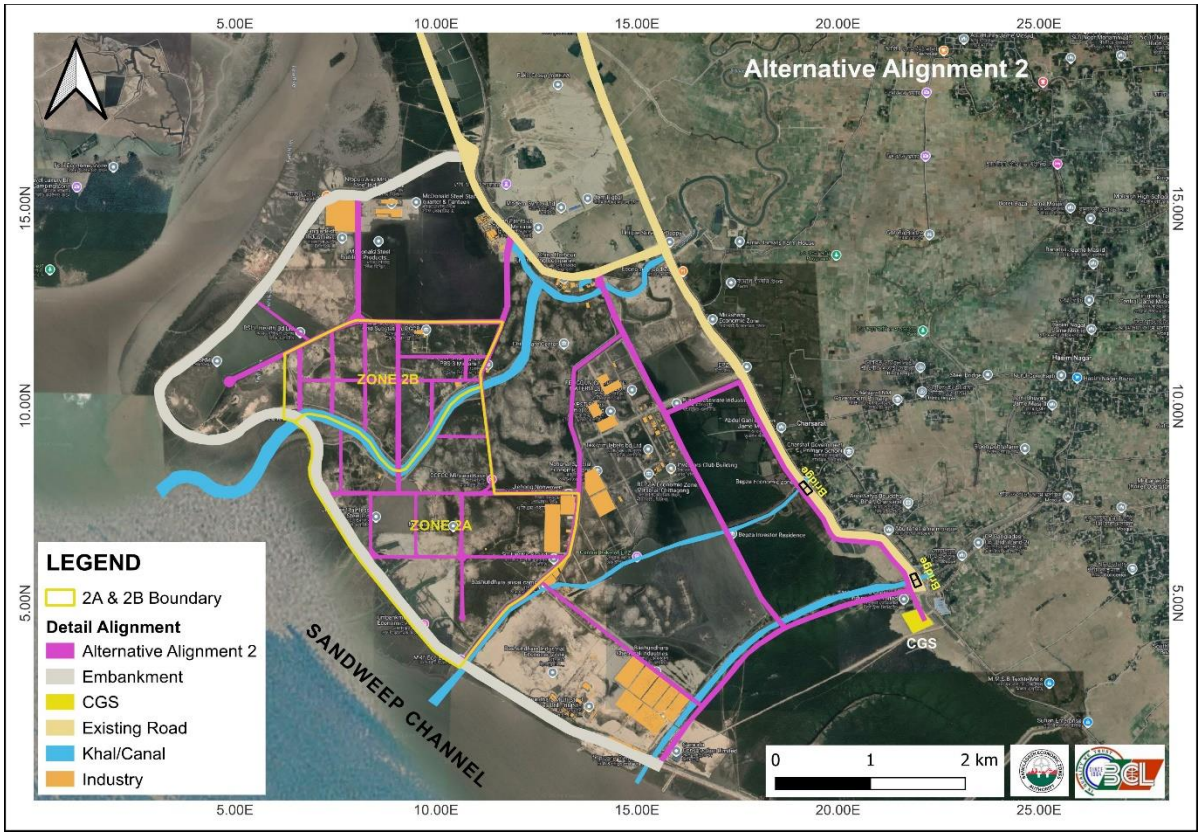


Figure 5-3: New gas pipeline network within Zone 2A-2B and adjacent area alignment- Alternative-2

5.5. ANALYSIS OF THE ALTERNATIVES OPTIONS

178. A comparative analysis was made between the proposed gas pipeline network and two Alternatives alignment in term of impacts on physical and ecological environments, socioeconomic and cost of the construction. The assessment has been carried out based on the multiple parameters under four sub-criteria i.e., physical environmental quality, ecological resources and socio-cultural resources, and economic cost.

179. The Leopold Matrix is the best know matrix, is adopted in this study in order to evaluate the impacts of three options. The Leopold matrix is a two-dimensional cross-referencing matrix as follows

- The activities linked to the sub-project that may have an impact on the environment and human
- The existing environmental and social condition that could possibly be affected by the sub-project

180. This methodology allows for a score (from 1 to 100) for each of the identified environmental impacts, parameters, which may, at the end of the process, produce a total score of environmental impacts generated by the activity or work.

181. The environmental and social impacts have been quantified in terms of Environmental Impact Value (EIV) of various environmental parameters. Relative importance of each parameter is multiplied by its environmental changes impact in order to assess the Environmental Impact Value(EIV) of respective environmental parameters

$$\text{EIV} = \sum_{i=1}^{N} (V_i) W_i$$

EIV = Environmental Impact Value
Vi = Relative change of the environmental quality of parameters (Degree of impacts)

Wi = Relative importance of weight or parameters
N = Total number of environmental parameters

182. Relative importance and its change of each parameter (degree of impacts or magnitude) have been assumed by expert judgment. The relative change of the environmental quality parameters or magnitude are calculated within a numerical scale ranging from 1 to 10, as to 1 to 10 for beneficial impacts, and, -1 to -10 for negative impacts.

183. Three options were analyzed and compared for the alternative analysis of the gas pipeline network as shown in **Table 5-2** . The analysis and shows the summary of EIV weighted scores 78 for the Proposed gas pipeline network, 21 for new alignment Alternative- 1 and 43 for the new alignment Alternative-2. The overall envirnmental impact value of the proposed gas pipeline network is higher than those of other two alternatives, indicates that the adverse environmental and social impacts will be 'Lower' in case of Proposed Network and, as well as construction cost will be less than the Alternative-1 and Alternative-2.

184. On the above discussion and comparative analysis, it is concluded that the Proposed network alignment is the best option and viable than considering other two alternatives for installation of gas pipeline supply networks in Zone 2A & Zone 2B due to reducing the number of road crossings, water body crossings and obstacles and interference,etc. The construction cost will be low and less detrimental effect.

Table 5-2: Analysis Alternatives for the Gas Pipeline Network-sub-project

Environ. Aspects (a)	Environmental Parameters (b)	Activities (c)	Relative Importance Value (d)	Proposed Gas-Pipeline Route			Alt-1: New Alignment			Alt-2: New alignment		
				Key observation/ indicator (e)	Magnitude of Impact (f)	Environmental Impact value (EIV)(g = d x f)	Key observation/ indicator(h)	Magnitude of Impact (h)	Environmental Impact value (EIV)(i= d x h)	Key observation/ indicator (j)	Magnitude of Impact (k)	Environmental Impact value (EIV) (l=d x l)
Physical Environment	Degradation of lands use	Degradation of lands use due to improper trenching and excavation. Possibilities of obstruction and interference with the future infrastructure development	4	Length of route =30 km	-2	-8	length = 43 km existing road + more outside roads	-3	-12	Length of route=35km	-3	-12
	Soil Characteristic	Due to construction of gas pipelines trenching, crossing the canals and disposal of solid and liquid waste may deteriorate the soil quality.	2	Length of route=30 km	-1	-2	Length of route	-3	-6	Length of route	-3	-6
	Surface water pollution	Surface water pollution due to disposal of Waste generation and handling hazardous	4	Number of canal and water body crossing (4)	-2	-8	Number of canal and water body crossing (9)	-3	-12	Number of canal and water body crossing (6)	-2	-8
	Ground water pollution	Pollution groundwater due to the disposal of waste water from labor camp, construction yard and sites	3	Length of route=30 km	-2	-6	length = 43 km existing road + more outside roads	-3	-9	Length of route=35km	-3	-9
	Ambient air quality deterioration (Trenching for gas pipeline, bending and joining pipe, movement of heavy vehicles and equipment)	Trenching for gas pipeline, bending and joining pipe, movement of heavy vehicles and equipment	5	,,	-2	-10	,,	-3	-15	,,	-3	-15
	Noise & Vibration pollution	Movement of Heavy vehicles and equipment	3	,,	-2	-6	,,	-3	-9	,,	-3	-9

	Drainage congestion, soil erosion and sliding	Possibility of soil erosion and road embankment sliding during excavation and trenching	7	,,	-3	-21	,,	-6	-42	,,	-4	-28
	Exposure to flooding	Overflow of drainage water due to excavation and open cut the trench, and drainage congestion due to improper landscaping	2	,,	-1	-2	,,	-1	-2	,,	-1	-2
	Subtotal (A)		**30**			**-63**			**-107**			**-89**
Ecological aspects	Canals crossing	Damage Canal bottom biodiversity such as Phytoplankton and Zooplankton and benthos	5	Number of canal and water body crossing (4)	-2	-10	Number of canal and water body crossing (8)	-1	-5	Number of canal and water body crossing (5)	-2	-10
	Disturbances of aquatic flora and fauna	Loss of aquatic flora such as Hechcha, Water Hyacinth, Trapa, Duckweed, etc.	5	,,	-2	-10	,,	-3	-15	,,	-2	-10
	Fish Resources	Disturbances of Fish resource	5	,,	-1	-5	,,	-2	-10	,,	-2	-10
	Loss of Flora	Loss of Vegetation within RoW of roads	5	Entire alignment of route	-1	-5	Entire alignment of route	-2	-10	Entire alignment of route	-2	-10
	Subtotal (B)		**20**	**0**		**-30**			**-40**			**-40**
Social Issues	Disturbances of communities	Residential and Commercial area near the sub project site due to movement of vehicles and equipment e.g., barriers to access)	4	Nearby at alignment	-1	-4	Nearby at alignment	-3	-12	Nearby at alignment		0
	Occupational Health and Safety	During construction works (Excavation, cutting & bending of pipe, Digging trenches, electric shock during welding and in HRD and valve stations etc.)	6	Entire alignment of route, base camp, construction yard	-3	-18	Entire alignment of route, base camp, construction yard	-4	-24	Entire alignment of route, base camp, constructio n yard	-3	-18
	Public safety / accidents	Movement of Heavy vehicles and equipment through the local road	3	,,	-1	-3	,,	-2	-6	,,	-2	-6
	Obstruction /interference with infrastructures	Interference of gas pipelines with future development of infrastructures	5	No obstruction	-1	-5	May be at any location	-3	-15	May be at any location of	-4	-20

	during construction						of entire alignment			entire alignment		
	Employment Generation	Labor required for construction of gas pipeline	9	Sub-project site	7	63	Sub-project site	9	81	,,	8	72
	Enhancement of Safety	Proper development of pipeline will increase safety of industries within the subproject area.	3	,,	5	15	,,	5	15	,,	5	15
	Greenery development due to tree plantation alongside existing road	Tree Plantation alongside the route	~~3~~	,,	2	6	,,	4	12	,,	4	12
	Economic Development	New industries will create opportunities and employment	6	,,	6	36	,,	6	36	,,	6	36
	Development of industrial hub	Presence of large number of industries	9	,,	9	81	,,	9	81	,,	9	81
	Construction cost	Construction cost will vary with length of the network route	2	Length of route =30 km	-1	-2	length=43 km	-2	-4	Length =35km	-1	-2
	Subtotal (C')		**50**			**171**			**168**			**172**
	Grand Total = (A+B+C)		**100**			**78**			**21**			**43**

5.6. NO SUB-PROJECT CONSIDERATION

185. No sub-project scenario'is also considered for the analysis. The 'No sub-project would not give opportunity of the area to be established as an efficient and smart Economic Zone without supply of gas through the planned pipeline network. Presently no gas connection is in the Zones 2A and 2B and its adjacent areas, The local people at the periphery are using LPG cylinder and fire wood for cooking purpose. As per Master Plan, gas will be required for 1200 customers to operate the industries in the sub-project area and the NSEZ committed to provide the gas facilities at the site. If 'No Project' is chosen, no benefits, such as no gas supplies to the industries in the national special economic zone will be expected. Industrial output will be limited without this sub project, and the ultimate goal will not be met. It is stated that the 'Without Project' alternative is undesirable, and that the potential socioeconomic benefits of carrying out this sub project far outweigh the government's ultimate goals of increasing employment opportunities and economic growth in order to achieve the status of a medium-income country. Without the sub-project local peoples profession will remain the same.

5.7. TECHNOLOGICAL ALTERNATIVE CONSIDERATIONS

186. In the current plan the open cut method will be applied to the road crossing, water crossing and railway crossing sections in this sub-project. Another common method is horizontal directional drilling method (HDD). The comparative analysis of open cut and HDD methods is as follows (**Table 5-3**);

Table 5-3: Comparative analysis of open cut and HDD method

Open cut method	HDD method
Significant amounts of dust and particulate matter can be produced by open-cut method, which can impair the quality of the air in the surrounding communities. Large-scale material excavation and the use of heavy equipment can release particles into the air, which can aggravate respiratory conditions in the populations surrounding.	At turning locations where the horizontal directional drilling, or HDD, technology will be used with minimal damage to the local air quality, a small amount of dust has been produced.
Significant land disturbance will result from the open-cut technique, necessitating a major rehabilitation effort to return the impacted lands to their pre-disturbance state.	HDD requires less surface area; it requires less significant land restoration.
Open-cut methods include the use of heavy equipment and pipe laying tasks, there will be risks to worker and community health and safety.	Instead, HDD method will reduce the health risks for workers and community people.
Local traffic volume will be increased.	Less traffic volume is anticipated.
 **Typical picture of open cut method.**	 **Typical picture of HDD method.**

187. Technologically, the open-cut approach will be used during the water body crossings, road crossings, and rail crossings, which have a significant detrimental influence on the environment, including pollution of air, water, and land resources, as well as adverse occupational and community health and safety issues. When using HHD instead of the open cut, the expected negative effects on the surrounding environments can be minimized with no or less harm to the health and safety of workers and also the community. Thus, to prevent adverse effects on the social and natural environments in the working areas, it is advised to use the HDD approach at road, rail, and water body crossings, which is the best alternative.

6. STAKEHOLDER ENGAGEMENT AND INFORMATION DISCLOSURE

6.1. INTRODUCTION

188. According to Environmental Social Standards (ESS10) and following Stakeholder Engagement Plan, BEZA[15] , this section describes the different methods of consultations, issues discussed with the stakeholders, and the outcome of the exercise. From December 2023 to June 2024 for the preparation of the ESIA and disseminating relevant information of the project during consultation process nineteen KII, FGD and one public consultation conducted.

6.2. OBJECTIVES

6.3. IDENTIFICATION OF STAKEHOLDERS:

189. The consultant used the stakeholder mapping for public participations and information disclosure included stakeholder's consultation meetings; Key Informant Interviews (KIIs), Focus Group Discussions (FGDs); individual contact with the officials of the KGDC, BEZA at field level, a project office and other organizations etc. During the preparation of the ESIA present study, all stakeholders are initially synthesized into two categories which are identified as:

190. **Project-affected parties**: those who will be or are likely to be affected by the project. Areas 2A and 2B are fully occupied by BEZA and no settlement is developed within study area. Therefore, no one will be affected by the project's interference between Zones 2A and 2B.

191. **Other interested parties**: those who may be interested in the project and who may positively or negatively influence the views of the affected parties or affect the sustainability of the implementation process or project outcomes. Project stakeholders such as local people, landowners, house owners, civil society organizations, locally active NGOs, government officials, farmers, transport owners, women and vulnerable groups, fishermen etc. will be affected indirectly during project construction due to labor flow and project construction activities.

192. A combination of mixed methods of information disclosure and consultation process was adopted at this stage of ESIA preparation. The method selected for consultation was basically designed keeping in mind the profile of the stakeholders, type of information desired and level of engagement required. In each consultation session the consultant introduced themselves, introduced the project and the purpose of engagement with the respective stakeholder. The primary methods followed in the consultation process are:

- Key Informant Interview and
- Focus group discussion.
- Stakeholder Consultation.

6.4. KEY INFORMANT INTERVIEWS

193. Based on the literature review, desk research, and meetings with BEZA, key stakeholders or informant have been identified who are currently playing pivotal role in the smooth operation of the Gas-pipeline network in 2A and 2B zones in the NSEZ. The key informants for this sub project are considered as both internal and external as follows;

- Key Government Agencies: Bangladesh Economic Zone Authority (BEZA), Bangladesh Export Processing Zones Authority (BEPZA), DPHE, DoF, BWDB, BIWTA, RHD, LGED
- Utility service providers: Karnaphuli Gas Distribution Company Limited (KGDCL).
- Local Government Agencies: Mirsharai Upazila Parishad
- Department of Inspection for Factories and Establishments (DIFE)
- Local community, local elites, local government representatives, school teacher, students, women
- Scientific Agencies (Government): Bangladesh Meteorological Department (BMD),
- Labor forces (farmer, fishermen, business group, entrepreneurs, day labor)
- Non-government organization

[15] Stakeholder Engagement Plan for Private Investment and Digital Entrepreneurship Project (PRIDE) PART 1 - Bangladesh Economic Zones Authority, January 2020
https://documents1.worldbank.org/curated/en/468621582247161451/pdf/Stakeholder-Engagement-Plan-SEP-Bangladesh-Private-Investment-Digital-Entrepreneurship-Project-P170688.pdf

- Regulatory Bodies: Department of Environment (DoE).

194. Nineteen KIIs were conducted with-the officials of different agencies and local people and the details in **Annex- 5, Data Book, Vol-2.**The opinions and suggestions were sought from all key informants and their opinion were as follows:

- Development of Gas Pipeline Network in project area will bring positive impact on the society, for example: increase employment opportunities, development of communication system, development of business over all the quality of life will be improved. The Gas Pipeline will be installed within the Economic Zone so there is no problem for the local people. However, there are some risks for the communities around the Gas Pipeline from Barotakia to Economic Zone, such as Gas Pipeline Leakage. Local forest drains and irrigation channels may be destroyed. Besides, many cows and buffaloes used to graze in the economic zone which will not be possible anymore.
- As the gas pipeline is within the economic zone, it will not hamper agricultural production or fisheries.
- After the installation of gas lines, many factories will go into production, because of which there will be a lot of development in this area and the country.
- Must monitor the activities to mitigate the social impact.
- No social forest/drainage system/irrigation channels should be disturbed while installing the gas pipeline.
- There may be conflict between the local community and the laborers coming from outside. Crime (theft, robbery, rape) may increase. Addiction and different kinds of diseases can spread.
- Providing compensation if any family is affected. Employment of local people should be arranged on a priority basis.
- The health & safety of all those working in the project must be ensured. Gas wastage should be prevented. Training and employment of local people should be arranged on a priority basis.

And detail in Annexure 13.


Manager (Environment), KGDCL, Chattogram H\Q


Sub-Assistant Engineer, PGCB sub station, NSEZ


Deputy Inspector General, DIFE


Forest Range Officer, Department of Forest

6.5. FOCUS GROUP DISCUSSIONS

195. A total seven (07) FGD were conducted to disseminate ad disclose the information of proposed Gas Pipeline Sub-project under National Special Economic Zone (NSEZ) Development Project and to know their opinions about the project. From December 2023 to January 2024, seven (7) focused group discussions with project affected/benefited people with emphasize on different groups such as disadvantage/vulnerable people including local communities, Laborers group, Farmers group, women group etc. A total 64 participants were involved in the KIIs, of them 10 were women. The picture and signature of the participants list was included in **Annex-5, Data Book, Vol-2**. To know in-depth information and project impacts on them including feedback/suggestions and recommendations by them to overcome the adverse effects. A table containing list of the FGD's are given in **Table 6-1.**

Table 6-1:FGDs with different Groups

Sl. No	Concern Group	Location	Date	Participants	
				Male	Female
1. 1	Local Community	Shop of Musharraf Member, Char Sarat, Mirsharai, Chattogram	9.12.2023	10	
2.	Affected People	Member's Office, Daborkhali Point, Char Sarat, Mirsharai, Chattogram	9.12.2023	09	
3.	Businessmen	Ichakhali Sluice-gate Bazar, Upazila: Mirsharai, District: Chattogram	10.12.2023	09	
4.	Local Community	Shop of Saiful Islam, Daborkhali Point, Char Sarat, Mirsharai, Chattogram	10.12.2023	07	
5.	Women Group	House of Mafij Shoudagor, Badiullahpara, Maghadia, Mirsharai, Chattogram	11.12.2023		10
6.	Fishermen	House of Shishuram Das, Sarkerpara, Union, Maghadia, Mirsharai, Chattogram	12.12.2023	11	
7.	Farmer Group	Shop of Belal Hossen, Sariatpara, Union: Maghadia, Upazila: Mirsharai, District: Chattogram	11.12.2023	08	
	Total participants= 64			**54**	**10**

196. Several important issues came out by the focus group discussions with different local people groups of the project area. Among these major points which are focused by the local people as suggestions or comments are given in bellow. Details of the FGDs and attendance sheets are given in **Annex-4, Data Book, Vol-2**. Major raised issues were from the FGDs are given below

- The community will be greatly benefited if gas connection is provided outside the economic zone.
- Communication and development will be improved because of the economic zone. Simultaneously, employment will increase, business will expand, and women will be empowered.
- Due to implementation of the project employment will increase, communication system and business also develop so overall lifestyle of the local people will improve. They were also looking for employment in the BEZA project work, to earn their livelihood during construction phase.
- The safety and security of a female labour is to be ensured at the construction yard during construction phase.
- When asked about gender-based violence, they reply that there are very few incidents of violence. It is to be noted that the main reason for such type of violence's non-harmonically relationship with in-laws, dowry, drug addiction, illicit relationships eve teasing etc. Usually, attempts are made to resolve the problem at the family level and if it is beyond their control, they go to law enforcement agencies for justice. However, they requested to take strong initiative to stop the violence against women. It was informed to them that a Grievance Redress Mechanism (GRM) has been developed in the RAP of the project to prevent such incidents and good governance.
- Requested to engage the poor and vulnerable people in the construction work
- Few people assume that existing crop lands within Zone 2A and Zone 2B will be impacted due to the implementation of the project and they will lose their livelihood
- Requested for skill development trainings for the poor, rehabilitation, loan facility on easy terms etc.

6.6. STAKEHOLDER CONSULTATION

197. On 16/1/24 Moghadiya Union Parishad chairman Mr. Md. Jahangir Hossain presided over a public consultation meeting in the Moghadiya Union Parishad Hall room with the presentation of Dr. Tajul Islam as part of environmental and social impact assessment of gas line network under National Special Economic Zone (NSEZ)

Development Project. Also present were Upazila Agriculture Extension Officer, Senior Fisheries Officer, Assistant Engineer (DPHE), UP members, political personalities, and people from various professions of the area.

198. Total Number of participants attended in the meeting were 53 out of the total 47 was male and 6 was female. The reason of low participation of women in the meeting may be due to their daily schedule of house chores such as cooking, cleaning, moping etc. Social and cultural taboos, and location of the meeting could also be a reason for absenteeism. Some female participants attend the meeting and after a while they go back to their urgent work. Details of the topics discussed in the meeting and attendance sheet of the participants are enclosed in **Annex-5.Data Book, Vol-2.**

6.6.1. OUTCOMES OF THE STAKEHOLDERS' CONSULTATION MEETINGS-

199. Discussion at an open forum were arranged where the stakeholders expressed their opinion and views. A few matters and issues related to GBV and gender equity were discussed with the participants. The participants had expressed their views, opinion and perspectives based on their experiences of the said matter gained from intra-households and also inter households' interactions as well. They also provided remedial suggestions on the adverse environmental and social issues during construction stage (**Table 6-2).**

Table 6-2: Summary of the Public Consultations

Public Level Consultation			
Date-16/1/2022		**Demand and Suggestions**	**Response of Authorities/ Consultants**
Maghadiya Union Parishad Hall room	Total: 52 Male: 47 Female: 6 (Annexure 13)	The participants raised their concerns about environmental and social issues such as pollution from construction activities, loss of livelihood, houses, and various diseases etc. Vulnerable PAPs should be considered, such as safety of female workers, new skill trainings for the vulnerable groups etc. Participant raised points on environmental and social risks and impacts on the disadvantaged and marginalized vulnerable groups and Labor Health and Safety (LHS). Steps to be taken by the Client to mitigate environmental degradation such as -to control dust generation during pipeline excavation works -to save the terrestrial flora and fauna and to uphold biodiversity in the locality as much possible -ensure the health safety at the sites -control gender-based violence (GBV) and sexual exploitation abuse and harassment at site and nearby locality -to control drainage of storm water/ rain water through proper drainage facility provision during construction works	-BEZA a will give priority to the environmental and social issues -Special support for the disadvantaged/marginalized groups in the site -. The project and its management will incorporate the above-mentioned mitigation measures in the project design and implementation as follows: -Occupational Health and Safety Management Plan and -Labor Management Plan will be prepared for the mitigation of these issues. -Occupational health and safety (OHS) measure will be ensured by providing PPE, first aid box, to the workers

6.7. INFORMATION DISCLOSURE

200. Disclosure of ESIA: The approved EISA will be disclosed on the BEZA and World Bank external websites. Many of the community may not have access to the internet, therefore face to face meetings and hard copy of the ESIA report and its summarized form in English and Bangla language must be made available to the local communities or other interested stakeholders. Both summarized reports will briefly present (i) the Project

impacts; (ii) mitigation measures and entitlement matrix; (iii) grievance redress mechanisms; (iv) the institutional framework for Project implementation.

7. IMPACTS, RISKS, AND MITIGATION MEASURES

7.1. INTRODUCTION

201. This chapter assessed potential impacts and risks on environmental and social issues, and mitigated them in a sustainable way to avoid, eliminate, or lessen the negative impacts that will occur during the pre-construction, construction, and operation and maintenance phases. The effects were evaluated based on project activities and existing baseline circumstances, including the natural environment, both physical and biological habitats, as well as the socioeconomic aspects of the project sites. A rapid site-specific environmental assessment was carried out to identify the potential environmental and social impacts on this sub-project specific identified VC, following the World Bank's Environmental and Social Standards (ESS).

7.2. IDENTIFICATION OF IMPACTS

202. The project's planned and unplanned activities have been evaluated for their potential impacts to interact with social and environmental resources. An interaction of scoping matrix offers a methodical process to identify the potential environmental and social impacts (positive or negative) associated with the sub project activities. The impacts were assessed in three phases as follows;

- Pre-Construction Phase
- Construction Phase, and
- Operation and Maintenance Phase

203. The matrix outlined of the Scoping results of anticipated environmental and social risks of the project activities based on the World Bank's ESS (1-10), is presented in Table 7-1

7.3. METHODOLOGY OF ASSESSMENT OF ENVIRONMENTAL AND SOCIAL ISSUES

204. The following is the method statement for the anticipated impacts identification and formulation of mitigation measures in this ESIA study:

- Environmental and social risks were evaluated using scoping and contextual analysis of project activities based on location, and geography.
- The significance of impacts has been determined by combining the perceived frequency of occurrence of the source of the impact, the duration, severity, and spatial extent of the impact and the sensitivity of the area being impacted upon.
- The Valued Components (Environmental and Social) for the identification of impacts have been assessed for the construction phase based on the ***ESSs of the WB.***
- Stakeholder consultations were held with local people, project affected people (PAPs), local NGOs, and various government officials, and participants' views, recommendations, and suggestions were recorded to better understand their concerns and expectations.
- Examining local, & international rules and regulations, and World Bank Environmental and Social Standards (ESS-1 to 10) in relation to project activities.
- Scoping of anticipated E&S risks of the project activities was carried out as shown in Table 7-1, based on the significance of impacts (**Table 7-2**). The significance of the impacts was assessed from the scores of 0-25 is low, 26-50 for moderate, 51-75 for substantial risks and 76-100 is considered as High risk
- Quantifying of environmental and social risk matrices and potential effects as shown in **Table 7-3.**
- Developing and implementing mitigation strategies to mitigate potential impacts; and establishing management plans and systems to monitor, manage, and continuously improve environmental and social performance.
- Evaluating the need for project workers and contractor representatives to improve capacity in order to properly manage and respond to environmental and social challenges.
- Suggestion for assessing and revising risk assessment and management plans on a frequent basis in response to changing situations, new information, and lessons learned during construction period, and
- Encourage a continuous improvement culture in environmental and social performance.

Table 7-1: Scoping of anticipated E&S risks of the sub-project activities based on the WB's ESSs

ESS standards	Parameters	Pre-Construction Phase						Construction Phase							Operation Phase	
		Manpower Engagement	Pipeline Route and Working Area selection	Selection of base camp/ Labor camp	Movement of heavy equipment	Utility Shifting	Vegetation Clearance	Trench excavation & Landfilling	Transporting, Lifting and Placement of pipes in the trench	Grading, Stringing, welding of pipes, coating, and wrapping	Water body, road and railway crossing through open-cut system	Lowering in, tying in, cathodic protection	Commissioning	Metering station and other permanent structures above	Gas pipeline leakage	Valve station and RMS
ESS-1: Assessment & Management of Environmental and Social Risks	Vulnerable to land use															
ESS-2: Labor & Working Conditions	Child labor															
	Social Conflict															
	Employment opportunity															
	Gender-based violence															
	Labor Influx															
	Occupational Health & Safety															
ESS-3: Resource Efficiency and Pollution Prevention and Management	Air Quality															
	Noise & Vibration															
	Surface water Quality															
	Groundwater Quality															
	Soil erosion															
	Soil Quality															
	Sediment quality															
ESS-4: Community Health and Safety	Community health& safety risks															

ESS standards	Parameters	Pre-Construction Phase						Construction Phase							Operation Phase	
		Manpower Engagement	Pipeline Route and Working Area selection	Selection of base camp/ Labor camp	Movement of heavy equipment	Utility Shifting	Vegetation Clearance	Trench excavation & Landfilling	Transporting, Lifting and Placement of pipes in the trench	Grading, Stringing, welding of pipes, coating, and wrapping	Water body, road and railway crossing through open-cut system	Lowering in, tying in, cathodic protection	Commissioning	Metering station and other permanent structures above	Gas pipeline leakage	Valve station and RMS
	Hazardous and non-hazardous waste															
	Traffic and Transport															
ESS-6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Terrestrial Ecology															
	Aquatic Ecology															
ESS-10: Stakeholder Engagement & Information Disclosure	Stakeholder Engagement & Information Disclosure															

Table 7-2: Determination of Significance of Impacts

Parameter	Low	Moderate	Substantial	High
Duration	Insignificant (repairable or reversible) environmental impact	Slightly effects on natural and social environment.	Irreversible environmental and social effects but remedial action is available.	Extensive irreversible environmental effects.
Spatial Extend	Specific location/within subproject	Within subproject boundary	Beyond immediate subproject components	Widespread
Likelihood	0-2=Unlikely to occur	3-5=Occasional	6-8=Possible (Negative/Positive)	9-10=Certain
Intensity	0-2= Low	3-5= Moderate	6-8= Substantial	9-10= High
Significance of Impact	**0-25= Low**	**26-50= Moderate**	**51-75= Substantial**	**76-100= High**

Note: Identified environmental and social impacts have been categorized into two dimensions i) Positive impact and ii) Negative impact. The consequences/severity of impacts are merely Low, Moderate, Substantial and High. The Table 7-2 presents the significance of impacts for different phases of the subproject

Table 7-3: Quantification of Environmental and Social Risks

Project Activities	Impacts	Duration	Reversible	Spread	Likelihood of Occurrence (0-10)	Intensity of Impact (0-10)	Significance Value (1-100)	Significance
Pre-Construction and Construction Phase								
-Manpower Engagement Pipeline Route and Working Area selection of base camp/ Labor camp, utility shifting during pre-construction phase and different activities during construction phase, -involvement of labor and force labor, social conflict -Occupational health and safety due to trench excavation & landfilling Transporting, Lifting and Placement of pipes in the trench. Grading, Stringing, welding of pipes, coating, and wrapping Water body, road and railway crossing through open-cut system, lowering in, tying in, cathodic protection, Handling the hazardous and non-hazardous material. -Commissioning, Metering station and other permanent structures above ground -Pollution of air, noise, surface water ground water, soil, etc. due to movement of heavy equipment and vehicles, - Traffic movement disruption and pollution -Vegetation Clearance. .	Vulnerable to Land Use	Low	Moderate	Moderate	5	7	35	Moderate
	Child labor	Moderate	Moderate	Moderate	3	3	9	Low
	Force Labor	Moderate	Moderate	Moderate	10	6	60	Substantial
	Occupational Health and Safety	Moderate	Moderate	Moderate	10	6	60	Substantial
	Social Conflict	Low	Low	Low	2	3	6	Low
	Gender based violence	Moderate	Moderate	Low	8	8	64	Substantial
	Employment opportunity/generation	Moderate	Moderate	Moderate	8	8	64	Substantial
	Labor Influx	Substantial	Substantial	Moderate	8	7	56	Substantial
	Air Quality	Moderate	Moderate	Low	8	8	64	Substantial
	Noise and Vibration	Moderate	Moderate	Low	10	6	60	Substantial
	Soil Erosion	Moderate	Moderate	Low	10	6	60	Substantial
	Surface and Ground Water Quality	Moderate	Moderate	Moderate	7	7	49	Moderate
	Hazardous and Non-hazardous waste	Moderate	Moderate	Low	8	7	56	Substantial
	Community Health and Safety	Moderate	Moderate	Low	8	8	64	Substantial
	Traffic and Transport	High	Low	Moderate	8	8	64	Substantial
	Terrestrial and Aquatic Ecology	Low	Moderate	Moderate	5	7	35	Moderate
Operational-Phase								
Operation phase: Gas pipeline leakage Valve station and RMS	Occupational Health & Safety	Moderate	Moderate	Moderate	8	5	40	Moderate
	Traffic and Transport	Moderate	Low	Moderate	8	5	40	Moderate
	Noise and vibration	Moderate	Low	Moderate	8	5	40	Moderate
	Community health and safety	Moderate	Low	Moderate	8	5	40	Moderate

Note: Expert judgment served as the basis for the calculation, usually taking into account events with a larger probability than their magnitude.
In this section, impacts are evaluated based on magnitude, immediacy, sustainability and reversibility. A10-point scale is adopted, for example: 1 to 10 for beneficial impacts, 0 for no impact, -1 to -10 for negative impacts.

7.4. POTENTIAL IMPACTS, RISK AND MITIGATION MEASURES DURING PRE-CONSTRUCTION AND CONSTUCTION PHASES

7.4.1. IMPACTS RELATED TO ESS-1: ASSESSMENT & MANAGEMENT OF ENVIRONMENTAL AND SOCIAL RISKS

205. Prior to the construction activities, vegetation clearance will affect the local topography and geology. Necessary protective measures against slope sliding or erosion, especially in the rainy season, should be considered to avoid these anticipated risks. However, the construction activities will bring degradation of the existing land use. Trenching, excavation, and trench filling after digging the gas pipeline will cause erosion of the slope, but the effect will not be significant, if proper mitigations measures are undertaken at the sites. Necessary protective measures against slope sliding or erosion, especially in the rainy season, should be considered to avoid these anticipated risks.

Mitigation Measures:

206. To avoid the anticipated impacts, the following measures should be considered during the pre-construction and construction stages:

- Vegetation clearance should be done appropriately to reduce the effects of the topography or local geology;
- Engineering controls should be implemented properly to protect soil erosion;
- Cutting and filling activities should be done appropriately to reduce the effects of the topographical level or existing land top level;
- Engineering controls should be planned properly to protect soil erosion during construction of gas pipeline trench;
- Supervision consultant will monitor the contractors' activities properly;
- Ditch/Trench excavation shall be accomplished by backhoe, ripper or other Employer approved technique.
- The Ditch shall provide minimum Cover **(1.22 meter)** from the top of the Pipe surface to the original or final ground surface, whichever is lower, and required by the applicable codes;
- Contractor shall provide additional cover to meet special construction requirements contained in right of way and permit conditions;
- Prior to lowering-in, any loose rock, debris, metal of any kind and hard objects shall be removed from the ditch. In areas where the native material, in the opinion of Employer, would damage the pipe coating, clean sand beams shall be set in the ditch bottom every 6 meters or less to support the pipe a minimum of 150 mm above the ditch bottom after allowing for settlement and the full pipe load. Sandbags or polyurethane foam supports may be used as an alternative to the sand berms provided that adequate support and bearing area are provided for the pipe;
- The Contractor must strip topsoil before beginning grading activities on cultivated lands;
- To avoid contamination, all removed topsoil must be kept separate from excavated subsoil;
- The Contractor shall take all reasonable steps to avoid inconvenience and harm to adjacent lands and shall limit cleared and graded work zones to the smallest widths possible;
- All current access, drainage, and irrigation systems on agricultural fields must be maintained and not stopped until the pipe is laid;
- During the clean-up, all terraces, levees, and earthen barriers that have been cut or damaged must be restored to their previous condition;
- The delay between grading and clean-up in agricultural areas must be kept to a minimum.
- Contractor shall apply concrete Set-on-Weight (s) to provide negative buoyancy for pipeline installation in low land areas where periodic flooding may occur;
- In cultivated lands and pastures, topsoil shall be replaced and loosened after any compaction by construction activities. Fences, dikes, drainage systems, irrigation systems, walls, and terraces shall be restored;
- Dikes cut or damaged during construction should be returned to their original condition;
- The Dikes shall be reinstated as soon as possible after backfilling;
- All debris, scrap and other waste material shall be collected and disposed of. Existing facilities which were damaged or altered by Contractor's activities shall be restored to their original condition;
- In cultivated lands and pasture, topsoil shall be replaced and loosened after any compaction by construction activities. Fences, dikes, drainage systems, irrigation systems, walls, and terraces shall be restored;
- All public and private roads used or crossed by Contractor shall be restored to a condition at least as good as the original and shall be maintained until accepted by Employer. All materials required shall be provided by the Contractor;

- Dry riverbanks shall be restored to the original contour and rock rip cap and terracing used on steep banks to prevent erosion and washout;
- Temporary access roads, stockpile sites, and camp locations shall be cleaned up and restored to the as-found condition;
- Borrow material sites shall be graded and cleaned up so as to render them safe to cross- country vehicular traffic;
- Surplus materials shall be collected, hauled, and stored at Employer designated locations.
- Contractor shall not arrange payments to landowners, tenants, or any agency in lieu of performing clean-up at any location;
- The pipeline section traverses across metal and un-metal road, waterlogged area and some minor waterways as per General Specifications of Pipeline construction and attached Design & Drawings;
- Highway/Metal Road crossing using casing by thrust/augur boring method and other crossing conduits, cables, utilities and other facilities as per specifications, drawings & requirements mentioned in Bid document;
- Un-metal Road crossing by open cut method without casing as per specifications, drawings & requirements mentioned in Bid document;
- The Creeks/Canals/Ponds by open cut method complete in all respect as per specifications, drawings & requirements mentioned in Bid document.

7.4.2. IMPACTS RELATED TO ESS-2: LABOR AND WORKING CONDITIONS

207. **Labor influx:** Due to the labor influx will have an impact on the health and safety of the workers, increasing the risk of contracting HIV/AIDS and other transmissible diseases at the labor camps, among other places. Nonetheless, the effects will be temporary, site-specific, and of moderate magnitude. The specifics are provided below:

Mitigation Measures:

- Workers should be provided with on-the-job trainings on OHS issues;
- Ensure appropriate PPE (Hard boots, life vest, safety goggles, hand gloves etc.) should be available at the site and using by workers;
- Sanitary toilets should be made at the sites; separate female toilet is required if female workers involved at the sites;
- Drinking water supply should be accessible by each worker at the site (portable drinking water supply is acceptable);
- Toolbox meeting (TBM) should be carried out on OHS issues before starting to work at the site
- Contractor must follow the Labor Management Plan of BEZA[16] ;
- Ensure Occupational Health and Safety Management as exhibited in **Annex -6, Data book, Vol-2**.;
- Daily recording of Labour Inflow and Out Flow satisfying the provision of Labour Influx Management and submission of Report Quarterly.

208. **Employment opportunity:** Employment opportunities will be ensured by direct employment for unskilled labor, indirect employment to the local community, and employment of women workers. Direct employment such as site clearance, excavation, loading and offloading of materials and deliveries, mason and construction works. Further, the construction labor force will be requiring food and other items, which is expected to be supplied by the local eateries, retail shops and the local community. The local community members can take advantage of these opportunities. Employment generation benefits improve the quality of life of the laborers and enhance their productivity and living standards.

Mitigation Measures:

209. Rate of Wages and Conditions of Labor As per requirements of ESS2 of ESF, the Contractor shall:

- Ensure minimum 30% local labour especially in the non-skilled jobs;
- Provide written agreement of contract to workers and payment slip;
- Ensure discrimination on employment and payment of wages are avoided and local people are given preference over outside labours meeting the job description;
- Pay wages as per current Labor Law and Government regulation;

[16] Labor Management Procedure (LMP), Private Investment and Digital Entrepreneurship (PRIDE) Project, Bangladesh Economic Zones Authority (BEZA), February 2020 .
https://documents1.worldbank.org/curated/en/141611582829764921/pdf/Revised-Labor-Management-Procedures-Bangladesh-Private-Investment-amp-Digital-Entrepreneurship-Project-P170688.pdf

- Keep records of hours worked, remuneration and deductions (including overtime), collective bargaining agreements.
- Record incidents and corresponding Root Cause Analysis (lost time incidents, medical treatment cases), first aid cases, high potential near misses, and remedial and preventive activities required (for example, revised job safety analysis, new or different equipment, skills training, and so forth);
- Ensure safe and healthy work and living conditions including maintaining of COVID-19 protocols, separate toilets for male and female, breast feeding corner for female employees, toilet cleanliness and hygiene maintenance;
- Establish a GRM to raise worker grievances following the GRM-BEZA as exhibited in Annex-16, Data Book, Vol-2;
- Use of Child labor and forced labor is strictly prohibited;

210. **Working Hours:** Contractor to follow the Bangladesh Labor Act 2006 and BEPZA Labor Law adapted by the BEZA 2019 and ILO Rules for maximum working hours in a day which is restricted to 8 (eight) hours. Workers working over 8 (eight) hrs. will be entitled to extra allowance for overtime.

211. Training of Contractor's Personnel and Code of Conduct (CoC): As per ESMP outlined in the ESIA the contractor to arrange training for the workers on the following issues:

- ESMP implementation and capacity building Training for site workers;
- SEA/SH (Sexual Exploitation and Abuse/ Sexual Harassment);
- Health, safety and hygiene;
- Awareness training about the communicable diseases like STDs, HIV/AIDS etc.;
- Training on resource efficiency;
- Waste management;
- Community health and safety Training;
- Occupational Health and Safety (OHS) Training including GRM, GBV, SEA;
- Community health and safety Training;
- Standard operating procedures (SOP) for construction works;
- COVID-19/Pandemic/Endemic Protocol;
- Contractor will also indicate the duration, frequency and timing of these training;

212. **Labor Camp**: Labor camp will be established at the project site however the anticipated risks caused by establishment of labor camp can be minimized by applying the following mitigation measures.

Mitigation Measures:

- Build labor camp within close proximity of the site. Keep it clean and hygienic with proper ventilation, sanitation, sleeping arrangement in raised bed, dining facilities, electrification and lighting;
- No electrical wire should be left on the floor of camp or site. Proper system should be developed and entry to the site of electricity meter should be restricted and should be allowed for authorized personnel only;
- The construction camps should be at least 500 m distance from habitations from the nearest settlements to avoid conflicts and stress over the infrastructure facilities with the local community;
- Location for stockyards for construction materials will be identified at least 1 km from water sources;
- Store house for hazardous material like diesel should be at distance from construction labor camps;
- Construction camps shall be provided with sanitary latrines (1 per 25 pax), bathing facility and urinals. Provide separate toilets and washing facilities for men and women. Keep those facilities in a clean, accessible and hygienic condition;
- Supply safe drinking water to the site. The camp should be cleaned daily;
- Provide sufficient number of waste bins to store different categories of wastes. Provide a designated waste collection area for dumping wastes before disposal;
- Ensure adequate drainage arrangement inside the camp. All sites used for camps will be adequately drained. They will not be subject to periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water unless such water surface can be subjected to mosquito control measures;
- The camps will be located such that the drainage from and through the camps will not endanger any domestic or public water supply. All sites will be graded, ditched and rendered free from depressions such that water may get stagnant and become a nuisance;
- Sanitary latrines shall be under cover and so partitioned off as to secure privacy and shall have a proper door and fastenings;
- Adequate and suitable facilities for washing clothes and utensils shall be provided and maintained for the use of contract labor employed therein;
- Sewerage drains will be provided for the flow of used water outside the camp;

- Drains and ditches will be treated with bleaching powder on a regular basis;
- The sewage system for the camp will be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place;
- Crèche facility should be provided for children if female workers are employed;
- The living accommodation and ancillary facilities for labor shall be erected and maintained to standards and scales approved by the resident engineer;
- Providing and maintaining Construction Camp with necessary furniture, sanitary & electrical/ power facilities, water supply, firefighting, water supply with hand washing soap, septic Tanks/Soak Pits, proper sewerage network system, safe drinking water supply, cooking arrangement, setting of waste bins and sufficient ventilation arrangement all complete including removal of structures and restoration of the site on completion of the work;
- The contractor shall submit the detailed plan and drawing of the construction camp for approval of the engineer;
- The construction camp should be provided with sufficient natural light, heat-protecting ceiling, dam proofing etc. as per the direction of E-I-C;
- Ensure implementation of the LMP of the BEZA prepared under the PRIDE project;
- All materials, equipment and plant, furniture, fittings recovered from dismantling the camps and removing access road will be the property of the contractor upon completion of the work;
- The contractor will be responsible for maintaining the facilities of the camps in good condition throughout the contract period and payment of this item shall be made only with the final bill. Area of Construction Camp: 139.35 sqm;
- Contractor shall prepare Waste Management Plan and Drainage Management Plan **f**ollowing **Annex 7, Data Book, Vol.2** and implement accordingly.

213. **Occupational Health and Safety**: During the pre-construction stage, clearing the site, selection of RoW (right of Way) of pipeline route and working area, base camp, and movement of heavy equipment will be at risk for project's contractor and project personnel, but the impact is low considering the nature of works. However, during the construction period, trenching, excavation, materials transportation and lifting of equipment and pipes, g Grading, Stringing, wielding of pipes, coatings and wrapping, potential health hazards are anticipated if proper safety preventive measures are not undertaken properly. Due to wielding, electrical shock may cause serious injuries to health and eyes. Coating and wrapping works, health risks are skin irritation and discomfort for respiratory system will occur. To reduce these anticipated impacts, the suggested mitigation measures should be employed regularly.

Mitigation Measures:

- The Contractor shall submit to the Engineer for Review a health and safety manual which has been specifically prepared for the Works, the Site and other places (if any) where the Contractor intends to execute the Works. The health and safety manual shall set out following health and safety requirements;
- General OHS Requirements of the Contractor: The Contractor shall follow-
- Shall observe and maintain standards of Health and Safety towards all of his employees not less than those laid down by the national standards or statutory regulations;
- Where appropriate, to prevent workers falling from heights, the Contractor shall make sure that every temporary floor openings shall either have railing of at least 900 mm height or shall be constantly attended; every floor hole shall be guarded by either a railing or a hinged cover, or constantly attended; every stairway floor opening shall be guarded by railing at least 900 mm high on the exposed sides; every ladder way floor opening or platform shall be guarded by a guard railing; every open sided floor or platform 1.2 m or more above adjacent ground level shall be guarded by a railing on all open sides;
- Shall provide all appropriate Personal Protective Equipment (PPE) such as hand gloves, eye shield and mask for welding activities, safety shoes, protective clothing (vest) and equipment for the work to be done and ensure its proper use. Where required, safety nets, belts, harnesses and lines shall be provided by the contractor. In addition, life jacket during working on the waterbodies;
- Provide the "safety directives for working with heavy equipment such as excavators, dump tracks, bulldozer, vibrator, crane, etc. " and also ensure use of appropriate safety protective gears such as hearing protection, hard hets/ helmet, foot and leg protection, and disseminate the probable risk and hazards to the workers;
- Shall provide and maintain in prominent and well-marked positions all necessary first-aid equipment, medical supplies and other related facilities. A sufficient number of trained personnel will be required to be available at all times to render first aid;
- Must provide or ensure that appropriate safety and/or health signs are in place at their work sites where hazards cannot be avoided or reduced;
- To arrange adequate fire prevention and fire-fighting provisions to deal with any fire hazard.

- Shall report to the Engineer promptly and in writing particulars of any accident or unusual or unforeseen occurrences on the site, whether these are likely to affect progress of the work or not;
- Ensure the Permit to work (PTW) before starting the any heavy equipment handling related activities;
- Ensure Occupational Health and Safety Management as exhibited in **Annex -6, Data book, Vol-2;**
- Ensure the Permit to work (PTW) before starting the any heavy equipment handling related activities;
- Ensure implementation of the LMP of the BEZA prepared under the PRIDE project;
- Ensure application of Emergency Response and Disaster Management Plan **Annex-10, Data Book, Vol-2.**

214. Pipeline & DRS Construction:

Mitigation Measures:

- Logbook shall be maintained for recording the accidents at site/mortality of the any aquatic mammal should be maintained. Analysis shall be carried out to assess the reason for the accident/mortality and measures should be taken to prevent repetition of the event ;
- Contractors having experience of oil and gas well-trained staff should only be allowed to carry out works. This will help in prevention of spillage of construction material or any accidents during the construction and installation of the DRS;
- Construction plan shall be prepared by contractor and submitted to BEZA for approval prior to carrying out construction works;
- Contractors shall submit method statement & risk assessment plan prior to carrying out any construction work. Worker should follow the defined safety procedures to avoid accidents and spills, and Contractor should ensure that other equipment users are provided with adequate information and instruction to avoid conflict;
- Adoption of safety measures for prevention of any accidents during construction and installation of the DRS. Safety measures include floats, air jackets, emergency light, extra boats, fire-lighting system etc. IFC EHS guidelines for environmental, Health, and Safety Guidelines for Onshore Oil and Gas should be followed for preparation of site-specific emergency management plan, etc.

215. Managing Physical Hazards on Construction Sites: The Hierarchy of Control Methods:

- Elimination/ Substitution: Not practiced during construction unless applied in design phase;
- Engineering controls: Second most effective means of protecting employees from hazards however, limited due to costs, resources and time constraints;
- Administrative and work practice controls: Most effective include most of the control measures;
- PPE: last resort; it is least effective.

216. **Heavy Equipment**: (Heavy Equipment includes but is not limited to: Backhoes, Bulldozers, Road Graders, Excavators, Scrapers Loaders, Dump Trucks, Earth Movers, Trucks 2 Tons GVW or Greater.)

- Operators should have: license, training, qualifications, certifications and medical fitness;
- Safeguard and Control Measures;
- Heavy Equipment should be equipped with back-up alarm, horn and seat belt;
- All Motorized Heavy Equipment should require Rollover Protective Structures (ROPS) with seat restraints.
- Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;
- Inspections Before use;
- Traffic Management Plan (TMP): TMP should be developed for project/ site to ensure safe interactions between work activities, equipment, people and environment.

217. **Material Handling:** Safeguard and Control Measures for Loading and Unloading Hazards.

- Use of mechanical lifting equipment e.g., Cranes, Forklifts and etc.
- Safe Work zone during loading/ unloading, inspection.

218. Fall from height: Measure will be taken as

- Choose the right access equipment for work at height (e.g., using mobile elevated work platform instead of a ladder);
- Provide edge protection such as using guard-rails and toe boards at open sides;
- Install safety canopy or safety nets strong enough to retain individuals;
- Provided workers personal fall arrest systems such as a harness with a short work restraint lanyard properly secured to a suitable anchorage point may be used.

219. **Slips and trips**: Measures will be taken as-

- Ensure that all operatives are provided with obstruction-free access and egress to their working areas;
- Keep work and storage areas tidy and designate specific areas for waste collection;
- Clean up all slippages immediately;
- Signpost all slippery areas and providing sufficient illumination at the workplace;
- Provide employees training, instruction and supervision for relevant work activities;
- Use PPEs such as lifting straps, shoulder harness, and slip resistant footwear to prevent sips, falls.

220. **Hot Work** – Welding, Brazing and Cutting: Safeguard and Control Measures include but not limited to:

- Fire prevention: Remove all combustible materials from the area;
- Appropriate precautions must be taken when using hot work in the vicinity of flammable materials;
- Fire protection: Establish fire watch and install Fire extinguisher;
- Use PPEs such as lifting straps, shoulder harness, and slip resistant footwear to prevent sips, falls. **Annex-10, Data Book, Vol-2.**

  i. Skin protection: fire resistant apron/ jacket and gloves, leather safety boots; welding helmet
  ii. Eye protection: Welding helmet with UV protected shades and face shields for grinding
  iii. Respiratory protection: Use filter respirators in ventilated areas and supplied air respirators (SARs) in confined spaces

221. **Electrical Safety:** Safeguard and Control Measures include but not limited to:

- Insulation - insulate electrical conductors with glass, rubber or plastic;
- Electrical protective devices - interrupts current flow when it exceeds conductor capacity likes fuses, circuit breakers & ground fault circuit interrupters (GFCI's);
- Only competent persons who are trained and qualified to work on electrical equipment;
- PPE for electrical work includes: Hard hat, Safety glasses, Long sleeve cotton shirt and long non-melting pants;
- Regularly check electrical equipment;
- Give instruction to workers to report any electrical faults immediately and stop using the tool or cable as soon as any damage is seen;
- Where possible, eliminate risks by using battery powered or cordless tools or tools which operate from a 110V supply system;
- Ensure Emergency Response and Disaster Management Plan as **Annex -10, Data Book, and Vol.**

222. Combating Pandemic and endemic diseases: Measure will be taken as

- Contractor will comply with the Government Instruction regarding COVID-19 and other pandemic and endemic diseases to ensure safe working environment and labour conditions.

223. **Protection of Environme**nt: Measures include but not limited to-

- For protection of environment, the contractor would take appropriate mitigation measures to control air, water, noise, soil/sediment pollution as per the national Acts/Rules/Standards. In case of non-availability of such standards, the GIIP is to be followed;
- The values for emissions, surface discharges, effluent and any other pollutants from the Contractor's activities that shall not be exceeded 20% of the GHG emission, especially Carbon Di-Oxide.

224. **Security of the Site**: Measures include but not limited to-

- The requirements for the security arrangements (ESS4 of the ESF states the principles of, GIIP as per ILO standard and as per applicable national law should be applicable). The contractor will ensure life and livelihood to the adjacent area of the proposed land filling. The contractor shall ensure that the surrounding land or crops are not damaged during earth filling, especially by ensuring that saline water does not enter.

225. **Drinking Water Facilities**: Measures include but not limited to-

- Providing continuous adequate drinking water supply at construction camps, worksite and site office as well by installing necessary tube-well/s where applicable or any other means depending on local situation;
- Providing essential arrangement for storing drinking water by supplying portable best quality water tank equivalent to Gazi/Padma of adequate capacity depending on the number of users, including supplying 1 (one) no. best quality water filter of minimum capacity 30 litters with necessary kits, etc.;

- As per satisfaction and direction of the Engineer-in-charge, all relevant goods and equipment under this item shall be property of the contractor and payment will be made after 100% completion of the contract successfully.

226. Temporary Sanitary Toilet Facilities: Measures will be taken as-

- Providing at least two nos. portable toilets or constructing temporary semi pucca toilets with two pit/soak-well latrine one for female worker and another for male worker at worksite (2 nos. in every construction camp, work sites) and workers accommodation site in a safe location, so that no adverse impact will generate on the surrounding environment, including providing requisite arrangement for water supplying etc.;
- All complete as per drawing, specification, direction and satisfaction of the Engineer-in-charge. All relevant accessories and arrangements under this item shall be property of the contractor and payment will be made after 100% completion of the contract successfully.

227. **First Aid** : Contractor shall ensure emergency requirements of first aid as below:

- First aid facilities should be made available at construction camp. First aid box should contain small, medium and large sized sterilized dressings, sterilized burns dressings, 2 % alcoholic solution of iodine, bottle containing salvolatile, snakebite lancet, bottle of potassium permanganate crystals, scissors, Ointment for burns & surgical antiseptic solution;
- First aid box should be available per 50 labours;
- A person trained in first-aid treatment shall be made in charge who shall always be readily available during the working hours at the work place;
- A suitable motor four-wheeler transport shall be kept readily available to carry injured or ill person to the nearest hospital.

228. **Personal Protection Equipment for Workers**: Providing and maintaining appropriate (safe design, fit and comfort) personal protection equipment (PPE) to ensure the highest possible protection for employees in establishing and maintaining a safe and healthful working environment at workplace, including demonstrating, providing training on proper understanding and development of skill in the use of PPE, including supplying

- Best quality safety jacket for construction workers made of 100% polyester waterproof fabric, fluorescent yellow/orange/green/red/blue or pantone colour;
- Suitable hand protection gloves for construction work of Flexible/ durable/ excellent puncture resistance working gloves with PVC palm and T/C drill back, pasted cuff, palm liner and fit properly and be reasonably comfortable to wear;
- Appropriate foot protection shoes having impact-resistant toes and heat-resistant soles that will protect the feet against hot working surfaces;
- Best quality safety helmets of ABS shell, tough, lightweight, durable which will be able to resist penetration by objects, absorb the shock of a blow and water-resistant and slow burning with available four-six-point adjustable suspension for shock- absorbing, slotted sides to accommodate accessories, such as face shields, earmuffs;
- Suitable eye protection goggles to protect against specific workplace hazards, fit properly and be reasonably comfortable to wear, provide unrestricted vision and movement, including instructing workers to wear strictly during working time and reviewing periodically, updating, evaluating the effectiveness of PPE and maintaining, replacing worn or damaged PPE etc. all complete as per requirement and full satisfaction of Engineer-in-charge. Payment will be made after 100% completion of the contract successfully.

229. **Utility Shifting:** During the pre-construction period, utility shifting can enhance the social conflict if proper consultation is not held with the local community.

Mitigation Measures:

- Stakeholder consultations are important for the local community such as focus group discussions (FGD), interviews, meetings etc., before and during utilities shifting;
- After construction, utilities should be installed appropriately at the disrupted sites by project cost;
- To reduce this impact, necessary information should be given to the surrounding neighbours, information should include (construction time, and construction natures etc.);
- To carry out regular stakeholder consultation with the local community;
- To make strong correlations with local people's representatives, religious leaders, social leaders, and others to avoid any kind of social conflict in the project areas;
- Any other necessary steps should be taken based on situations like meetings, workshops etc.

230. **Gender Based Violence (GBV)**: The gender-based violence (GBV) and sexual exploitation and abuse/Sexual Harassment (SH) risks may increase to some extent within local communities when there are large influxes of male workers from outside the area. Generally, the female employment tends to be more concentrated in low-paid and low-productivity occupations. Increasing women's labor force participation and improving the quality of female employment will require more significant support for women's access to employment opportunities and high-quality skills development programs.

231. Gender-based violence (GBV) may occur as a result of recruiting female workers on the job sites and giving poor wages to female and child workers. Physical and sexual harassment will be extremely common in GBV instances. However, this influence is temporary, project-specific, and will have limited impact.

232. However, the probable impact is expected at site if proper human resource management are not taken in project site such as wage discrimination between men and female, eve teasing and sexual abuse, discouraged to speak and demand equitable benefits in the name of purdah/ dignity of women, etc. Contractors must address the risk of gender-based violence, through-

Mitigation Measures:

- Mandatory and repeated training and awareness raising for the workforce about refraining from unacceptable conduct toward local community members, specifically women;
- Informing workers about national laws that make sexual harassment and gender- based violence a punishable offence which is prosecuted;
- Introducing and signing of a Worker Code of Conduct by all workers as part of the employment contract, and including sanctions for non-compliance (e.g., termination);
- Adopting a policy to cooperate with law enforcement agencies in investigating complaints about gender-based violence. In this regard, the contractor shall strictly adhere to the provisions of the project's GBV/SEA/SH Action Plan and GRM **Annex-14, Data Book, Vol-2.;**
- The contractor also shall manage a grievance mechanism on potential GBV/SEA/SH cases under the guidance of the Project PIU and shall take into account in submitting bid the provisions for service providers in case of potential GBV victims/cases;
- Design of Grievance Complain Box, obtaining approval of Engineer, Manufacture, Supply, Erection at Pre-approved location of the Site and Maintenance during the entire period of Construction to the satisfaction of the Engineer;
- Design of billboards for posting of GRM related information, Obtaining approval of Engineer, Manufacture, Supply, Erection at Preapproved public places, and Maintenance during the entire period of Land development to the satisfaction of the Engineer;
- Provision for receiving Daily grievance, Proper registration of complain and management, resolution of such grievances, selection, engagement and monitoring of the referral service providers (GO, NGO, Private) satisfying the provision of GBV/SEA/SH risk mitigation guidelines during the period of construction and submission of Report Quarterly satisfying the provision of Particular Condition Part D and obtaining approval from the Engineer;
- Preparation of information brochures related to GBV/SEA/SH risk, mitigation measures, Design, Obtaining approval of Engineer, Manufacture, Supply Erection and Maintenance of billboards, dissemination of information to adjacent community through brochures/leaflets and community consultation during the period of construction satisfying the provision of Communication guidelines and submission of Report Quarterly satisfying the provision of Particular Condition Part D and obtaining approval from the Engineer.

233. **Child Labor**: The contractor sometimes hires or recruits the child labor workforce into the project. In keeping with internationally recognized standards, the project will make a distinction between child labor and young workers. The project will not tolerate child labor under any circumstances.

Mitigation Measures

- The Contractor, including its Subcontractors, shall not employ or engage a child under the age of 14 unless the national law specifies a higher age (the minimum age);
- The Contractor, including its Subcontractors, shall not employ or engage a child between the minimum age and the age of 18 in a manner that is likely to be hazardous, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development;
- The Contractor including its Subcontractors, shall only employ or engage children between the minimum age and the age of 18 after an appropriate risk assessment has been conducted by the Contractor with the Engineer's consent. The Contractor shall be subject to regular monitoring by the Project Manager that includes monitoring of health, working conditions and hours of work;

- Work considered hazardous for children is work that, by its nature or the circumstances in which it is carried out, is likely to jeopardize the health, safety, or morals of children. Such work activities prohibited for children include work;
- Control exposure to physical, psychological or sexual abuse;
- Precautionary measures in underground, underwater, working at heights or in confined spaces.
- Precautionary measures should be use of dangerous machinery, equipment or tools, or involving handling or transport of heavy loads;
- Prohibit in unhealthy environments exposing children to hazardous substances, agents, or processes, or to temperatures, noise or vibration damaging to health; or
- Work under difficult conditions such as work for long hours, during the night or in confinement on the premises of the employer.

234. The Contractor shall also take measures to require its suppliers (other than Subcontractors) not to employ or engage child labor. If child labor cases are identified, the Contractor shall take measures to require the suppliers to take appropriate steps to remedy them. Where the supplier does not remedy the situation, the Contractor shall within a reasonable period substitute the supplier with a supplier that is able to manage such risks.

235. **Force Labor**: It will occur during the construction period e.g., excavation, trenching, transporting materials, and others, however, force is not allowed at the construction sites. The following mitigation measures shall be implied to reduce this anticipated risk.

Mitigation Measures:

- The Contractor, including its Subcontractors, shall not employ or engage forced labour;
- Forced labour consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements;
- No persons shall be employed or engaged who have been subject to trafficking;
- Trafficking in persons is defined as the recruitment, transportation, transfer, harbouring or receipt of persons by means of the threat or use of force or other forms of coercion, abduction, fraud, deception, abuse of power, or of a position of vulnerability, or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person for the purposes of exploitation;
- The Contractor shall also take measures to require its suppliers (other than Subcontractors) not to employ or engage forced labour including trafficked persons;
- If forced labour/trafficking cases are identified, the Contractor shall take measures to require the suppliers to take appropriate steps to remedy them. Where the supplier does not remedy the situation, the Contractor shall within a reasonable period substitute the supplier with a supplier that is able to manage such risks.

7.4.3. IMPACTS RELATED TO ESS-3:RESOURCE EFFICIENCY AND POLLUTION PREVENTION AND MANAGEMENT

236. **Air Pollution**: Air pollution will occur due to site preparation, construction works, earth filling, stack yards and labour shed construction, grading and movement of vehicles etc.

Mitigation Measures:

- Ensure that all vehicles and machines comply with technical and environmental safety regulations;
- Schedule the operation times for vehicles, machines working in the construction area to reduce air emissions;
- The contractor shall maintain an inventory of the number, type and location of all stationary emission sources within the boundary of the construction site during the period of construction;
- The Contractor shall undertake at all times to prevent dust nuisance and excessive exhaust emissions as a result of his activities;
- Before the commencement of any work, the Engineer may require the methods of working and equipment intended to be used on the site to be made available for inspection and approval to ensure that they are suitable for the project;
- The Contractor shall ensure that all Plant and Equipment to be used on site are properly maintained in good operating condition and that the Plant and Equipment does not give rise to excessive exhaust smoke emissions;
- In the process of material handling, any material which has the potential to create dust shall be treated with water or wetting agent sprays, especially when dusty materials are being loaded or unloaded;
- Any vehicle with an open load-carrying area used for moving materials, and having the potential to create dust, shall have properly fitting side and tail boards. Materials having the potential to create dust shall not be

loaded to a level higher than the side and tail boards and shall be covered by a clean tarpaulin. The tarpaulin shall be properly secured and shall extend at least 300 mm over the edges of the side and tail boards.

- Stockpiles of dusty materials will be covered by polythene or tarpaulin;
- The Contractor shall frequently clean and water the any public road used by vehicles accessing the site to minimize the fugitive dust emissions;
- Regular watering and sprinkling for dust suppression are to be done properly;
- Compaction of prepared site to re-strain the fugitive emissions;
- The Contractor shall restrict all vehicles on the Site to a maximum speed of 15-20 km/hr km per hour and confine haulage and delivery vehicles to designated roadways inside the site.
- Where inspection of the site by the Engineer or the monitoring indicates significant increase in dust level the contractor shall review the mitigation measures that will include but not limited to the following-
  - Checking of water spraying/dust suppression equipment;
  - Maintenance or replacement of any plant or equipment contributing to the impact;
  - Checking and maintenance of tarpaulin or enclosures used; to cover the aggregates generating dust;
- The contractor shall, as a result of the review, implement any further mitigation measures that may be required such that the dust levels are reduced;
- In the case that the contractor fails to implement the necessary mitigation measures, or the increased dust level persists despite the mitigation measures then the Engineer can instruct the Contractor to temporarily suspend the causative works until the Engineer is assured that proper mitigation measures have been implemented;
- Air quality monitoring to be carried out during construction phase to check the pollutants level in the air.

237. **Noise Pollution**: Noise pollution may occur because of: Operation of vehicles and equipment during the site preparation, earth work, stack yards and labour shed construction, transportation of construction materials etc.

Mitigation Measures:

- Construction activities in day time and minimize night time working;
- Regulate the speed for traffic in and around the project areas;
- Regularly carry out maintenance and routine inspections on vehicles and construction machineries to ensure the technical standards;
- Ensure the construction equipment are with proper silencer and muffler, padding/noise isolator and select the least noisy machine;
- The personnel involved in high noise generating activities shall be provided with personal protective devices like ear plug, earmuffs etc.

238. **Water Pollution**: Surface and groundwater can be contaminated by sewage & wastewater from labour camp, dumping of moist soil for prolong period and effluent disposal etc.

Mitigation Measures:

- The contractor shall design methods of working to minimize water pollution and to meet the appropriate environmental standards and shall provide experienced personnel with suitable training to ensure that these methods are implemented;
- The contractor shall provide toilets with septic tanks system or sanitary pits of sufficient capacity for the number of workers on the site. No overflows from the storage tanks to the surface water drains will be permitted;
- Water pollution may occur due to: diesel and oil, cement, glues. Paint, other toxic chemicals etc. All of these contaminants have the potential to end up in water bodies as a result of runoff from construction site in a number of ways, such as through drains, seeping into soil, or runoff directly into nearby water bodies;
- Remedial measures may include:-
- Keep materials such as sand or cement secure: Materials must be located where there isn't a risk of them being washed into waterways or drains;
- Monitor and improve management and disposal of site waste: Contractor to ensure all waste is correctly dealt with to stop it from spreading;
- Cover up all drains to prevent waste from ending up in the water. Side drain and cross drains should be consideres as site specific;
- Minimize land disturbance and leave maximum vegetation cover;
- Properly collect and treat any wastewater;
- Regular monitoring of the water quality during the construction and installation of the DRS. If monitoring of the water quality of the Ichakhali canal and adjacent water bodies indicates any adverse impact on the surface

water the contractor shall check whether this impact is due to any project activities and take appropriate mitigation measures to prevent such adverse impact from project activities;

- Ichhakhali canal at site has been retained and no waste is disposed off in the canal;
- Temporary storm water drains have been provided for whole site. These drains are connected to Ichakhali canal. These drains have been provided with stilt trap so as to arrest sediments from run-off before discharging into canal;
- Silts are removed periodically from these stilt traps to avoid choking and overflow;
- To provide sufficient silt removal during the excavation or digging phase, temporary settling ponds could be required to reduce the amount of contaminated water left over during landfilling. It must be considered for spoil outflow from both permanent and transient spoil deposits. Cover may be taken into consideration to stop fine particles from washing off. Preventing the placement of either temporary or permanent spoil stacks near drains or watercourses is imperative. Before beginning the excavation activities, a temporary drainage system should be ensured. A Waste Management Plan is required, like **Annex-8, Data Book, Vol-2,** to be implemented during construction works.

239. **Soil Pollution**: Project site soil and sediment can be polluted due to disposal of solid and liquid waste of diversified construction works, operation of heavy equipment, oil spillage of construction vehicles etc.

Mitigation Measures:

- Excess dredged material should not be disposed at any location other than the project location;
- Construction vehicles will remain on compacted roads;
- Fuel, lubricating oil, and used oil storage areas will be in the designated area;
- Contractor shall ensure daily collection and disposal of construction waste, debris, oil, fuel spillage, used oil etc;
- To avoid soil compaction along the transportation routes, only identified haul roads would be used for transportation;
- Sedimentation tanks should be provided in line with storm water drains to trap the sediments from run-off. Sand bags can be used to trap sediments more effectively;
- The Spill Management Plan shall be implemented to comply ESS-3. Mechanical Recovery will include Skimmers for recovery of oil/chemicals, Oil/water/chemical separators, and storage etc. following the **Annex-9: Spill Management Plan, Data Book, Vol-2;**
- Bioremediation will be considered as the final treatment step after completing conventional treatment or in areas where other methods are not possible to use or recommended for use.

7.4.4. IMPACTS RELATED TO ESS-4: COMMUNITY HEALTH AND SAFETY

240. The common anticipated impacts related to ESS-4 is mainly community health and safety, traffic and transport, and hazardous and non-hazardous wastes etc. The details are given below-

241. **Community health and safety**: The local community near the project area will not to be impacted by the proposed onsite construction activities since there is no residence adjacent to the project site. However, offsite infrastructure such as accesses road is permitting movement of construction vehicles for the transportation of construction materials at the project site. The number of vehicles will increase. This increasing number of traffic will occur traffic congestion with the time. In addition, road accidents may occur due to the movement of vehicles with construction materials and equipment and operation of machineries and equipment. Specially the school going children are the major victim of accidents in the approach road. Communicable diseases can spread among the local community from the influx of construction workers due to improper management of construction camp.

242. The community health and safety will be at risk due to the trenching, excavating, backfilling, pipe installation, wielding, vehicle movement and other types of construction works. To reduce this anticipated risk, the following mitigation measures are suggested to apply during construction period.

Mitigation Measures:

243. Security of the Site

- The contractor shall provide necessary security arrangements as per requirements of ESS4 of the ESF (the principles of proportionality), BEZA building construction rules, BNBC 2020, and GIIP as per ILO standard and as per applicable national law;
- Ensure Emergency Response and Disaster Management Plan as in **Annex -10, Data book, Vol-2.**

244. Dissemination of Information regarding Construction Work

- The contractor shall disseminate following information of the project through installation of signboards informing the local residents who live nearby the proposed project area;
- Location of construction work;
- Notices of the construction work etc.

245. Installation of boundary fence

- For the smooth and safety operation of traffics, the contractor shall install boundary fence (at least 2 m height) around the working area. Contractor shall be responsible for arranging of the barricades or fence and type of materials. The contractor will deploy security personnel to prevent unauthorized entry to the site. The contractor shall undertake at all times to maintain safety operation of traffics during construction works.

246. Safety Signs/ Markings

- The contractor will provide safety signs/ markings around the site. Size and locations of signs will be as per the instruction of the engineer.

247. Reporting Requirement

- If there is any public complaint reported, immediate action should be taken informing the engineer including the written report stating the details. The Contractor shall also report such incidences in the monthly and quarterly report, as set out in the ES monitoring plan;

248. Management and Safety of Hazardous Materials

- Contractor will avoid or minimize community exposure to hazardous materials and substances that may be released by the project activities, project-related traffic and road safety risks, diseases and hazard due to use of vibratory equipment, construction debris handling and disposal etc. Contractor will ensure effective measures in place to address emergency events. Ensure that safeguarding of personnel and property is carried out in a manner that avoids or minimizes risks to the project affected communities.

249. **Emergency Contact:** To handle any emergency situation during construction following minimum information should be available at site:

- Name & Address of Contractor
- Project Location
- Name, Designation & Contact Numbers of the organization, nearby hospitals, fire agencies, police offices etc. and key personnel including their assigned responsibilities in case of an emergency to be specified.
- Site Layout Diagram showing location of fire extinguishers, emergency collection area and fire alarm.
- Measure for combating Pandemic and endemic diseases**:** Contractor will comply with the Government Instruction regarding COVID-19[17] and other pandemic and endemic diseases for any kind of engagement at the community level.
- Prepare Emergency Response and Disaster Management Plan **Annex-10, Data Book, Vol-2**

250. **Traffic and transport**: During the pre-construction period, it is estimated that around 509 electric poles, 74 light posts and water pipeline are located alongside the edge of the existing road networks within the Zone 2A and zone 2B at different distances presented in Annexure- 2. A few of them may be shifted due to construction of gas pipelines, and shifting of utilities like electric poles may require temporary power cut which may disturb the life of common local people. But the impact will be of short term. Sometime during shifting underground cable fault may be anticipated which will cause the dangerous situation of the locality. Generally, erection of electric poles may cause inconvenience, block the access to the local residents, shopkeepers, students and children. Occupational and public safety issues of the workers, technicians and residents are a serious concern during shifting of the utilities.

251. Materials carrying vehicles and construction vehicles (Excavator, pay loader, grader, dump-truck etc.) may damage environment in the construction area and may be a disturbance to nearby population. Without proper traffic management accidents may also occur.

Mitigation Measures

- Defensive driving training of drivers and proper maintenance of vehicles;
- Establishing diversion roads during the construction;

[17] Local Government COVID-19 Response and Recovery Project (LGCRRP) Labor Management Procedure (LMP) March 2021 https://lgd.portal.gov.bd/sites/default/files/files/lgd.portal.gov.bd/divisional_noc/f383263a_94af_4b8e_9975_f0b577421a4d/2021-04-08-11-29-b0b17d7c64e475147d4259658edb5e0e.pdf

- Place traffic sign/cautionary sign to avoid undue traffic congestion;
- At night, the passage shall be delineated with lanterns/ suitable light source. As night traffic is significant in the adjacent areas, movement of construction vehicles to be planned during off-peak period.
- For regulation of traffic, the flagmen shall be equipped with red and green flags and illuminating vest at night especially near at intersection;
- Maintaining traffic management at worksite from time of commencement of contractor's activities to time of completion activities, including ensuring that the road is safe for users, providing a safe working area for those involved in work on trafficked network and minimizing any disruption to smooth flow of traffic (this includes providing necessary barricades, warning signs/lights, guide signs, flagmen, maintaining diversion roads by cutting, filling, constructing, etc. or by any other means) in accordance with the full satisfaction of the Engineering-in-charge, unless specified otherwise, including keeping provision for existing traffic and pedestrian movements in such a way as to assure that a single lane at least 3.0m wide is available for public traffic at all times (including access to properties and local roads) affected by the contractor's activities shall be maintained at all times (day & night), including removal of all temporary constructions on completion of the activities, etc. all complete as per requirement and instruction of Engineer-in-charge. All relevant accessories and arrangements under this item shall be the property of the contractor and payment will be made after 100% completion of the contract successfully;
- Development and implementation of Traffic Management Plan (**Annex-11, Data Book, Vol-2)** and implement.

252. **Hazardous and Non-hazardous Waste**: The Project will generate both solid non-hazardous and hazardous wastes throughout the construction phase. The anticipated non-hazardous waste types include excavated material, broken aggregates, solid waste, filling materials, wastewater etc. While hazardous waste may include used oil, empty drums or replaced parts of the construction machinery, used battery etc.

Mitigation Measures:

- The Contractor shall provide sufficient containers on the site for the temporary storage of solid waste generated from project activities;
- Separate containers shall be provided for hazardous and non-hazardous wastes, which will be clearly labelled;
- The hazardous waste/e-waste to be collected in steel drums and stored in a segregated roofed area and periodically disposed at approved waste disposal facilitates;
- The camp site shall have separate bins for collecting the organic and inorganic waste;
- The contractor shall provide appropriate facilities for temporary dumping of all types of wastes before their proper disposal;
- The contractor shall not dispose any waste, rubbish or offensive matter in any place not approved by the Engineer or Statutory Authority having jurisdiction;
- The contractor shall construct sanitary latrine or septic tank system or install portable cabin toilet for workers/ employees;
- In case the contractor fails to implement waste management measures then the Engineer can instruct the contractor to temporarily suspend the causative works until the Engineer is assured that proper mitigation measures have been implemented.

253. Waste Disposal Facilities at Construction office, site and camps: The Contractor shall follow the mitigation measures.

Mitigation Measures:

- Providing, installing and maintaining at least 03 (three) nos. waste collection bins one for organic waste, construction and other for hazardous waste of minimum capacity of 30liters with hinge supported 450mm dia cover plate for opening, made of durable plastic material at worksite;
- Waste management plan should be followed by contractor **Annex-7, Data Book, Vol-2**
- Bins will be kept in a safe and easily accessible place, so that will easy to use and no adverse impact will generate on the surrounding environment, including continuing the full functioning of waste disposal (buried/incineration) in accordance with the full satisfaction of the project manager throughout the contract period, all complete as per drawing, specification and direction of the Engineer-in-charge;
- Entire relevant accessories and arrangements under this item shall be property of the contractor and payment will be made after 100% completion of the contract successfully;
- If there is any spillage of hazardous waste, the contractor will remove it immediately following Spill Management Plan as included in **Annex-9, Data Book, Vol-2.**

7.4.5. IMPACTS RELATED TO ESS-6: BIODIVERSITY CONSERVATION AND SUSTAINABLE MANAGEMENT OF LIVING NATURAL RESOURCES

254. Terrestrial and Aquatic ecology: The proposed project sites don't cover any protected areas, and ecologically sensitive areas. No trees are observed at the roadside would be affected by construction of gas pipelines. Some bushes type vegetation may be affected. The project has some extent influence on aquatic biodiversity when pipeline will cross the canal and ditches and low-lying areas. The existing aquatic biodiversity's will be affected if the surrounding environment is heavily polluted (soil, water, etc.) by the construction activities such as discharge of liquid and solid waste from workers camps and construction yard. To lessen the effects on biodiversity, the following steps should be considered throughout construction and operation. The contractor shall follow the mitigation measures as suggested below:

Mitigation Measures

- construction and installation of DRS should not be carried out during breeding & spawning season of fishes (September to October);
- Measures like provision of bubble curtains or creation of agitation in water should be carried out prior carrying out the construction so as to provide avoidance time and let the species move away from drudging point and to prevent any injury/mortality. Construction/installation should be halted in case of sighting of Rare Endangered Threatened (RET) species, if any;
- Contractors should submit SOPs and action time chart with risk management plan prior to any construction work;
- Construction sub-contractor should follow the defined safety procedures to avoid accidents and spills etc.
- To compensate for the removal of affected vegetation and trees a tree plantation plan should be considered the BEZA. This will be environmental enhancement measures and greenery plan as shown in **Annex-13, Data Book, Vol-2.**

7.4.6. STAKEHOLDER CONSULTATIONS: IMPACTS RELATED TO ESS-10

255. Eight KIIs and seven FGDs and one consultation meetings were carried in the project affected areas. Participants raised the concerns about their adverse impacts regarding i) improper labor management, occupational health and safety, and their risks during construction works, ii) provision of benefits for the disadvantaged, marginalized and vulnerable households and groups of the project or not. ii) anticipated environmental pollution like dust and noise generation, water pollution, etc. due to construction works iii) expected for community exposure to water-borne, water based, water-related, and vector-borne diseases during construction stage, and communicable and non-communicable diseases, and COVID-19, those could result from project activities influx of labors, iv), v) the probabilities project adverse impacts on the communities alongside the project road due to Sexual Exploitation and Abuse (SEA), Sexual Harassment (SH) and Gender Based Violence (GBV) during construction works. The participants are annoyed if the occurrences of sexual harassment of women during construction and operation stages of the project, if proper safety is not ensured by the competent authorities.

Mitigation Measures:

- The Contractor shall provide relevant contract- related information, as the Employer and/or Project Manager may reasonably request to conduct contract stakeholder engagement. "Stakeholder" refers to individuals or groups who-
- are affected or likely to be affected by the Contract;
- may have an interest in the Contract;
- The Contractor may also directly participate in contract stakeholder engagements following the Stakeholder Engagements Plan of BEZ[18] , as the Employer and/or Project Manager may reasonably request.

7.5. IMPACT DUE TO OPERATION OF ON-SITE INTERVENTION OF ZONES 2A & 2B

256. The operation phase of gas pipeline network establishment has minimal adverse impact. Operation and Maintenance Period, the following activities are anticipated:

- Pipeline Operation and Maintenance,
- Station Operation the DRS,
- Waste and Disposal activities,

[18] Stakeholder Engagement Plan for Private Investment and Digital Entrepreneurship Project (PRIDE) PART 1 - BEZA, January 2020
https://documents1.worldbank.org/curated/en/468621582247161451/pdf/Stakeholder-Engagement-Plan-SEP-Bangladesh-Private-Investment-Digital-Entrepreneurship-Project-P170688.pdf

- Successful implementation of the project will ensure the availability of gas to the upcoming industrial consumers in Zone 2A and Zone 2B and will increase dispatch capacity of KGDCL gas networks. This in turn will help to meet the gas demand in Zone 2A and Zone 2B, and its surrounding areas for verity of on-site other Intervention operations, which will bring positive impacts to both Zones. In the Zone 2A and 2B there are following subprojects. Gas pipelines network will meet the demand for Implementation of these sub-projects.

Sub-project A.1: Construction of arterial and non-arterial roads, footpath and plot entry culvert.
Sub-project A.2: Construction of integrated storm water management network
Sub-project A.3: Water supply network
Sub-project A.4: Site upgradation
Sub-project A.5: Construction of telecommunication network
Sub-project A.6: Construction of some key public buildings and facilities
Sub-project A.7: Construction of Internal Power Distribution Network
Sub-project B.1: Construction of a Common effluent treatment plant (CETP)
Sub-project B.5: Development of a landfill site for solid waste generated
Sub-project B.6: Construction of a biogas plant

257. Beside the positive impacts there will be some adverse impacts on local environment and social parameter due to operation of CETP, Biogas treatment plant and sanitary land fill. Furthermore, majority of the on-site other Intervention operations will bring positive impacts to both Zones. Beside these positive impacts there will be some adverse impacts on local environment and social parameter due to operation of different kinds of industries such as pharmaceuticals, textile including RMG, leather products, industry, automobile and ancillary industries, light engineering industry, utilities, basic social infrastructure (medical, residential, and academic) to cater to the requirements of unskilled and semi-skilled manpower in the larger NSEZ zone fill. During the Operation and Maintenance Period, the following activities are anticipated: The potential environmental and social impacts linked with the subprojects during the operation phase are discussed below.

7.5.1. IMPACTS RELATED TO ESS-2: LABOR AND WORKING CONDITIONS

258. Occupational health and safety

- During the operation period, occupational health and safety will be affected by the gas pipe leakage, fire and explosions.

Mitigation Measures:
- To avoid this anticipated impact, maintenance like checking, re-testing of gas pipeline should be carried out regularly and if leakage found, immediately shut down the gas supply and repairing the line as early as possible etc.
- Implement stringent safety zones and evacuation procedures. Provide workers with appropriate personal protective equipment (PPE), including flame-resistant clothing and respiratory protection.
- Conduct regular emergency response drills to enhance preparedness.
- Ensure responders have proper training and equipment for firefighting and rescue operations.
- Develop and practice well-defined evacuation and rescue plans.
- Ensure clear communication channels for rapid response.
- Offer psychological support services and counselling for affected individuals.
- Fire extinguishers and fireballs and other latest technology should be accessible at the site and capacitate the workers to use this equipment during fire events and explosion etc. **Annex-6, Data Book, Vol-2.**

7.5.2. IMPACTS RELATED TO ESS-3: RESOURCE EFFICIENCY AND POLLUTION PREVENTION AND MANAGEMENT

259. **Noise and Vibration**: The valve stations, and others pipeline facilities can produce excessive noise, affecting the local terrestrial ecosystem and human health. The valve stations, and others pipeline facilities can produce excessive noise, affecting the local terrestrial ecosystem and human health. But after implementation of on-site interventions, noise will be mainly generated from CETP, biogas and land fill site, due to waste treatment machinery, pumps, blowers, diesel generator sets, vehicular movement for material transportation and loading and unloading activities

Mitigation Measures:
- Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less than 90 dB(A);
- If required, high noise producing generators such as concrete mixers, generators, graders, etc. must be provided with noise shields;

- Machinery and vehicles will be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to a minimum;
- Workers in the vicinity of high noise levels will be provided earplugs, helmets and will be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8-hour shift.
- During construction vibratory compactors will be used sparingly within the urban areas. In case of complaints from roadside residents, the engineer will ask the site engineer to take suitable steps of restricting the work hours even further or use an alternative roller;
- Proposed tree and shrub plantations planned for avenue plantation especially close to settlements, may form an effective sound buffer during the operation stage;
- 3-meter boundary with 3 tier plantation surrounding periphery of the project should be proposed as a barrier to reduce the transmission of point source noise towards sensitive receptor;
- Use noise barriers and enclosures to reduce sound transmission;
- Provide information on noise levels and expected durations of noisy activities;
- Schedule maintenance during off-peak hours.

260. **Air Pollution**: Air pollutants such as VOCs, NOx, PM will be released from the gas pipeline operation and maintenance such as pipeline pigging. These pollutants can significantly contribute to deteriorating the local air quality and affecting human health and natural environments.

Mitigation Measures:

- To reduce this risk, implement regular maintenance and inspection schedules;
- Use advanced leak detection systems for early identification;
- Install automatic shut-off valves to minimize gas release in case of a leak;
- Develop and practice emergency response plans;
- Provide training for personnel on handling pipeline leaks;
- Establish communication protocols with local authorities and communities;
- Install fire and explosion detection systems;
- Implement automatic fire suppression systems;
- Establish evacuation plans for nearby areas;
- Coordinate with local fire departments for rapid response;
- Establish evacuation plans for nearby areas.

261. In addition, beside the positive impacts there will be some adverse impacts on local environment and social parameter due to operation of different kinds of industries such as pharmaceuticals, textile including RMG, leather products, industry, automobile and ancillary industries, light engineering industry, utilities, basic social infrastructure (medical, residential, and academic). To predict pollution level and its management through very sound and scientific modeling technique such as air dispersion model is used for this project. For this this region, baseline environmental monitoring of certain environmental attributes viz. Meteorology, Ambient Air Quality, Ambient Noise Quality are studied surrounding projected area. The model AERMOD 8.9 has been used to predict and simulate the effects of criteria pollutants from major emission sources of the industries during operation phase in the Project area and analyzed the effect on ambient air quality for NO_2, SO_2, PM2.5 and PM10. The baseline study was done in January to March 2024 for a period of 3 months. Meteorological file has been prepared by wind direction, wind speed, temperature (in K), mixing height, stability class (urban and rural) and cloud cover etc. During operation of the Boiler & DG mainly emits the criteria pollutants like Particulate Matters (PM), Oxides of Nitrogen (NOx), Oxides of Sulfur (SOx), Carbon Monoxide (CO) etc. The emissions of total particulate matter can be comprised with PM2.5 and PM10 (Particles ≤2.5µm and PM≤10 µm in size) which will be released in the flue gas during combustion process. Emission of SO_2 in the flue gas depends on the percentage of sulfur present in the HSD which oxidized in the boiler and produced SO_2. Nitrogen oxides are products of all fuel/air combustion processes. Nitric oxide (NO) is the primary component of NOx; however, nitrogen dioxide (NO_2) and nitrous oxide (N_2O) are also formed in smaller amounts. The rate of emission of the pollutants in the flu gas have been presented in Table 7-4 in compliance with the Air Pollution Control rule 2022.

Table 7-4: Emission rate from the stack

SL. No.	Emission Features		Project Target Value	APCR 2022
1.	**Coal based Emission Features**			
	Particulate Matter (PM)	New	30 mg/Nm³	50 mg/Nm³
		Old		100 mg/Nm³
	Sulfur Dioxide (SO_2)	New	40 mg/Nm³	200 mg/Nm³
		Old		400 mg/Nm³
	Oxides of Nitrogen (NOx)	New	180 mg/Nm³	200 mg/Nm³
		Old		400 mg/Nm³

SL. No.	Emission Features		Project Target Value	APCR 2022
2.	**Oil Based Emission Features**			
	Particulate Matter (PM)	Old	30 mg/Nm³	50 mg/Nm³
		New		80 mg/Nm³
	Sulfur Dioxide (SO_2)	Old	40 mg/Nm³	200 mg/Nm³
		New		400 mg/Nm³
	Oxides of Nitrogen (NOx)	Old	180 mg/Nm³	200 mg/Nm³
		New		400 mg/Nm³

Source: Air Pollution Control Rule 2022

262. An area of 10 km by 10 km centering the stack has been selected for the air quality dispersion modeling. The project area and its nearby area which might be affected by the worst air quality during operation of the plant. Therefore, 6 no's of stack emission have been calculated based on the technical specification for using it for dispersion modeling study in AERMOD. The model was run assuming for 24-hour activities. The predicted maximum incremental GLC (24-hour average) of PM_{10}, $PM_{2.5}$, NO_X and SO_2 was found as 15.40 µg/m³, 10.12 µg/m³, 6.16 µg/m³, and 2.98 µg/m³ respectively. The predicted maximum incremental GLC (24-hour average) and predicted cumulative GLC at baseline air quality monitoring locations are presented in Table 7-5. The details of air modeling are included in **Annex 12, Data Book, Vol-2.**

Table 7-5: Maximum GLC of the Pollutants

Location Code	Baseline Conc. (µg/m3)				Predicted GLC (µg/m3)				Total GLC (µg/m3) (Existing + Proposed Scenario)			
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2
AQ1	79.5	46.4	11.6	21.2	0.02	0.01	0	0	79.52	46.41	11.6	21.2
AQ2	55.8	33.4	25.5	29.2	0.01	0.01	0	0	55.81	33.41	25.5	29.2
AQ3	33.9	20.2	24.4	31.1	0.12	0.08	0.03	0.05	34.02	20.28	24.43	31.15
AQ4	59.5	35.8	21.6	27.1	0.66	0.44	0.08	0.27	60.16	36.24	21.68	27.37
AQ5	54.3	33.2	15.4	17.9	0.45	0.3	0.06	0.18	54.75	33.5	15.46	18.08
AQ6	19.5	10.8	26.4	19.5	0.15	0.1	0.02	0.06	19.65	10.9	26.42	19.56
AQ7	31.7	17.3	31.5	16	0.24	0.16	0.05	0.1	31.94	17.46	31.55	16.1
AQ8	58.2	34.9	22.2	18.6	0.26	0.18	0.05	0.11	58.46	35.08	22.25	18.71
AQ9	25.7	16	39.9	33.1	0.15	0.1	0.03	0.06	25.85	16.1	39.93	33.16
AQ10	71.2	40.1	18.6	15.2	0.62	0.41	0.03	0.25	71.82	40.51	18.63	15.45

Result of Air Modeling:

263. Model has-been run with the dataset of rate of emission of the pollutants from the **Boiler & DG sets** with receptor point of Ten (10) ambient air quality location to determine the maximum emission for addressing the worst-case situation in future as per APCR 2022 target value. The stack emission data and background air quality of the criteria pollutants has been measured during baseline study. Both these data of the criterion pollutants are comprised from multiple sources. Monitored data is already depicted in the Tables in **Appendix- 12, Data Book, Vol-2**

264. The spatial distribution of PM10 and PM2.5 of the incinerator will contribute negligible amount of particulate matter both PM10 and PM2.5 for both the average duration of short term (24hr) and long-term period. Figure 7-1, Figure 7-2, Figure 7-3 and Figure 7-4 indicates the resultant maximum ground level concentration (GLC) of PM10, $PM_{2.5,}$ SO_2 and NOx at the ambient air quality monitoring locations

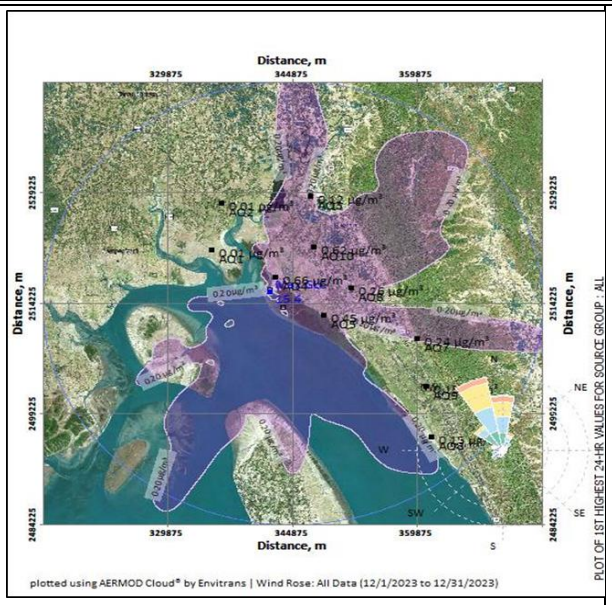


Figure 7-1: Isopleths of 24-hourly Average Maximum GLC of the PM10

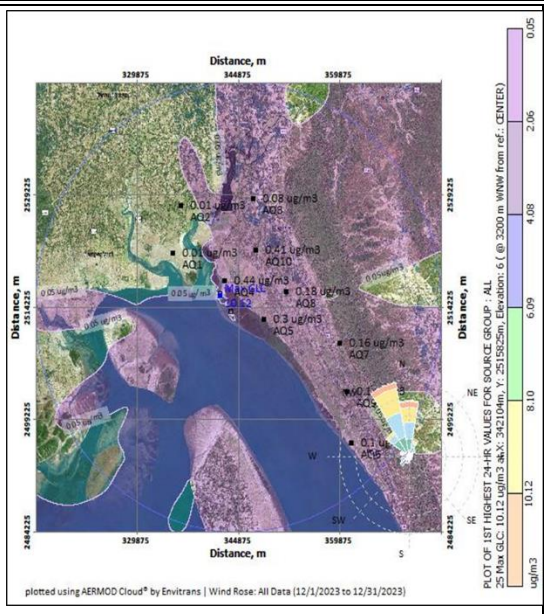


Figure 7-2: Isopleths of one-month maximum incremental GLC of the $PM_{2.5}$

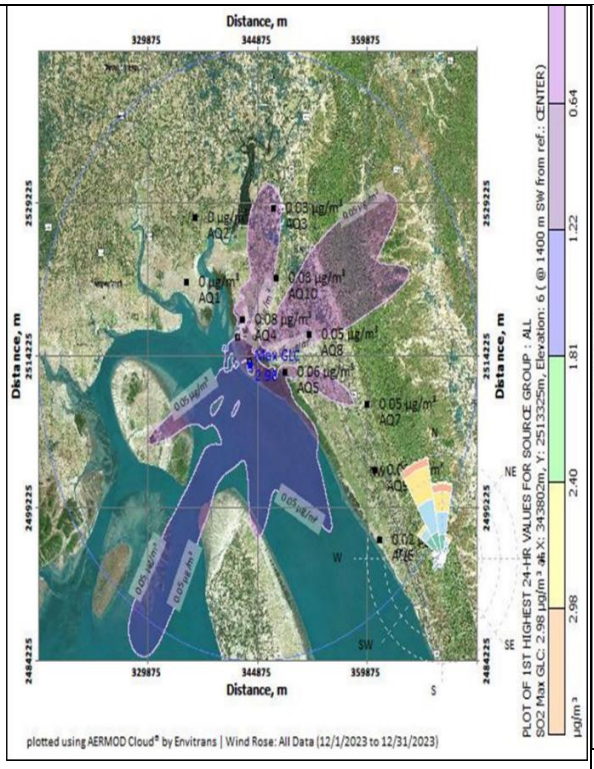


Figure 7-3: Isopleths of 24-hourly Average Maximum GLC of the SO_2

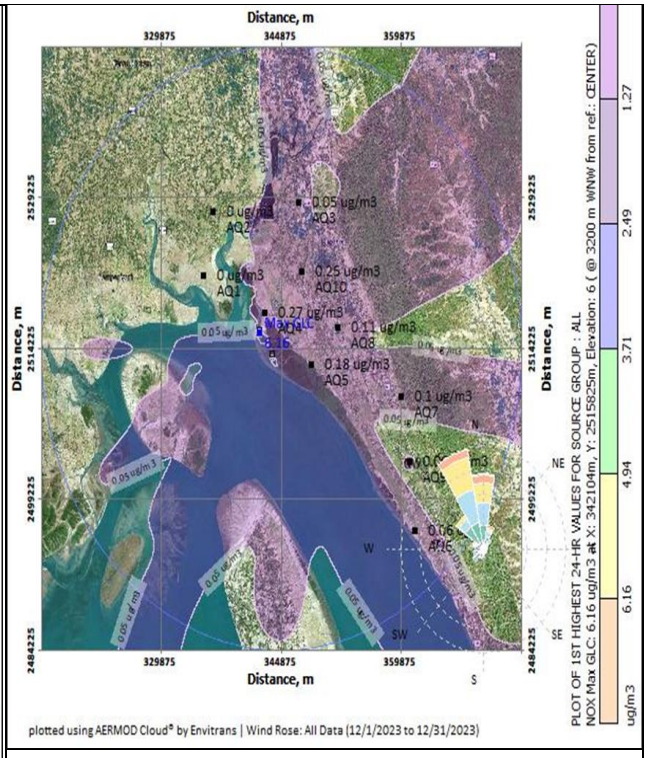


Figure 7-4: Isopleths of 24-hourly Average Maximum GLC of the NO_2

265. The incremental value of PM_{10} for the ambient air has been found to be 'Moderate' category during the baseline studies as well as after the incremental ground level concentration. Therefore, there is no significant impact on existing air quality owing to the project. It is however to be noted that the air pollution quality in the study area is already Moderate category. All cases the maximum level of NO_2 and NOx will be within the standard limit both for long term and short-term period. The Mitigation Measures on Air Pollution control during Operation Phase as follows;

Mitigation Measures:

- Stack height shall be maintained as per the guidelines suggested by APCR 2022.

- The emission standard from the stacks should follow EU or USA standard[19] where the national standard yet to be formulated
- Suppression of dust by sprinkling of water twice or thrice a day depending upon weather conditions.
- Two tier green belt shall be made along the boundary wall to reduce the impact of air pollution from air coming from outside boundary and inside air shall be restricted inside only.
- Landscaping shall be done properly so that no dust emission shall be there. All the pavers shall be surrounded with grass.
- Wheel washing bay shall be provided during construction phase. Extended area RCC shall be provided to prevent mud sticking to tyres.
- Barricading of boundary wall shall be done 1/3rd of building height. As the building height increases, the height of wall shall also be increased up to mass of 10m.
- All the DG sets on site shall be centralized and shall be closed acoustic type.
- Stack height of DG sets shall be maintained above the roof top of highest building.
- All the construction material shall be covered with the tarpaulin sheets to avoid fugitive emissions.
- All the trucks/dumpers shall be covered while entering and going out from the site.
- All the buildings shall be covered with suitable envelope to prevent dust emission due to cutting of bricks and tiles during plumbing and other works.
- NOx emission control technology should be adopted like low NOx burner or SCR/SNCR to reduce the NOx emission rate to the ambient environment
- The vehicles used in transportation will comply norms as per the motor vehicle act.
- They should take policy level intervention to reduce the particulate matter over the air shed with the assistance of other authorities and stakeholders.
- Water spraying will be practiced frequently and regular maintenance of valves, pipes etc.
- Providing protective gear, such as shoes. face masks, and gloves to the employees during the working hours
- Restrict access to disposal sites such that only safety trained personnel with protective gear are permitted to high-risk areas;
- Regular periodic monitoring of work area to check the emission level.
- Three tire green belt development surrounding the periphery of the project site

7.5.3. IMPACTS RELATED TO ESS-4: COMMUNITY HEALTH AND SAFETY

266. **Community health and safety**: The community and workers Health and Safety (OHS) will be affected by pipeline ruptures, equipment failures, spillage accidents etc., during the operation and maintenance period. In addition, gas pipe leakage can occur caused faulty construction, damage from excavation equipment or corrosion can also affect the community and workers health and safety in the working areas. Gas leaks can contribute to accumulation of gas that will ignite easily and cause fire accidents or explosions.

Mitigation Measures:

- To avoid this anticipated impact, maintenance like checking, re-testing of gas pipeline should be carried out regularly and if leakage found, immediately shut down the gas supply and repairing the line as early as possible etc.
- Implement stringent safety zones and evacuation procedures. Provide workers with appropriate personal protective equipment (PPE), including flame-resistant clothing and respiratory protection.
- Conduct regular emergency response drills to enhance preparedness.
- Ensure responders have proper training and equipment for firefighting and rescue operations.
- Develop and practice well-defined evacuation and rescue plans.
- Ensure clear communication channels for rapid response.
- Offer psychological support services and counselling for affected individuals.
- Fire extinguishers and fireballs and other latest technology should be accessible at the site and capacitate the workers to use this equipment during fire events and explosion etc.
- Ensure proper implantation of the SEP of the BEZA prepared under PRIDE project

267. **Traffic and transport** : Emergency response activities, road closures, and evacuation procedures can lead to significant disruptions in traffic flow, potentially causing delays and congestion. Smoke, flames, or hazardous materials released during a pipeline incident can reduce visibility on roads, increasing the risk of accidents. Evacuation procedures may lead to increased traffic on evacuation routes, posing challenges in managing a safe and orderly evacuation process. The impact on road safety during gas pipeline incidents can be minimized, ensuring a more effective and safer response.

Mitigation Measures:

[19] IFC, 'Environmental, Health, and Safety Guidelines for Waste Management Facilities'.

- Maintain liaison with local traffic department and share the project traffic management plan for their information.
- Develop and implement traffic management plans to divert traffic away from the affected area and ensure the safety of both drivers and emergency responders. Install or activate advanced warning systems, such as flashing lights or variable message signs, to alert drivers to reduced visibility conditions and potential hazards.
- Foster collaboration between public agencies, private transportation companies, and local businesses to improve overall transportation resilience during emergencies.

7.5.4. BENEFICIAL IMPACTS

268. Establishment of an economic zone will increase the economic benefits of the people within the project's impact zone. It is envisaged that the development of economic zones will enhance the economic growth of the area with the following benefits.

- To improve the socio-economic conditions of local settlements.
- This gas pipeline network will supply natural gas Industrial Economic Zones of NSEZ. It will speed up industrial development and create employment opportunities not only in Mirsharai, Sitakunda and Sonagazi areas but also in the surrounding areas. Employment opportunities will gradually increase which will increase the demand for skilled, educated, and unskilled people which will increase the quality of education in Bangladesh.
- Furthermore, it will facilitate improved access to market centres, educational institutions, healthcare facilities, and offices.
- The cumulative positive impacts of the project will result in increased mobility, employment generation, and above all better economic integration of the area with the major market and trade centres within and outside the districts.
- More opportunities for the women to educate themselves, train themselves and contribute to improve on the economic conditions of their home and community.
- Women empowerment with the onset of training programs involving the awareness among the women population.

269. Table **7-6** shows that 69.64% survey people believe new industry will set-up in BEZA industrial area, 64.29% belove investment will be increase, 99.11% said employment opportunity will be increased, 98.21% believe scope of woman employment will be increased, 100% people believe income will be increased.

Table 7-6: Benefit for the Gas Pipeline

SL.NO	Issue	HHs reported the issue (n=112)	%
1	Set-up industries	78	69..64
2	Increase investment	72	64.29
3	Increase employment	111	99.11
4	Women employment will increase	110	98.21
5	Increase income	112	100
6	Improve lifestyle	99	88.39
7	Improve livelihood facilities	109	97.32
8	Improve infrastructure	95	84.82
9	Others	8	7.14

270. **Impact on Employment**: An extensive number of un-skilled and semi-skilled contractual labor can be employed during the construction phase of the project. Most of the labors will be hired from the local community and neighboring district based on availability. The construction phase activities will facilitate intermixing of local workforce (mostly unskilled) with the migrant workforce (mostly skilled). As may be seen in the table below, only 83.93% of the HHs are interested in working in NSEZ different stage (Construction period after construction) different factory as skill and un-skill labor. Only 16.17% are not interested in working at NSEZ (Table 7-7).

271. Woman employment opportunity will be increase in different industry. Now most female are doing their homestead work and maximum time they site daily.

272. Basically, this area is a conservative area. Most of the local women are not interested in working outside the residence but migrant women are interested in working outside the residence. Among survey sample about 83.04% female people are interested to work in NSEZ

273. Construction of gas pipelines will require many workers. Local workers work here, and the rest of the workers are brought from outside. About 98.21% of the respondents believe that migrant workers will come here for work in Beja to fill the labor shortage. Local enterprises, particularly those involved in the production and sale

of construction materials, material suppliers are potential benefactors of the civil works involved in the project. Local market, businessman and shop owners will also be benefited from the construction activity as a considerable number of manpower will engage this project. About 95.54% of respondents said that local business will improve for NSEZ project. About 97.32% of people believe that the project will improve livelihood facilities.

Table 7-7: People opinion about the Project

Issue	HHs reported the issue (n=112)	%
Are you interested to work BEZA	Yes=94	83.93
	NO=18	16.17
Do You think female people are interested to work at BEZA	Yes=111	99.11
	NO=1	0.89
Increase employment	111	99.11
Women employment will increase	110	98.21
Do you think migratory people will come here for work at BEZA	110	98.21
	2	1.79
Impact on Local Business	107	95.54
	5	4.46
Improve livelihood facilities	109	97.32
Improve infrastructure	95	84.82
Others	8	7.14

7.6. CUMULATIVE IMPACT ASSESSMENT

274. Gas pipeline network will be developed by the BEZA under the PRIDE Project in NSEZ at Zone 2A and Zone 2B. A cumulative impact assessment (CIA) associated with the construction of 30 km gas pipe lines, considering the other projects or activities like water supplies, landfilling of IMD zones, roads, drains development and embellishment of factories and industries in the NSEZ areas etc., was carried out following the IFC Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets. Cumulative impact refers to the combined effect of multiple impacts from the proposed project and anticipated future projects. These combined impacts can lead to significant adverse or beneficial effects that would not occur with standalone projects. The list of the supporting facilities are presented in **Table 7-8.** These supporting facilities are directly and significantly related to the sub-project and planned to be carried out, but not depends on the existance of this sub-project.

Table 7-8: List of supporting facilities within Zone 2A and 2B

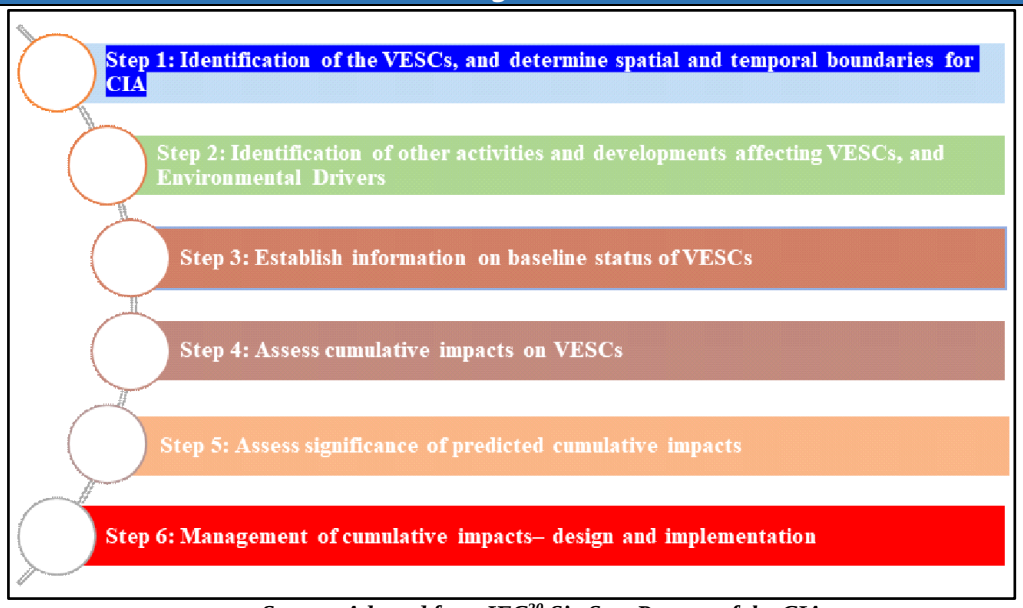
Sl. No	Facilities	Name of Supporting facilities ,	Remarks
1	Power	Power Transmission line	PGCB as investor
2	Water supply-Surface Water	Water from Muhuri reservoir will be under the jurisdiction on NSEZ-BEZA	Ongoing
3	Water supply-Surface Water	Water from Meghna river will be as associated facilities operated by CWASA	Proposed
5	Road	External and Internal Road	Proposed RHD and LGED

Source: (PIU, 2024)

275. The objectives of the CIA include

- Determining whether the combined impacts of the project, other projects and activities, and natural environmental factors will result in a VC condition that may threaten sustainability, which is likely an unacceptable outcome (i.e., exceed a threshold for VESC condition).
- Identifying management measures that could be implemented to prevent unacceptable VESC conditions. This may include additional mitigation for the assessed project, other existing or foreseeable future projects, or other regional management strategies to keep VESC conditions within acceptable limits.

276. The methodology for assessing the CIA on the current and future conditions of the identified VESCs follows the IFC's six-step process guidelines. This includes developing management plans/procedures to avoid, eliminate, or minimize impacts, as depicted below.



Source: Adopted from IFC[20] Six Step Process of the CIA

277. The CIA analysis revealed that air quality (dust, suspended particulate matters) VCs poses the possibility of negative impacts as likely or unlikely and the consequence of low or medium with minor risk or substantial risks. Finally, for each VC, management plan has been derived to mitigate negative impacts. Responsibilities for BEZA and other organizations have also been outlined to manage different monitoring and mitigation aspects. The assessment of environmental and social risks was assessed based on scoping and contextual analysis, stakeholders' opinions, existing national rules, and regulations and World Bank's Environmental and Social Standards Guidelines, and other international rules and regulations, quantifying the risks matrices and potential impacts, and formulating the strategies to mitigate the potential risks and establishing environmental and social management plan and monitoring plan etc.

278. The summary of impact evaluation is presented in **Table 7-9.** The relative weightage values have been considered for Gas Pipeline network. The graded values are calculated for 'without EMP measures' and 'with EMP measures. The total graded values show that implementation of ESMP measures will considerably mitigate or enhance the impacts on VCs.

279. The assessment of cumulative impacts of various completed and ongoing activities in and around the proposed additional area on each selected VC is discussed in Table below. The following assumptions were made for the CIA:

- This will form part of the full CIA as part of the ESIA for the Gas Network development project in Zone 2A and Zone 2B. The CIA only considers the impacts of Zones 2A and 2B due to gas pipeline development activities or being carried out in and around the area.
- The proposed CIA area considered cumulative impacts on the three selected VESCs. It does not include consideration of cumulative impacts of future proposed projects and impacts during the operation phase for which sufficient information are not available currently.
- The temporal boundary of the assessment is only during the construction phase.
- The spatial boundary of the CIA is the entire Zones 2A and 2B.
- No public consultation was conducted regarding the selection of VCs. This however should be an integral component of the full CIA.
- Impacts were assigned in three categories: low, moderate and high

Table 7-9: Cumulative Impact Assessment of Project and Other Activities on Valued Components

Project Activity	ESS	Valued Component (VCs)	Categorization of Impact
Project Activities	ESS-1	Vulnerable to Land Use	

[20] International Finance Corporation (IFC) Good practice handbook on CIA six-step approach. In partnership with Australian Aid, Pablo Cardinale pcardinale@ if.org, https://www.ifc.org/content/dam/ifc/doc/mgrt/3-gph-steps-cardinale.pdf

Project Activity	ESS	Valued Component (VCs)	Categorization of Impact
Preconstruction Phase Pipeline Route and Working Area selection Selection of base camp and construction yard **Construction Phase** Trench excavation Grading, Stringing, welding of pipes, coating, and wrapping Water body, road and railway crossing through open-cut system Lowering in, tying in, cathodic protection Commissioning Landfilling trench after fixing the pipelines Metering station and other permanent structures above ground.	ESS-2	Child labor	
		Force Labor	
		Occupational Health and Safety	
		Social Conflict	
		Gender based violence	
		Employment opportunity	
		Labor Influx	
	ESS-3	Air Quality	
		Noise and Vibration	
		Soil Erosion	
		Surface and Ground Water Quality	
	ESS-4	Hazardous and Non-hazardous waste	
		Community Health and Safety	
		Traffic and Transport	
	ESS-6	Terrestrial and Aquatic Ecology	
Operation and Maintenance Gas pipeline leakage Valve station and RMS Fire and explosion in the gas pipeline	ESS-2	Occupational Health and Safety	
	ESS-4	Community Health and Safety	
		Transport and Traffic	

Categorization of Impact

	Low (L)	Impacts are localized, of short duration and are expected to have an insignificant effect on the valued component
	Moderate (M)	Impacts are more widespread, of moderate duration and are expected to have a limited to moderate effect on the valued component
	Substantial (S)	Impacts are more widespread substantially and expected to let have the effect on the valued component significantly for a certain period.
	High (H)	Impacts are widespread, of longer duration and are expected to have an adverse effect on the valued component

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1. INTRODUCTION

280. The Environmental and Social Management Plan (ESMP) outlines the strategies and measures to manage and mitigate the potential environmental and social impacts associates with the project implementation. The objectives of the ESMP are typically designed to ensure responsible and sustainable practices throughout the project lifecycle. The specific objectives are as follows:

- Ensure that the project adheres to all relevant national, International, and World Bank environmental and social regulations and standards;
- Identify and assess potential environmental and social impacts of the project. Develop strategies to mitigate and manage adverse impacts to an acceptable level;
- Enhancing stakeholder engagement including local communities, indigenous groups, and other relevant parties;
- Establish mechanisms for communication, consultation, and feedback to address concerns and incorporate local knowledge;
- Implement measures to protect and conserve biodiversity, ecosystems, and natural resources affected by the project;
- Promote resource efficiency and sustainable use of natural resources;
- Develop effective waste management plans to minimize environmental pollution;
- Address social issues such as displacement, resettlement, and labor conditions;
- Build the capacity of local communities, project staff, and relevant stakeholders to understand and manage environmental and social issues;
- Develop and implement plans for responding to emergencies, accidents, or unforeseen events that may have environmental or social implications;
- Establish a robust monitoring and reporting system to track the implementation of the ESMP and assess its effectiveness;
- Regularly communicate the project's environmental and social performance to stakeholders and the Project Authority;
- Encourage continuous improvement by reviewing and updating the ESMP as necessary to ensure best practices etc.

8.2. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

281. The environmental and social management plan (ESMP) has been prepared with aimed to avoid, reduce, and mitigated the potential environmental and social risks associated with the project activities. The ESMP is outlined in detailing the risks and mitigation measures identified in different phases like Pre-Construction, Construction and Operation & Maintenance Period. The details are given below:

Table 8-1: Environmental and Social Management Plan of Gas pipeline network of the sub-project

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
Pre-Construction and Construction Phase						
▶ Manpower Engagement ▶ Pipeline Route and Working Area selection ▶ Selection of base camp/ Labor camp ▶ Movement of heavy equipment ▶ Utility Shifting ▶ Vegetation Clearance ▶ Trench excavation & Landfilling ▶ Transporting, Lifting and Placement of pipes in the trench ▶ Grading, Stringing, welding of pipes, coating, and wrapping ▶ Water body, road and railway crossing through open-cut system ▶ Lowering in, tying in, cathodic protection ▶ Commissioning ▶ Metering station and other	ESS-1: Assessment and Management of Environmental and social Risks	**Vulnerable to Land Use:** Vulnerable to land use-trenching, excavation, and trench filling after digging the gas pipeline will cause erosion of the slope.	• Proper mitigations measures such as using backhoe, ripper or other approved technique, ditch shall provide minimum cover (1.22 meter) from the top of the pipe surface to the original or final ground surface, contractor shall provide additional cover to meet special construction requirements contained in right of way and permit conditions and prior to lowering-in, any loose rock, debris, metal of any kind and hard objects shall be removed from the ditch etc. can help to minimize the impacts to land use pattern in the project areas.	Contractor	KGDCL/ BEZA	Contract cost
	ESS-2: Labor and Working Conditions	**Labor Influx:** An influx of labor will take place in the project areas due to the lack of appropriate local workers for this specific type of project activity. The health and safety of the working force are impacted with the possibility of developing HIV/AIDS and other infectious diseases at the labor camps, and construction camps. Nonetheless, the effects will be temporary, site-specific, and manageable	282. To reduce or avoid this anticipated risk, workers should be provided with on-the-job trainings on OHS issues. Ensure appropriate PPE (Hard boots, life vest, safety goggles, hand gloves etc.) should be available at the site and used by workers. Sanitary toilets should be made at the sites; separate female toilet is required if female workers involved at the sites. Drinking water supply should be accessible by each worker at the site (portable drinking water supply is acceptable.) and conducting Toolbox meeting (TBM) at the construction sites etc.	Contractor	KGDCL/ BEZA	Contract cost
		Employment opportunities: Employment opportunities will be created for both skill and unskilled labors and indirect employment of the local community at the construction sites.	283. To mitigate the social unrest, the contractor should recruit a minimum of 30% local labor, especially in the non-skilled jobs and non-discriminated wages as per current	Contractor	KGDCL/ BEZA	Contract cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
permanent structures above ground. ▶ Gas pipeline leakage ▶ Valve station and RMS			Labor Law and Government regulations should also be ensured.			
		Labor Camp: Labor camp will be established at the project site however the anticipated risks caused by establishment of labor camp can be minimized by applying the following the mitigation measures.	284. To mitigate this risk, labor camp should be within close proximity of the site, good accommodation for the labors and keep it clean and hygienic with proper ventilation, sanitation (latrines 1 per 25 persons and separate bathing facility and urinals, male and women). The construction camps should be at least 500 m distance from the human settlements to avoid conflicts and stress over the infrastructure facilities with the local community, and location for stockyards for construction materials will be identified at least 1 km from water sources. Store houses for hazardous material like diesel should be at distance from construction labor camps.	Contractor	KGDCL/ BEZA	Contract cost
		Occupational Health and Safety: During the pre-construction stage, clearing the site, selection of RoW (right of Way) of pipeline route and working area, base camp, and movement of heavy equipment will be at risk for staff and workers, but the impact is moderately significance considering the nature of works. However, during the construction period, trenching, excavation, materials transportation and lifting of equipment and pipes, Grading, Stringing, wielding of pipes, coatings and wrapping, potential health hazards are	285. To reduce these anticipated impacts, the suggested mitigation measures should be employed regularly 286. Standards of Health and Safety for all employees not less than those laid down by the national standards or statutory regulations. 287. The Contractor shall provide all appropriate protective clothing and equipment for the work to be done and ensure its proper use. Where required, safety nets, belts, harnesses and lines shall be	Contractor	KGDCL/ BEZA	Contract cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
		anticipated if proper safety preventive measures are not undertaken properly. Due to wielding, electrical shock may cause serious injuries to health and eyes. Coating and wrapping works, health risks are skin irritation and discomfort for respiratory system will occur.	provided by the contractor. The "safety directives for work equipment" and "safety directives for protective gears" shall be prepared and disseminated to the workers by the contractor. 288. Construct sanitary latrine or septic tank system or install portable cabin toilet for workers/ employees 289. Heavy Equipment: (Heavy Equipment includes but is not limited to: Backhoes, Bulldozers, Road Graders, Excavators, Scrapers Loaders, Dump Trucks, Earth Movers, Trucks 2 Tons GVW or Greater.) Operators should have license, training, qualifications, certifications and medical fitness Heavy Equipment should be equipped with back-up alarm, horn and seat belt. All Motorized Heavy Equipment should require Rollover Protective Structures (ROPS) with seat restraints. Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas. Inspections Before use. Traffic Management Plan should be developed for the project/ site to ensure safe interactions between work activities, equipment, people and environment. 290. Material Handling: Safeguard and Control Measures should be considered for Loading and Unloading Hazards. Use of mechanical lifting equipment e.g., Cranes, Forklifts and etc. Conduct Safe Work zone during loading/ unloading and regular inspection.			

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
			291. Electrical Safety: Insulation - insulate electrical conductors with glass, rubber or plastic. Electrical protective devices - interrupts current flow when it exceeds conductor capacity like fuses, circuit breakers & ground fault circuit interrupters (GFCI's). Only competent people who are trained and qualified to work on electrical equipment. PPE for electrical work includes Hard hat, Safety glasses, long sleeve cotton shirt and long non-melting pants. Regularly check electrical equipment. Give instructions to workers to report any electrical faults immediately and stop using the tool or cable as soon as any damage is seen. Where possible, eliminate risks by using battery powered or cordless tools or tools which operate from a 110V supply system.			
		Social conflict: During the pre-construction period, utility shifting can enhance the social conflict if proper consultation is not held with the local community. However, during the construction period,	292. Stakeholder consultations are important for the local community such as focus group discussions (FGD), interviews, meetings etc., before and during utilities shifting. 293. After construction, utilities should be installed appropriately at the disrupted sites by project cost. 294. To reduce this impact, necessary information should be given to the surrounding neighbours, information should include (construction time, and construction natures etc.) 295. To carry out regular stakeholder consultation with the local community. 296. To make strong correlations with local people's representatives, religious leaders, social leaders, and others to avoid	Contractor	KGDCL/ BEZA	Contract cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
			any kind of social conflict in the project areas. 297. Any other necessary steps should be taken based on situations like meetings, workshops etc.			
		Gender Based Violence (GBV): The gender-based violence (GBV) and sexual exploitation and abuse/Sexual Harassment (SH) risks may increase to some extent within local communities when there are large influxes of male workers from outside the area. Generally, the female employment tends to be more concentrated in low-paid and low-productivity occupations. Increasing women's labor force participation and improving the quality of female employment will require more significant support for women's access to employment opportunities and high-quality skills development programs.	298. Mandatory and repeated training and awareness raising for the workforce about refraining from unacceptable conduct toward local community members, specifically women. Informing workers about national laws that make sexual harassment and gender- based violence a punishable offence which is prosecuted. Introducing, and signing of a Worker Code of Conduct by all workers as part of the employment contract, and including sanctions for non-compliance (e.g., termination). Adopting a policy to cooperate with law enforcement agencies in investigating complaints about gender-based violence. a grievance mechanism on potential GBV/SEA/SH cases under the guidance of the Project PIU and shall take into account in submitting bid the provisions for service providers in case of potential GBV victims/cases	Contractor	KGDCL/ BEZA	Contract cost
		Child Labor: The contractor sometimes hires or recruits the child labor workforce into the project. In keeping with internationally recognized standards, the project will make a distinction between child labor and young workers. The project will not tolerate child labor under any circumstances.	• To reduce this risk, the Contractor, including its Subcontractors, shall not employ or engage a child under the age of 14 unless the national law specifies a higher age (the minimum age). Shall not employ or engage a child between the minimum age and the age of 18 in a manner that is likely to be hazardous, or to interfere with, the child's education, or to be harmful to the child's health or physical, psychological or	Contractor	KGDCL/ BEZA	Contract cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
			sexual abuse. mental, spiritual, moral, or social development.			
		Force Labor: It will occur during the construction period e.g., excavation, trenching, transporting materials, and others, however, force is not allowed at the construction sites. The following mitigation measures shall be implied to reduce this anticipated risk.	• To reduce this anticipated risk, the Contractor, including its Subcontractors, shall not employ or engage forced labor. • Forced labor consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labor, such as indentured labor, bonded labor or similar labor-contracting arrangements. • No persons shall be employed or engaged who have been subject to trafficking. Trafficking in persons is defined as the recruitment, transportation, transfer, harboring or receipt of persons by means of the threat or use of force or other forms of coercion, abduction, fraud, deception, abuse of power, or of a position of vulnerability, or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person for the purposes of exploitation.			
	ESS-3: Resource efficiency and Pollution prevention	**Air pollution:** **Air pollution** will occur due to site preparation, construction works, earth filling, stack yards and labour shed construction, grading and movement of vehicles etc.	• Ensure that all vehicles and machines comply with technical and environmental safety regulation. Schedule the operation times for vehicles, machines working in the construction area to reduce air emissions. The contractor shall maintain	BEZA	KGDCL/ BEZA	Contract cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
	and Management		an inventory of the number, type and location of all stationary emission sources within the boundary of the construction site during the period of construction. • Before the commencement of any work, the Engineer may require the methods of working and equipment intended to be used on the site to be made available for inspection and approval to ensure that they are suitable for the project. The Contractor shall ensure that all Plant and Equipment to be used on site are properly maintained in good operating condition and that the Plant and Equipment does not give rise to excessive exhaust smoke emissions. In the process of material handling, any material which has the potential to create dust shall be treated with water or wetting agent sprays, especially when dusty materials are being loaded or unloaded. • Any vehicle with an open load-carrying area used for moving materials, and having the potential to create dust, shall have properly fitting side and tail boards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards and shall be covered by a clean tarpaulin. The tarpaulin shall be properly secured and shall extend at least 300 mm over the edges of the side and tail boards. Stockpiles of dusty materials will be covered by polythene or tarpaulin. • The Contractor shall frequently clean and water the any public road used by vehicles			

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
			accessing the site to minimize the fugitive dust emissions. Regular watering and sprinkling for dust suppression are to be done properly. Compaction of prepared site to re-strain the fugitive emissions. The Contractor shall restrict all vehicles on the Site to a maximum speed of 15-20 km/hr. km per hour and confine haulage and delivery vehicles to designated roadways inside the site.			
		Noise Pollution: Noise pollution may occur because of: Operation of vehicles and equipment during the site preparation, earth work, stack yards and labour shed construction, transportation of construction materials etc.	• To avoid or mitigated this problem, construction activities in day time and minimize night time working. Regulate the speed for traffic in and around the project areas and carry out maintenance and routine inspections on vehicles and construction machineries to ensure the technical standards. Ensure the construction equipment are with proper silencer and muffler, padding/noise isolator and select the least noisy machine. The personnel involved in high noise generating activities shall be provided with personal protective devices like ear plug, earmuffs etc.	BEZA	KGDCL/ BEZA	Contract cost
		Water Pollution: Surface and groundwater can be contaminated by sewage & wastewater from labour camp, dumping of moist soil for prolong period and effluent disposal etc.	• To reduce the water polltuion, the contractor shall design methods of working to minimize water pollution and necessary trainings to the workers to ensure that these methods are implemented. The contractor shall provide toilets with septic tanks system or sanitary pits of sufficient capacity for the number of workers on the site. No overflows from the storage tanks to the surface water drains will be permitted. Diesel and oil, cement, glues. Paint, other toxic chemicals	BEZA	KGDCL/ BEZA	Contract cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
			etc., shall be handled properly and cover up all drains to prevent waste from ending up in the water. Minimize land disturbance and leave maximum vegetation cover.			
		Soil Pollution: Project site soil and sediment can be polluted due to disposal of solid and liquid waste of diversified construction works, operation of heavy equipment, oil spillage of construction vehicles etc.	• To reduce or mitigate this problem, construction vehicles will remain on compacted roads. Fuel, lubricating oil, and used oil storage areas will be in the designated area. Contractor shall ensure daily collection and disposal of construction waste, debris, oil, fuel spillage, used oil etc. To avoid soil compaction along the transportation routes, only identified haul roads would be used for transportation and sand bags can be used to trap sediments more effectively in the trenching and execavated sites.	BEZA	KGDCL/ BEZA	Contract cost
	ESS-4: Community Health and Safety	**Community health and safety:** The local community near the project area will not to be impacted by the proposed onsite construction activities since there is no residence adjacent to the project site. However, offsite infrastructure such as accesses road is permitting movement of construction vehicles for the transportation of construction materials at the project site. The number of vehicles will increase. This increasing number of traffic will occur traffic congestion with the time. In addition, road accidents may occur due to the movement of vehicles with construction materials and equipment and operation of machineries and	• To reduce this anticipated risk, site security must be maintained, information regarding construction work must be disseminated, and a boundary fence (at least 2 m in height) should be installed around the working area. Safety Signs/ Markings**:** The contractor will provide safety signs/ markings around the site. Size and locations of signs will be as per the instruction of the engineer.		KGDCL/ BEZA	Contract cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
		equipment. Specially the school going children are the major victim of accidents in the approach road. Communicable diseases can spread among the local community from the influx of construction workers due to improper management of construction camp. The community health and safety will be at risk due to the trenching, excavating, backfilling, pipe installation, wielding, vehicle movement and other types of construction works.				
		Traffic and transport: No of electrical poles, street light posts and water pipeline and other utilities facilities will be required for shifting during construction period, and shifting of utilities like electric poles may require temporary power cut which may disturb the life of common local people. But the impact will be of short term. Generally, erection of electric poles may cause inconvenience, block the access to the local residents, shopkeepers, students and children. Occupational and public safety issues of the workers, technicians and residents are a serious concern during shifting of the utilities. Materials carrying vehicles and construction vehicles (Excavator, pay loader, grader, dump-truck etc.) may damage environment in the construction area and may be a disturbance to nearby	• To minimize these anticipated impacts, defensive driving training of drivers and proper maintenance of vehicles is required. Establishing diversion roads during the construction, traffic sign/cautionary sign to avoid undue traffic congestion, lighting at night-times and movement of construction vehicles to be planned during off-peak period and flagmen shall be equipped with red and green flags and illuminating vest at night especially near at intersection etc.	BEZA	KGDCL/ BEZA	Contract cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
		population. Without proper traffic management, accidents may also occur.				
		Hazardous and Non-hazardous Waste: The Project will generate both solid non-hazardous and hazardous wastes throughout the construction phase. The anticipated non-hazardous waste types include excavated material, broken aggregates, solid waste, filling materials, wastewater etc. While hazardous waste may include used oil, empty drums or replaced parts of the construction machinery, used battery etc.	• To reduce this anticipated impact, the contractor shall provide sufficient containers for the temporary storage of solid waste including separate containers for hazardous and non-hazardous wastes and shall be clearly labelled. The hazardous waste/e-waste to be collected in bins, steel drums and stored in a segregated roofed area and periodically disposed at approved waste disposal facilitates. The contractor shall provide appropriate facilities for temporary dumping of all types of waste before final disposal. The contractor shall not dispose any waste, rubbish or offensive matter in any place not approved by the Engineer or project authority	BEZA	KGDCL/ BEZA	Contract cost
	ESS-6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	**Terrestrial and Aquatic ecology:** The proposed project sites will not cover any protected areas, or ecologically sensitive areas. No trees will be affected by the construction activities except some bush types of vegetation. The project has limited impacts to aquatic biodiversity during crossing the canal and ditches and low-lying areas etc.	• To lessen the effects on biodiversity, bubble curtains or creation of agitation in water should be carried out prior carrying out the construction to provide avoidance time and let the species move away from crossing point and to prevent any injury/mortality. Contractors should submit SOPs and action time charts with risk management plan prior to any construction work.	BEZA	KGDCL/ BEZA	Contract cost
	ESS-10: Stakeholder consultations	Stakeholder consultation will be regularly held with the project affected people, workers and local community to avoid social conflict and strengthening the environmentally friendly project implementation.	• It should be regularly held with the project affected people, workers and local community to avoid social conflict and strengthening the environmentally friendly project implementation	BEZA	KGDCL/ BEZA	Contract cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
Operation and Maintenance Phase						
▶ Pipeline Operation and Maintenance ▶ Station Operation the DRS	ESS-2: Labor and Working Conditions	**Occupational health and safety** During the operation period, occupational health and safety will be affected by the gas pipe leakage, fire and explosions	• To avoid this anticipated impact, maintenance like checking, re-testing of gas pipeline should be carried out regularly and if leakage found, immediately shut down the gas supply and repairing the line as early as possible etc. Regular emergency exercises are required to increase preparedness by ensuring that responders are properly equipped and trained for rescue and firefighting duties and that the rescue and evacuation plan is implemented. To ensure quick action, it is vital to make sure that communication lines are open. • Fire extinguishers and fireballs and other latest technology should be accessible at the site and capacitate the workers to use this equipment during fire events and explosion etc.	BEZA	KGDCL/ BEZA	Operation cost
	ESS-3: Resource Efficiency, Pollution prevention and Management	**Noise and Vibration:** The valve stations, and others pipeline facilities can produce excessive noise, affecting the local terrestrial ecosystem and human health. The valve stations, and others pipeline facilities can produce excessive noise, affecting the local terrestrial ecosystem and human health. But after implementation of on-site interventions, noise will be mainly generated from CETP, biogas and land fill site, due to waste treatment machinery, pumps, blowers, diesel	• Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less than 90 dB(A). Workers in the vicinity of high noise levels will be provided earplugs, to prevent prolonged exposure to noise levels of more than 90dB(A) per 8-hour shift.	BEZA	BEZA	Operation cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
		generator sets, vehicular movement for material transportation and loading and unloading activities.				
		Air Pollution: Air pollutants such as VOCs, NOx, PM may be released from the gas pipeline operation, RMS operation and maintenance such as pipeline pigging, fire and explosions, gas pipeline leaks etc. These pollutants can significantly contribute to deteriorating the local air quality and affecting human health and natural environments.	• To mitigate this problem, implement To mitigate this problem, implement regular maintenance and inspection schedules, develop and practice emergency response plans, provide personnel with the necessary training on handling pipeline leaks, install fire and explosion detection systems, implement automatic fire suppression systems, create evacuation plans for nearby areas, strengthen coordination with local fire departments for rapid response, and use advanced leak detection systems for early identification and the installation of automatic shut-off valves to minimize gas release in the event of a leak..	BEZA	BEZA	Operation cost
	ESS-4: Community Health and Safety	**Community health and safety:** The community and workers Health and Safety (OHS) will be affected by pipeline ruptures, equipment failures, spillage accidents etc., during the operation and maintenance period. In addition, gas pipe leakage can occur caused faulty construction, damage from excavation equipment or corrosion can also affect the community and workers health and safety in the working areas. Gas leaks can contribute to accumulation of gas that will ignite easily and cause fire accidents or explosions.	• To avoid this anticipated impact, maintenance like checking, re-testing of gas pipeline should be carried out regularly and if leakage found, immediately shut down the gas supply and repairing the line as early as possible etc. • Implement stringent safety zones and evacuation procedures. Provide workers with appropriate personal protective equipment (PPE), including flame-resistant clothing and respiratory protection. • Conduct regular emergency response drills to enhance preparedness.	BEZA	BEZA	Operation cost

Project Activities	WB's ESS standards	Potential Risks	Mitigation Measures	Responsible Agencies		Associated Cost
				Planning and Execution	Supervision & Monitoring	
			• Ensure responders have proper training and equipment for firefighting and rescue operations. • Develop and practice well-defined evacuation and rescue plans. • Ensure clear communication channels for rapid response. • Offer psychological support services and counselling for affected individuals. • Fire extinguishers and fireballs and other latest technology should be accessible at the site and capacitate the workers to use this equipment during fire events and explosion etc.			
		Traffic and transport: Emergency response activities, road closures, and evacuation procedures can lead to significant disruptions in traffic flow, potentially causing delays and congestion. Smoke, flames, or hazardous materials released during a pipeline incident can reduce visibility on roads, increasing the risk of accidents. Evacuation procedures may lead to increased traffic on evacuation routes, posing challenges in managing a safe and orderly evacuation process. The impact on road safety during gas pipeline incidents can be minimized, ensuring a more effective and safer response.	• Maintain liaison with local traffic department and share the project traffic management plan for their information. • Develop and implement traffic management plans to divert traffic away from the affected area and ensure the safety of both drivers and emergency responders. Install or activate advanced warning systems, such as flashing lights or variable message signs, to alert drivers to reduced visibility conditions and potential hazards. • Foster collaboration between public agencies, private transportation companies, and local businesses to improve overall transportation resilience during emergencies.	BEZA	BEZA	Operation cost

8.3. ENVIRONMENTAL AND SOCIAL MONITORING PLAN (ESMOP)

299. The following are the primary goals of the Environmental and Social Monitoring Plan (ESMoP):

- To decrease negative effects, increase the effectiveness of ESMP, and improve the natural and social environments at project sites.
- To examine the requirements of environmental management plan for improvement.
- To evaluate the distinction between baseline circumstances and changes in the degree of environmental repercussions caused by project operations.

300. The monitoring will include physical measurements of specified parameters such as air, water (drinking and surface and seawater), noise, soil quality, and so on, in compliance with ECR 2023 and the World Bank's sub-project related ESS standards.). Furthermore, visual observations will be conducted in areas such as biodiversity assessment and monitoring, adoption of best practices, workplace and community health and safety, stakeholder involvement, and so on.

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Table 8-2: Environmental and Social Monitoring Plan (ESMoP)

Affected Component	Environmental Issue	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Supervision and Monitoring
Water quality	Surface water quality	Temperature, Total Dissolved Solid (TDS), Salinity, Turbidity, Total Suspended Solids (TSS), pH , Dissolved oxygen (DO), Biochemical Oxygen Demand (BOD5), Chemical Oxygen Demand (COD)	Ichakhali canal, Daborkhali canal and Bamonsundor canal	As per National/International Standard	Before, during and after construction from each canal	Contractor	KGDCL/ PIU-BEZA
	Ground water quality	Drinking water quality parameters notably pH, Manganese, Iron, Arsenic, TC, FC, pH, DO,TDS, Turbidity, Chloride	Labor camp	Standard	Quarterly	Contractor	KGDCL/ PIU-BEZA
Ambient Air Quality	Dust generation	SPM, PM $_{2.5}$, PM_{10}, CO, SO_2, NOx.	At 04 Locations (At project site, nearest settlement/Important Sensitive Receptors: as directed by engineer)	As per requirement of Standard method	Quarterly including the baseline condition, (before) and during construction as per the instruction of engineer	Contractor	KGDCL/ PIU-BEZA
		General air quality (visibility)	Project site	Visual Inspection	Daily	Contractor	KGDCL/ PIU-BEZA
Noise	Increase in ambient noise levels	Noise levels in Leq, Leq_{day}, Leq_{night} and hourly Leq	At 04 Locations (At project site, nearest settlement/Important Sensitive Receptors: as directed by engineer)	At least -2 hrs.	Quarterly	Contractor	KGDCL/ PIU-BEZA
Soil Quality	Quality of Soil	pH, Total Sulphur, NH4+, Total Nitrogen, Total Phosphorus, Total Mercury, Cd, Total Cyanides (CN), Cr & Cr+6), Pb, As, Polychlorinated biphenyl, (PCB), Cu, Zn, Oil & Grease and Salinity.	Construction Area	Standard, Analytical methods	Baseline, Once during Construction / Installation and after installing pipeline networks.	Contractor	KGDCL/ PIU-BEZA

Affected Component	Environmental Issue	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Supervision and Monitoring
Occupational Health and Safety and	Accidents or incidents	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas and construction workers camp	Incidents/ accidents	Daily	Contractor	
Infectious Diseases	Risk of HIV/AIDS	Ensuring that contractor's personnel and local community understand HIV-AIDS awareness campaign	Project site	Consultation with workers & community	Daily	Contractor	KGDCL/ PIU-BEZA
Community Health and safety	Community disturbance and potential safety hazard due to road traffic	Accidents, incidents and complaints and traffic related issues: --Speed control of construction vehicles, -Timing/scheduling of construction vehicles, Traffic control, -Site attention sign/traffic flag man etc.	Approach Road	Incidents,	Daily	Contractor	
Operation and Maintenance Period (Defect Liability Phase)							
Water Quality	Gas pipeline leakage and spill can contaminate the nearby water resources	Visibility	Accident/ Incident sites	Visual Inspection	Daily during incidental/ accidental events)	PIU-BEZA	KGDCL/ PIU-BEZA
Air Quality	Air pollutants will be released from the gas pipeline operation and maintenance such as pipeline pigging.	VOCs, NOx, PM	Accident or incident areas	As per National/International Standard	Once a year	PIU-BEZA	KGDCL/ PIU-BEZA
Noise Level	The valve stations, and others pipeline facilities can produce excessive noise.	Noise levels in Leq, Leq_{day}, Leq_{night} and hourly Leq	Valve station sites.	At least 2 hrs.	Quarterly	PIU-BEZA	KGDCL/ PIU-BEZA
Occupational Health & Safety	Accidents or incidents	Near-misses, incidents, occupational diseases, dangerous	Sub-project activity areas	Incidents/ accidents	Daily (during incidental/	PIU-BEZA	KGDCL/ PIU-BEZA
Community Health & Safety	Accidents or incidents	Occurrences	Sub-project activity areas	Incidents/ accidents	accidental events)	PIU-BEZA	KGDCL/ PIU-BEZA
Terrestrial Ecology	Re-vegetation	Replace the dead trees	Designated sites where plantation will occur.	Visual Inspection	Quarterly	PIU-BEZA	KGDCL/ PIU-BEZA

8.3.1. E&S MONITORING, REPORTING AND DOCUMENTATION REQUIREMENTS

8.3.1.1. GENERAL INSTRUCTION

301. Implementation shall include monitoring and reporting on the results of the above measures. Monitoring reports shall be submitted on a monthly and quarterly basis as per the schedule.

- The Contractor shall accurately test and measure the ES parameters as approved by the Engineer. All tests are to be conducted from government approved labs.
- Details of parameters to be monitored, locations (as guideline) and frequency of monitoring are shown in Table 8-4 of this document.

8.3.1.2. THIRD PARTY MONITORING

302. For effective implementation and an independent environment evaluation, a third-party ES consulting firm will be hired by the contractor. This consulting firm will be given the responsibility to monitor the overall performance of the contractor independently in complying with the provisions of the ESMP for satisfactory environmental management of the proposed project including compliance with the DoE conditions

8.3.2. REPORTING AND DOCUMENTATION REQUIREMENTS

303. As per the monitoring requirements, the contractor is required to prepare the following reports and submit them to the Engineer for approval. The details are given in Table 8-3**.**

Table 8-3: Environmental Reporting and Responsibility

Submission	Contents
Baseline Report Before Starting construction and installation of the DRS	► Approach and Methodology for Implementing ES monitoring plan. ► Key Project Concern, Activity Summary and ES Action Plan. ► All applicable monitoring items specified in the table 10-5 of ES Monitoring plan including the test result shown from government approved/accredited lab as separate annex. ► Consultation with stakeholders, Contractor's response, and follow-up measures.
Monthly report 10th of the next month	► Project activity summary. ► Complaints by public or authorities and the Contractor's responses or action plans. ► Summary of the daily site inspection records. ► Accidents and incidences. ► All applicable monitoring items specified in the table 10-5 of ES Monitoring plan including the test result shown from government approved lab as separate annex. ► Mitigation measures undertaken in case the test result exceeding the allowable limit. ► Compliances of the monitoring items and counter measures if it is applicable within next month.
Quarterly report 15th of the next month after each three-month	► Activity summary. ► Complaints by public or authorities and the Contractor's responses or action plans (if any). ► Quarterly summary of the monthly monitoring items. ► All applicable monitoring items should be monitored as specified in the **of** ES Monitoring plan in **Table 9-3**. ► Summary of mitigation measures undertaken in case the test result exceeding the allowable limit. ► Compliances of the monitoring items and counter measures if it is applicable within next quarter. ► Outstanding ES issues so far;
Annual/ Completion Report	► Annual/final summary of the compliance status of all applicable monitoring items, implementation of mitigation measures, outstanding ES issues and way forwards etc.

8.4. ESTIMATED BUDGET FOR IMPLEMENTING THE ESMP

304. The tentetive estimated total cost for the implementation of ESMP is approximately 19.39 Million BDT (0.162 Million USD). However, the amount is estimated for the construciton phase is 16.25 Million BDT and for the operation phase is 1.37 Million BDT. The enviornmental qaulity parameters monitoring cost is estimated at amount of 3.2 Million BDT. Details shown in **Table 8-4.**

Table 8-4: ESMP implementation tentative budget

Sl. No.	Monitoring Issues	Description	Monitoring Locations/ Sites	Monitoring Frequency/ Unit	Unit Rate (BDT)	Cost in (BDT)
A	**Construction Phase (30 Months)**					
A.1	**Environmental Pollution Monitoring (Environmental Monitoring for Water qualities air, water, noise and soil attributes)**					
1	Surface water Quality	Temperature, TDS, Salinity, Turbidity, TSS, pH, DO, BOD, COD	Three (3) samples from Ichakhali canal, Daborkhali canal and Bamonsundor canal	Before, during and after construction (a total of 9 samples from 3 locations)	45,000	405,000
2	Ground Water Quality and drinking water	pH, Manganese, Iron, As, TC, FC, pH, DO,TDS, Turbidity, Chloride,	Labor and Construction Camp (2 locations)	Once before construction and quarterly during construction (a total of 21 samples)	30,000	630,000
3	Air Quality	PM10, PM2.5, NO_2, SO_2, CO and O_3	04 Locations (at project site, nearest Important Sensitive Receptors: as directed by engineer)	Pre-construction once and quarterly during construction (a total of 41samples)	45,000	1,845,000
4	Noise Level	Noise levels in Leq, Leqday, Leqnight and hourly Leq	04 Locations (at project site, nearest settlement /Important receptors	Pre-construction once and quarterly during construction (a total of 41 samples)	8,000	328,000
5	Soil Quality	pH, Total Mercury, Cd, Cr & Pb, Cu, Zn, Salinity.	Construction Area (2 Samples)	Two samples during construction	50,000	100,000
	Sub total					**3,208,000**
A-2	**Environmental Mitigation Measures**					
1	Dust suppressing by water sprayer	Suppressing quantity	Road surface			Civil work
2	Providing sewage tank/soak well in construction camps and yards;	Installation of sufficient and good quality toilets and sewage tank	Labor camps, administrative office and working sites			Civil work
3	Installation of Tube well and safe drinking water supply at labor camps and working site	Installation of sufficient numbers of tube wells and ensure the safe drinking water supply	Labor camps, administrative office and working sites			Civil work
4	Providing solid waste management facility in construction camps (Waste bins)	Sufficient solid waste management provided	Labor camps, administrative office and working sites	Monthly	20,000	240,000
5	Disposal of construction debris and other waste materials and transportation	Labor camps, administrative office and working sites	Labor camps, administrative office and working sites	Monthly	20,000	240,000
6	Implementation of TMP	Roads Networks in NSEZ	**Project areas**	Daily	LS	400,000
7	Occupational Health and Safety and	PPE cost (safety jacket/ life jacket, high visibility vest, helmets, hand protection gloves, protective shoes, safety helmets, eye protection goggles, Face mask/KN95, Hand Sanitizer)	Labor camp and working sites.	Monthly	20,000	240,000

8	Implementation of Environmental Enhancement Measures Greenery Plan	Approximately 12000 sapling plantation alongside the road networks in Zone 2A and 2B	Road side	LS	700	8,400,000
		Plantation of Vetivar / Nepiar / Barmuda grasses	Road shoulder and slops	LS	LS	1,200,000
9	Informatory Signage for safety near sensitive locations and built-up sections			LS		150,000
	Sub total					**10,870,000**
A-3	**Training for Workers and Institutional Strengthening, and implementation of SEP**					
1	Capacity Building	Training of the workers & project professional	Working sites	LS		1,800,000
2	Implementation of SEP			LS		**375,700**
	Sub Total					**2175700**
	Total A (A1+A2+A3)					**16,253,700**
B	**Operation Phase in Defeats Liability period (1 year)**					
1	Water Quality	Gas pipeline leakage and spill can contaminate the nearby water resources	Working sites	LS		**150,000**
2	Air Quality	Air pollutants will be released from the gas pipeline operation and maintenance such as pipeline pigging.	Working sites	LS		**360,000**
3	Noise Level	The valve stations, and others pipeline facilities can produce excessive noise.	Working sites	LS		**64,000**
4	Water Quality	Gas pipeline leakage and spill can contaminate the nearby water resources	Working sites	LS		**200,000**
5	Occupational Health and Safety	Accidents or incidents	Working sites			**100,000**
6	Terrestrial Ecology	Re-vegetation	Road sides			**500,000**
	Sub total					**1,374,000**
	Total (A+B)					**17,627,700**
	Contingency 10%					1762700
	Grand Total (BDT)					**19,390,470**
	Total Cost (Million BDT)					**19.39**
	Total Cost (Million USD) Note: (1 USD = BDT 119.52 Nov 02, 2024					**0.162**

8.5. INSTITUTIONAL SETTING AND IMPLEMENTATION ARRANGEMENTS

305. The Environmental and Social Management Plan (ESMP) will be carried out under the direct supervision of the Project Management Unit (PMU) of NSEZ. PMU will be in charge of overall coordination between various government agencies such as the DOE (Department of Environment) and the World Bank in order to implement the Environmental and Social Management Plan (ESMP) to the project sites during the Design & Pre-Construction, Construction, and Operation & Maintenance Periods in accordance with the World Bank Environmental and Social Standards (ESS-1 to 10) and the Environmental Conservation Rule 2023 (ECR 2023), as well as other applicable national laws and regulations.

306. The main executing body PIU of the PRIDE, BEZA will be responsible to implementation of environmental and social management. Presently, BEZA has individual environmental and social consultants, but not having a dedicated social and environmental cell or unit for monitoring and handling all social, environmental and health and safety issues for the development project. To ensure E&S compliance, the PMU of the NSEZ has developed Environmental Framework with the help of the World Bank. The contractor will implement the environmental and social mitigation measures as per the ESMP.

307. The BEZA will appoint a PMC under the PMU and their qualified safeguard specialists will review the report from DSC and contractors on implementation of the ESMP and will also ensure that ESIA recommendations, ESMP, and ESMoP are followed during the Pre-Construction and Construction Periods. However, BEZA will assume additional responsibility for environmental and social issues throughout the Operation Period

308. The PMU of NSEZ will hire contractors to construct gas pipelines as per requirement of Bid document inclusion of safeguard specification in accordance with the ESMP. Contractors should prepare a site-specific Construction Environmental and Social Management Plan (C-ESMP) based on the ESIA report including E'MP's recommendations and World Bank guidelines. To implement the C-ESMP, contractors will recruit Environmental and Social Management Officer (ESMO) and Occupational Health and Safety Officer (OHSO) for monitoring Environmental and Social framework compliance the during contractor activities.

309. The C-ESMP should be included the labor management plan, waste management plan, traffic management plan, occupational health and safety plan, spill management plan, drainage management plan, tree planation plan and greenery plan etc. as well as environmental and social code of practices **(Annex-15, Databook, Volume-2),** and to be implemented during construction stage in compliance of the ESMP of the project.

310. In the institutional arrangement procedure, Project Director will be directly involved. The PD and DPD would be supported by Environmental and Social Specialists. Under PMU, there will be relevant officials and consultants to support the PD. The Team Leader/Deputy Team Leader of Design and Supervision consultant, KGDCL will monitor the contractor's activities and reportable to the PIU.

311. Engagement of Contractor to complete the work and supervision and payment to Contractor will be implemented by Karnaphuli Gas Distribution Company Limited (KGDCL) on behalf of BEZA. The Contractor will submit monthly and quarterly progress reports on Environmental and Social compliance). After reviewing it will be sent to the World Bank. The implementation flowchart of the ESMP for the Gas Pipeline Network in Zone 2A, Zone 2B and its surrounding areas is shown in **Figure 8-1.**

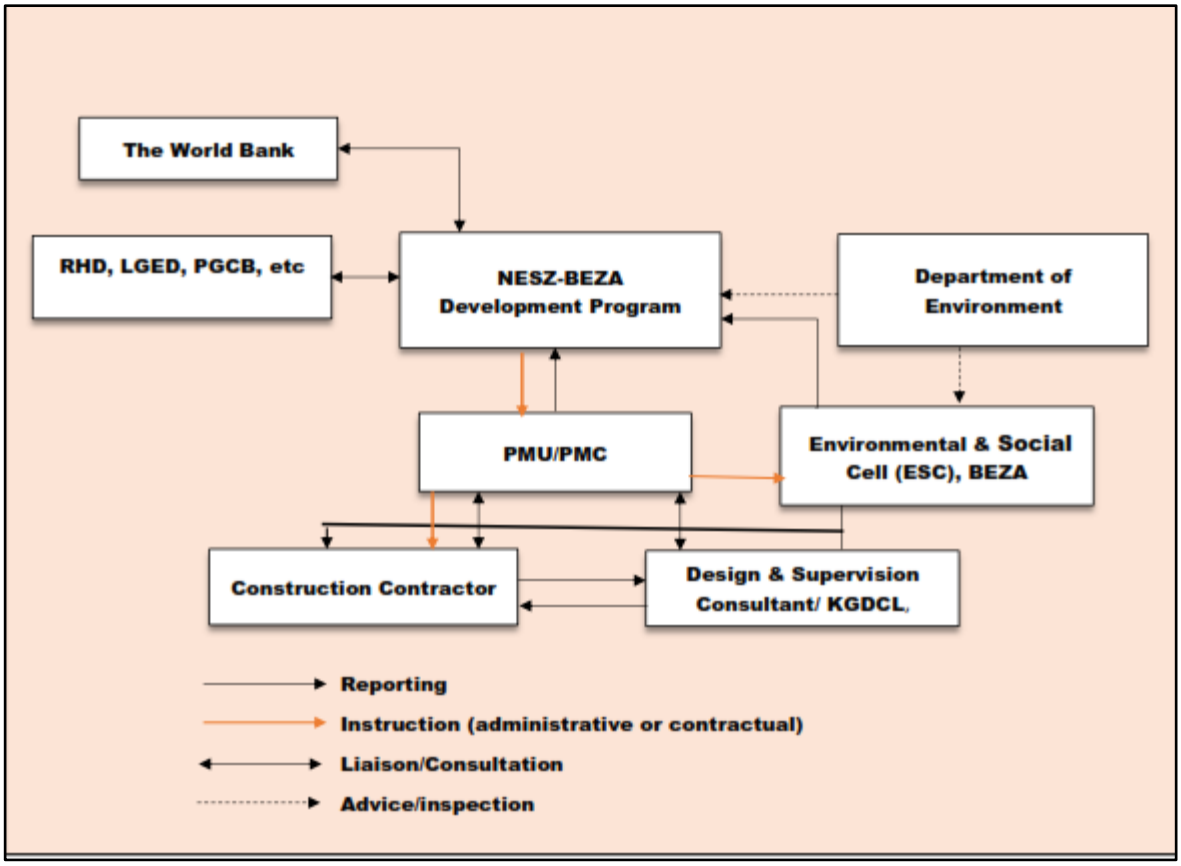

Figure 8-1: Implementation of ESMP for Gas Pipeline Network in Zone 2A and Zone 2B

8.5.1. TRAINING REQUIREMENT AND INSTITUTIONAL STRENGTHENING

312. The contractors (Implementing Agency of civil works), Monitoring and Supervision Agency (PMU of NSEZ), and others will be trained in environmental and social management plans (ESMP), environmental and social monitoring plans (ESMoP), mitigation strategies, occupational and community health and safety management, waste management, emergency response, traffic management, biodiversity management, stakeholder engagement, and the use of grievance redress mechanisms, among other things. Table 8-5 shows the summarizes the subjects, techniques, and anticipated cost of trainings. The Environmental and Social Consultant Team (E&S Team) will prepare a training session plan after consulting with the PMU of NSEZ following the World Bank recommendations.

Table 8-5: Training program and implementation cost

Training Topics	Target Audiences	Timing	Estimated Cost (BDT)	Cost (USD)
ESMP Implementation: Roles and Responsibilities, Monitoring, Supervision and Reporting Procedures. Training on ESF 2018, and 10 ESSs of the World Bank.	Contractor's representatives, PMU of NSEZ representatives,	Prior to construction (2 days)	Cost: 300,000	3000
		Refresher training in each year up to construction period (1 day)	Cost: 200,000	2000
Grievance Redress Mechanism: Roles and Responsibilities, Procedures, Occupational and Community Health and Safety, Emergency Preparedness and Response, Pollution Control and Environmental Monitoring, construction waste management, Inspection and Reporting, Public Consultation, Contractor Engagement and Management, including ESMP enforcement, Operation-Phase Environmental & Social Management and Monitoring	Contractor's representatives, PMU of NSEZ representatives,	Refresher training in each year up to construction period (1 day)	Cost: 300,000	3000
		Refresher training in each year up to construction period (1 day)	Cost: 200,000	2000

Training Topics	Target Audiences	Timing	Estimated Cost (BDT)	Cost (USD)
Labor and Working Conditions: Terms and conditions of employment according to national working laws and regulations. Contractor and sub-contractor codes of conduct, Worker's organizations, Child labor and minimum age employment Rules etc.	Contractor's representatives, PMU of NSEZ representatives,	Prior to construction (1 days)	Cost: 300,000	3000
		Refresher training in each year up to construction period (1 day)	Cost: 200,000	2000
GBV Risk: Raising awareness and measures to prevent and mitigate GBV risks. The topics, activities and targeted groups will be developed in the GBV Action Plan including GBV-specific GRM	Contractor's representatives, PMU of NSEZ representatives,	Prior to construction (1 days)	Cost: 200,000	2000
		Refresher training in each year up to construction period (1 day)	Cost: 100,000	1000
Total Cost (BDT): Eighteen Lakh Taka only.			***18,00,000***	***18000***

Note:1 USD= 100 BDT.

9. CONCLUSIONS AND RECOMMENDATIONS

9.1. CONCLUSIONS

313. The construction of gas pipelines and other associated structures is critical for addressing potential environmental and social implications and mitigating predicted repercussions in order to minimize or reduce the impacts on the natural and social environments. This ESIA report provides a complete examination of environmental baseline conditions, prospective repercussions, and sustainable mitigation strategies.

314. The construction of gas pipelines will have a large positive effect on industry operations as a primary source of fuel, and all industrial infrastructures will get access to supply gas in Zone 2A and Zone 2B of the NSEZ. Local communities may also have gas supply facilities and improve their socioeconomic conditions. However, this project does not need land purchase or resettlement to relocate houses or properties from the project site to other sites. As a result, no one will be forced to abandon their ancestral homestead or lose their property because of the proposed sub-project activities, which will have a beneficial impact on project execution. Furthermore, the project activities will have no direct or indirect influence on indigenous people. Furthermore, locals will be hired or recruited to work at project sites on a contractual or daily basis, increasing employment generation even further. The ESIA report incorporates feedback from stakeholders and the public, including concerns about the potential impact on the natural and social ecosystems surrounding the project.

315. On the other hand, there will be some negative consequences as a result of the project activities, but most of them will be temporary and insignificant. The most negative impacts are deteriorating the local air quality due to dust suppression by different types of project activities, excessive noise will be generated by using different equipment, vehicles, and other logistics support, surface water quality will be affected by the installation of gas pipeline along the water resources, local biodiversity, both floral and faunal species will be affected or migrated to a safe distance, increased road traffic, and other factors will jeopardize occupational and community health and safety.

316. Medium term and significant impacts are mainly causes removal of trees from the project sites, but it is to be mitigated by taking a replantation plan (1:3) immediately after completion of construction. During operation and maintenance period, fire accidents will be escalated by gas leakage from the pipeline that would cause disastrous impacts to the natural and social environment if quality of works will not be ensured during construction. All the possible impacts are identified and suggested mitigation measures are outlined in this ESIA report. If appropriate precautions are not taken, occupational and community health and safety will be at danger. Strict oversight and appropriate implementation of ESMP are necessary to reduce these hazards.

317. In this study, to predict pollution level and its management an air dispersion model, noise model and pollution load modeling are used widely based on the present scenario of study area. For this purpose, the baseline environmental monitoring of certain environmental attributes viz. meteorology, ambient air quality, ambient noise quality was studied for the future development of industrial infrastructures in the Zone 2A and 2B and surrounding zones of the NSEZ, and it is likely impacts are insignificance in context of implementation of Gas Pipeline Network through adopting the mitigation and monitoring measures as highlighted in the ESMP and ESMoP of this ESIA study

9.2. RECOMMENDATIONS

- The following recommendations have been made to strengthen the environmental and social management and monitoring plan during the pre-construction, construction, and operation and maintenance periods:
- Integrate findings and suggestions into the project planning process, design, incorporate into Bid Document and implementation.
- Prioritizing Occupational Health and Safety plan can lower workplace risks for workers.
- Provide Community health and safety plans to mitigate project related impacts to the local community.
- Regular stakeholder consultation is essential for reducing social conflict and engaging the community effectively during implementation.
- Excavation of trench or digging for the Gas pipeline construction could degrade the existing lands and may create drainage congestion and water logging situation, but this drainage congestion will be minimal, if proper good engineering practices are adopted by the Contractor following the guidelines of drainage management plans, and as well as construction solid and liquid waste and hazardous wastes management plans etc. of this ESMP to control generated waste during construction work. .
- All activities during pre-construction, construction, and operation & maintenance periods should be in compliance of the ESMP recommendations and to be executed through the allocated ESMP budget for implementing mitigation and monitoring measures.

- Prior commencement of civil works the Contractors should prepare site specific all management plans and it should be implemented properly and regularly reviewed, and updated as the corrective measures during construction works;
- Ensuring monitoring of key environmental and social parameters as per ESMP,
- Ensuring sufficient budget is allocated for ESMP (mitigation and monitoring measures), including third party monitoring;
- Ensuring training and capacity building activities are implemented in a timely manner;
- Ensure all management plans are implemented and regularly reviewed and updated as required;
- Implementation of Project GRM and Stakeholder Engagement Plan (SEP) and continuing stakeholder engagement throughout the project life.
- Obtaining the Environmental clearances from the DoE
- Ensuring the ESMP and ESMoP should be incorporated in the Bid Document as environmental and social safeguard specification to make the project environmentally sound, socially acceptable and sustainable.
- Implement a tree plantation plan (TPP) right away after construction or pipeline installation to make air quality better and safer place to live in, help the biodiversity for repairing damaged ecosystems and promote animal regeneration and as well as reinforcement on the site.

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