



*Draft  
Environmental  
Impact  
Assessment  
Report*

For proposed Feni  
Economic Zone, Feni,  
Bangladesh

*Dec- 2020*

**Draft**

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# Abbreviation & Glossary

%	Percentage
°C	Degree Celsius
µg/m <sup>3</sup>	microgram per cubic meter
ACGIH	American Conference of Governmental Industrial Hygienists
AEZ	Agro Economic Zone
AMSL	Above Mean Sea Level
BBS	Bangladesh Bureau of Statistics
BEZA	Bangladesh Economic Processing Zone Authority
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BOD	Biochemical Oxygen Demand
BWDB	Bangladesh Water Development Board
CaCO <sub>3</sub>	Calcium Carbonate
CETP	Common Effluent Treatment Plant
CH <sub>2</sub> O	Formaldehyde
Cl <sub>2</sub>	Chlorine
Cm	Centimetre
CO	Carbon monoxide
CO <sub>2</sub>	Carbon dioxide
COD	Chemical Oxygen Demand
CPR	Common Property Resources
dB	Decibel
DG	Diesel Generator
DO	Dissolve Oxygen
DOE	Department of Environment
DPHE	Department of Public Health and Engineering
EC	Electrical Conductivity
ECA	Ecologically Critical Area

ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPP	Emergency Preparedness Plan
ETP	Effluent Treatment Plant
EU	European Union
EZ	Economic Zone
FDI	Foreign Direct Investment
FGD	Focus Group Discussions
FMD	Foot & Mouth Disease
GDP	Gross Domestic Product
GIS	Geo-Informatics System
gm	Gram
GoB	Government of Bangladesh
GSB	Geological Survey of Bangladesh
GSHAP	Global Seismic Hazard Assessment Program
H <sub>2</sub> S	Hydrogen sulphide
ICT	Inland Container Terminal
IEE	Initial Environmental Examination
IWM	Institute of Water Modeling
JICA	Japan International Cooperation Agency
Kg	Kilogram
KV	Kilo Volts
LPG	Liquefied Petroleum Gas
m	Meter
MBR	Membrane Bio Reactor
MLD	Million Litres Per Day

MMSCFD	Million standard cubic feet per day
MSW	Municipal Solid Waste
MVA	Mega Volts Ampere
NaCL	Sodium Chloride
NGL	Normal Ground Level
NH <sub>3</sub>	Ammonia
NNE	North-North-East
NO	Nitric oxide
NO <sub>2</sub>	Nitrogen dioxide
NO <sub>x</sub>	Nitrogen Oxides
O <sub>3</sub>	Ozone
PCC	Pretoria Portland cement
PGCB	Power Grid Company, Bangladesh
PIU	Project Implement Unit
PM 10	Particulate Matter 10
PM 2.5	Particulate Matter 2.5
PPE	Personal Protective Equipment
PPP	Public Private Partnership

PVC	Polyvinyl chloride
RBC	Rotating Biological Contactors
RCC	Reinforced Cement Concrete
REB	Rural Electrification Board
RHD	Roads and Highways Department
RMG	Readymade Garments
SBR	Sequencing Batch Reactor
SO <sub>2</sub>	Sulphur dioxide
SPM	Suspended Particulate Matter
SRDI	Soil Resource Development Institute
STP	Sewage Treatment Plant
TDS	Total Dissolved Solid
ToR	Terms of Reference
UASB	Up-flow Anaerobic Sludge Blanket
UG	Under Ground
USA	United States of America
VOC	Volatile Organic Compound

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# ***Executive Summary***

## ***Project Background***

The government of Bangladesh has envisaged organized industrialization for the country, which can help its competitiveness by encouraging investment from global manufacturers across sectors. With this in mind, the EZ model has been adopted and pushed to encourage industrialization in an organized manner, which can help the country gain a stronger foothold in manufacturing and diversify its export basket, which has been relying on the readymade garments sector (RMG).

GoB has adopted a proactive approach to promulgate investment within the country and foster organized industrialization. In tandem with this initiative, the economic zone (EZ) regime was ushered in, and Bangladesh Economic Zones Authority (BEZA) was conceptualized. BEZA is the nodal agency mandated for economic zone development in the country. BEZA in support with World Bank is implementing a Private Sector Development Support Project (PSDSP) to upkeep pilot EZ projects under the new EZ regime.

As part of this scheme, pre-feasibility studies for various sites for locating economic zones were undertaken of which, Feni being one of them. This assignment is in succession to the earlier studies, capturing the Environmental and Social Impact Assessment (ESIA) study for the Feni Economic Zone. The purpose of conducting the ESIA study is to carry out an assessment of the proposed projects to determine the magnitude of positive and negative impact likely to be caused by the proposed development and associated activities taking into account environmental, social, cultural, economic and legal considerations and to develop a necessary plan to mitigate the negative impacts towards safeguarding environmental and social concerns.

The proposed EZ is spread over an area of 9,446.80 acres and it is located in Sonagazi upazila, Feni district of Chattogram division. A key location attribute of the proposed EZ site is its location along the Dhaka-Chattogram industrial and transport corridor, Bangladesh's most important highway Dhaka-Chattogram Highway (N1) passes in proximity to this site. According to an Asian Development Bank (ADB) study conducted in 2013, 90% of Bangladesh's goods for export and import pass through this highway. Around 30,000 vehicles (the highest among all road alignments in the country) pass through this road daily,<sup>2</sup> which include trucks carrying cargoes of apparel, light machinery, chemicals, steel roads, agricultural produce, processed food, cement etc.

This strategic location will help industries in the proposed EZ site, cater to the consumer market in Dhaka and form upstream and downstream linkages with industries along Dhaka-Chattogram Highway. Industries in the proposed EZ will also have access to markets and industries in Northeast India due to its proximity to the Indian state of Tripura.

PricewaterhouseCoopers Pvt. Ltd. (PwC) has been appointed by Bangladesh Economic Zones Authority (BEZA) to undertake an Environmental and Social Impact Assessment for Feni Economic Zone, Bangladesh. The report is about Environmental Impact Assessment (EIA).

## ***Project Objective***

The project objective is to develop a multi-sector Economic Zone in Feni within the proposed Bangabandhu Sheikh Mujib Shilpa Nagar Area (BSMSN). The aim of setting up the EZ in Feni is to develop light and medium industries which may include the following:

- Textile and textile accessories
- Pharmaceuticals
- Food and Agro Processing Industry
- Electronics Industry
- Automobile Industry
- Power and Energy
- Leather Product Industries

- Light Industry (motorcycle assembly, machinery parts and general assembly)

All facilities required for target industries have been planned and identified. This will enable the proposed EZ to function as an integrated package having the required facilities and service activities with sufficient provision for future growth and expansion.

Given the industrial base and the concept of EZ which has evolved to leverage the cluster advantage of industries, the proposed project will strengthen the district's position in the industrial sector map of Bangladesh and will contribute to the economy. A careful planning exercise has been undertaken to position the project taking into account the geographic, demographic, raw material resources, industrial, economic and social characteristics of region and it is in this context that master planning of the project assumes significance.

## ***Project Description***

The site for the EZ has been selected for the development of the economic zone. Scope of the proposed project is to develop EZ site and on-site -offsite facilities for the upcoming EZ zone. These EZ facilities will be developed by BEZA. Proposed off-site facilities will help in improving the infrastructure of the area and will attract developers. The proposed development will help in improving the infrastructure of the EZ area. Proposed interventions at the selected site are given below:

- Site development
- Land Filling
- Approach Roads & Internal Road Network
- Creation of industrial Plots
- Administrative & residential building
- Development of water supply network
- Development of sewer and effluent system network
- Development of CETPs & STPs
- Power supply system and substation at project site
- Super Dyke (length of 30km)
- Boundary Wall
- Embankment for River Feni

## ***Project Site***

The proposed EZ is located in Sonagazi Upazila, Feni district of Chattogram division. Chattogram division, located in the southeastern part of the country is geographically the largest division of Bangladesh with industrial city of Chattogram being the primary driver of the division's economy. Chattogram division contributes to ~18.9% of overall GDP of the country and it houses various industrial units. Owing to the presence of Bangladesh's most important seaport, Chattogram Sea Port, this division has seen rapid industrialization with steel re-rolling mills, cement plants and other trade dependent industries being established in this area. Chattogram division has 11 districts (zilas) and 99 sub-districts (Upazilas).

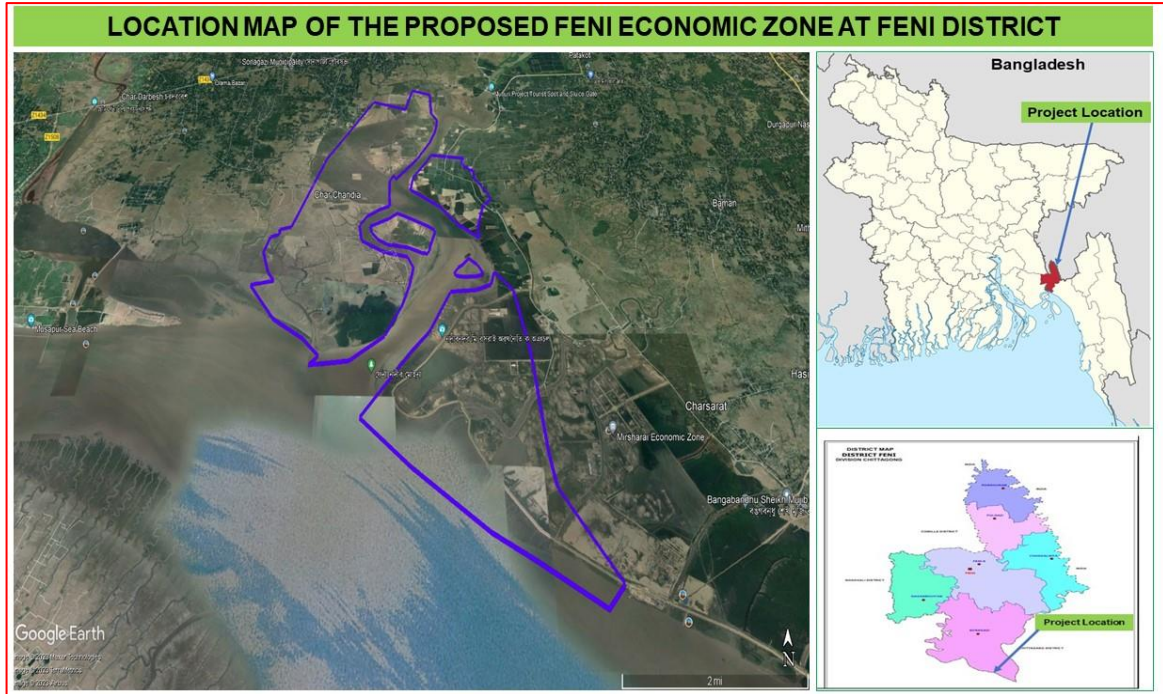
Feni district is located in the middle of Chattogram division and shares border with India to its north and Bay of Bengal to its South. The following surround it –

- Comilla district – North-West

- India – North & East
- Chattogram district – South-East
- Sandwip Channel (Bay of Bengal) – South
- Noakhali - West

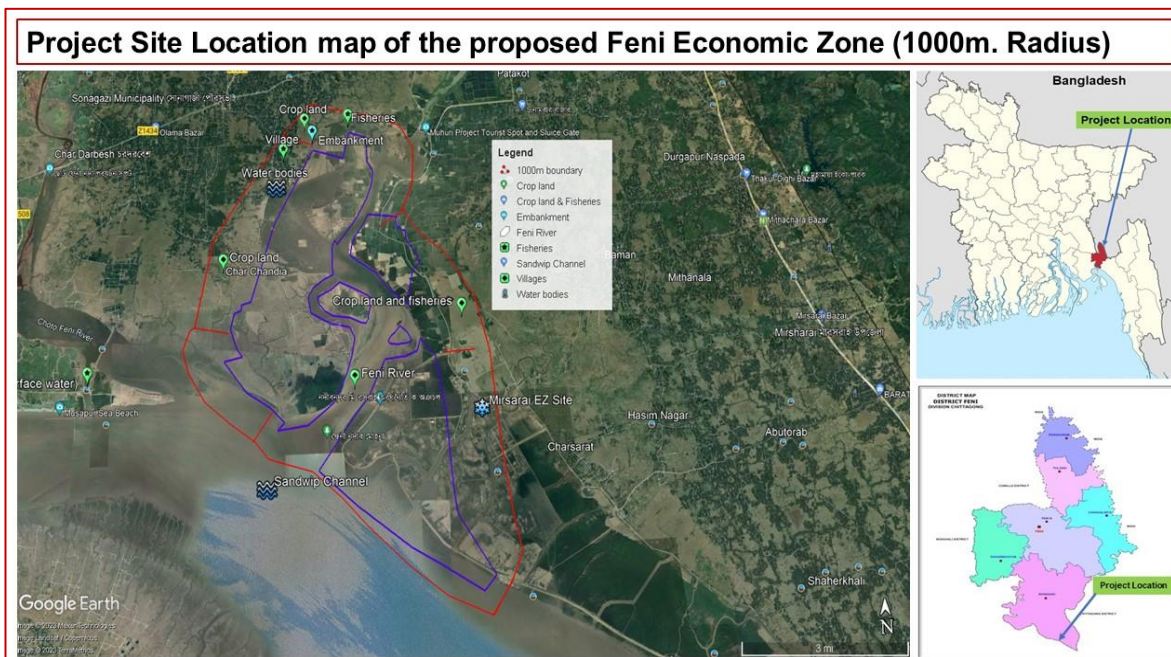
Feni district comprises 6 upazilas; the proposed EZ is located in the Sonagazi upazila.

*Figure 1: Location of the Feni Economic Zone (Chattogram Division - Feni District - Sonagazi Upazila)*



Source: Google Earth

*Figure 2: Project Site location map of the Feni EZ (1000m radius)*



Source: Google Earth



# ***Baseline Environment***

## ***Meteorology***

The project area lies in the South-Eastern climate zone of the country and shows three main seasons, i.e., Southwest Monsoon, Northeast Monsoon and Hot Season. The climate is tropical in the project area. Project area has significant rainfall most months, with a short dry season. According to Köppen and Geiger, this climate is classified as Tropical Monsoon Climate (Am). The meteorological condition has been established using data on different metrological parameters accumulated from Bangladesh Meteorological Department. A summary of the analysis of metrological parameters is given in the following sections.

As a part of the EIA study, long-term climatological information for the following parameters has been collected from Bangladesh Meteorological Department (BMD)-

- Temperature
- Humidity
- Rainfall
- Evaporation
- Wind Speed and Direction
- Sunshine Hours

## ***Natural Hazards***

Bangladesh very often becomes the landing ground of cyclones formed in the Bay of Bengal. This is because of the funnel shaped coast of the Bay of Bengal, most of the damage occurs in the coastal regions of Khulna, Patuakhali, Barisal, Noakhali and Chittagong and the offshore islands of Bhola, Hatiya, Sandwip, Manpura, Kutubdia, Maheshkhali, Nijhum Dwip, Urir Char and other newly formed islands. The coastal zone of Bangladesh is disaster-prone. Project site is located in SE part of the coastal areas of Bangladesh.

Bangladesh has been divided into three generalized seismic zones. The northeastern regions of Bangladesh are the most active zones and belong to the zone-I. The zone II consists of the regions of recent uplifted Pleistocene blocks and considered as moderately active. The southwest Bangladesh is a seismically quiet zone and is represented by zone III. In the earthquake zoning map 26 percent of Bangladesh falls in high risk, 38 percent moderate and 36 percent in low-risk zone in terms of earthquake vulnerability. Proposed site is located in Zone II.

## ***Land Use***

According to the land use map of Sonagaji Upazila, Feni District the proposed site falls under the following zones-

- Agricultural Land
- River Canal
- Tidal Flat
- Mangrove Forest
- Mixed Crop Zone

## ***Environmental Monitoring***

The information on the existing environmental conditions of the proposed project site and of its close vicinity have been generated through primary baseline monitoring and secondary sources with respect to the physical, biological and socio-economic environment. A zone of 10 km area around the EZ is considered as Study Area.

## ***Surface Water System***

Major water bodies within 10 km study area are Bay of Bengal, River Feni, Feni reservoir, Choto Feni River, Muhuri River. The project site lies in the flood plain of Feni River. The principal tributary of the Feni River is the Muhuri River, which drains the Feni plain. Choto Feni is another river passing through the southwestern border of the proposed area. It flows through the northern part of the study area and flows into the Sandwip Channel of the Bay of Bengal. River Feni bifurcates the EZ site into two land parcels.

## ***Ground Water Scenario***

The preliminary interpretation of the tentative ground water depth in the proposed site, data for 1 of the nearest boreholes have been observed<sup>1</sup>. It was observed on basis of the lithology profile that the recommended depth of tapping the water is from 155 m Below Ground Level to 215 m Below Ground Level. Appropriate hydrological observations and tests need to be carried out within the proposed EZ site to determine the exact depth of groundwater.

## ***Biological Environment***

There is no protected area or Ecologically Critical Area located within the study area of 10Km radius from proposed site boundary. The proposed study area supports well-grown mangrove vegetation. Two Mangroves patches is located within proposed site towards in Southern and North-Eastern side. The project area is located in a location where tidal influence is prominent. The Southern part of the project area remains submerged during high tide due to the proximity of Bay of Bengal. Proposed EZ is located just adjacent to confluence point of Feni River and Bay of Bengal. The mixing of saline water from sea and fresh water of River in the confluence area generates a brackish water ecosystem. The project area supports significant growth of various mangrove species as well. The project area is located in Mangrove-Intertidal Zone. The char land, which covers a significant part of project area, has been chosen by the Forest Department for taking up plantation activity. The *Kalo Bain (Avicennia officinalis)*, *Sada Bain (Avicennia marina)* and *Keora (Sonneratia apetala)* are the predominantly planted mangroves species found in the area. *Gneoa (Excoecaria agallocha)*, a mangrove species grows here naturally. The Muhuri dam region, located adjacent towards northern side of Proposed site is known as an Important Bird and Biodiversity Area (IBA). IBA sites are identified by BirdLife International based on using an internationally agreed set of criteria as being globally important for the conservation of bird populations.

## ***Agricultural Resources***

As informed by the Upazila Agriculture Office and locals, the proposed site area is predominantly single cropped in nature (Amon Paddy). Addition to that, some farmers also grow lentils like *Khesari and Musur*.

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<sup>1</sup> Basis interaction with Department of Public Health and Engineering (DPHE) official

## ***Livestock and poultry***

The proposed project area is barren and free of any encumbrances. There are no livestock or poultry farms in the project area

## ***Fisheries***

Fisheries resources of the study area are rich and diversified. Study area consists of estuary, rivers, aquaculture ponds, canals and Khals.

## ***Socio-economic***

Preparation of Social Impact Assessment Report is under process. Information pertaining to Ownership Pattern, Project affected Households (PAHs) and Project Affected People (PAPs) shall be provided in final EIA Report.

## ***Environment and Social Impacts of the Proposed Project***

The environmental impacts assessment was carried out considering the present environmental setting of the project area, and the nature and extent of the proposed activities. The proposed project involves the development of EZ for upcoming industries in Feni. Potential environmental impacts associated with EZ are classified as:

- impacts during design, site preparation and construction phase and
- Impacts during the operation phase.

The anticipated impacts and the proposed mitigation measures are outlined in the below tables

*Table: Environmental Impacts and Mitigation Plan: Preconstruction & Construction Phase of EZ Development*

<b>Impact</b>	<b>Mitigation Measures</b>
<b>Setting up of construction camps/labour camps</b>	<ul style="list-style-type: none"><li>• 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.</li><li>• Location for stockyards for construction materials will be identified at least 1 km from water sources</li><li>• The living accommodation and ancillary facilities for labour shall be erected and maintained to standards and scales approved by the resident engineer</li><li>• All sites used for camps will be adequately drained. There should not be any risk of periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water</li><li>• The camps will be located such that the drainage from and through the camps will not endanger any domestic or public water supply</li><li>• All sites will be graded, ditched, and rendered free from depressions such that water may get stagnant and become a nuisance</li><li>• Construction camps shall be provided with sanitary latrines (1 per 25 pax), a bathing facility, and urinals.</li><li>• Sanitary latrines shall be under cover and so partitioned off as to secure privacy and shall have a proper door and fastenings</li><li>• Adequate and suitable facilities for washing clothes and utensils shall be provided and maintained for the use of contract labor employed therein.</li><li>• Sewerage drains will be provided for the flow of used water outside the camp.</li></ul>

Impact	Mitigation Measures
	<ul style="list-style-type: none"> <li>• Drains and ditches will be treated with bleaching powder on a regular basis.</li> <li>• 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.</li> <li>• Clean potable drinking water facility should be provided at the site and the water quality should be monitored regularly</li> <li>• Crèche facility should be provided for children if female workers are employed</li> <li>• First aid facilities should be made available at the construction camp. The first aid box should contain small, medium and large-sized sterilized dressings, sterilized burns dressings, a 2 % alcoholic solution of iodine, a bottle containing sal volatile, snakebite lancet, bottle of potassium permanganate crystals, scissors, Ointment for burns &amp; surgical antiseptic solution</li> <li>• 1 first aid box should be available per 50 labors</li> <li>• A person trained in first-aid treatment should be made in charge who will always be readily available during an emergency</li> <li>• A suitable motor transport shall be kept readily available to carry injured or ill persons to the nearest hospital.</li> </ul>
<b>Landfilling and Dredging</b>	<ul style="list-style-type: none"> <li>• Residential facilities or sensitive facilities like hospitals, schools etc. shall not be located in the downwind direction of the identified sites for getting landfilling material.</li> <li>• The material used for landfilling should have similar characteristics to the native soil and be free of any type of contamination.</li> </ul> <p>For dredging activity for landfilling purposes:</p> <ul style="list-style-type: none"> <li>• Dredging should not impact natural drainage courses</li> <li>• Dredging sites should be located away from sensitive locations</li> <li>• Permission from the concerned local body should be taken before finalizing the location</li> <li>• The magnitude and frequency of dredging activity should be monitored to avoid impacts on the natural drainage</li> </ul>
<b>Creation of Dyke</b>	<ul style="list-style-type: none"> <li>• Provision for channels at suitable location on the embankment (Dyke) to allow the tidal flow (in and out) to some acceptable volume</li> <li>• Plantation and its maintenance on the buffer zones as shown in the master plan</li> <li>• Effort to plant mangrove species on the Char Land which is likely to be formed on the outer periphery of proposed dyke</li> </ul>
<b>Soil Erosion and Sedimentation control</b>	<ul style="list-style-type: none"> <li>• Contractor should plan the activities so that no naked / loose earth surface is left out before the onset of monsoon.</li> <li>• Topsoil along the roadside should be stripped and kept under covered shed for plantation</li> <li>• After the construction activity is over, topsoil will be utilized for landscaping activity.</li> <li>• To avoid soil compaction along the transportation routes, only identified haul roads would be used for transportation.</li> <li>• Turfing of low embankments and plantation of grasses and shrubs should be done in slope stabilization.</li> <li>• Soil erosion checking measures as the formation of sediment basins, slope drains, etc., should be carried out.</li> </ul>
<b>Disposal of Debris and any waste generated</b>	<ul style="list-style-type: none"> <li>• Waste from construction camp should be segregated at site. Food/wet waste should be composted in pit at the site, recyclable should be sent to recyclers if any and rejected waste should be disposed regularly through responsible agency in the area</li> <li>• Dustbins should be provided at the site and construction camps to prevent littering of waste</li> <li>• Storage area of minimum 2 days should be provided at construction camp for storage of the waste generated from labour camps</li> </ul>

Impact	Mitigation Measures
	<ul style="list-style-type: none"> <li>• Construction debris should also be segregated at the site. This debris should be used for filling to the extent possible. Recyclable waste should be sold in the local markets and reject waste should be sent to the identified debris disposal site</li> <li>• All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary will be considered incidental.</li> <li>• Construction debris should be stored under covered sheds on paved surfaces to prevent leaching</li> <li>• Utmost care shall be taken to ensure safe collection, transport and disposal of construction waste and debris.</li> </ul>
<b>Dust Generation &amp; Air Emission</b>	<ul style="list-style-type: none"> <li>• Vehicles delivering materials should be covered with tarpaulin to reduce spills and dust blowing off the load.</li> <li>• Compaction of the prepared site to re-strain the fugitive emissions.</li> <li>• Water should be sprayed in the cement and earth mixing sites as well as after compaction.</li> <li>• In high dust areas, workers should be provided and encouraged to use masks.</li> <li>• Regular maintenance, servicing of the vehicles and periodic emission checks for equipment and machinery would be carried out in conformity with Schedule 6 – ‘Standards for Emission from Motor’ of The Environment Conservation Rules 1997 (Amended 2002);</li> <li>• Water will be sprayed on the haul road.</li> <li>• All the vehicles entering the project site will be checked for Pollution-Under-Control Certificates.</li> <li>• Air quality monitoring is to be carried out during the construction phase to check the pollutants level in the air</li> </ul>
<b>Procurement &amp; setting up of Crushers, Hot-mix plants, other Vehicles, Equipment and Machinery</b>	<ul style="list-style-type: none"> <li>• Specifications of crushers, hot mix plants and batching plants, other Construction Vehicles, Equipment and Machinery to be procured should comply to the DoE Standards/ norms</li> <li>• Residential facilities or sensitive facilities like hospitals, schools etc. shall not be located in the downwind direction of the identified plant site</li> <li>• Adequate stack height and emission control devices such as bag house filters, cyclone separators, water scrubbers etc., should be attached</li> <li>• An impervious platform for storage of bituminous and other liquid hazardous chemicals</li> <li>• Pollution control measures for Diesel Generator (DG) set i.e. stack height, acoustic enclosure etc.</li> <li>• Provision of readily available first aid kit, and firefighting equipment at the plant site at the appropriate location to respond in case of an accident.</li> <li>• Periodical monitoring of air quality and noise levels as per conditions stipulated under the statutory clearance from DoE. Whenever the emission exceeds the permissible level, the plants should be stopped, and necessary repairing works of faults should be done to bring down the emission levels</li> </ul>
<b>Contamination of soil</b>	<ul style="list-style-type: none"> <li>• Impervious platform and oil and grease trap for the collection of spillages from construction equipment vehicle maintenance platform will be appropriately provided at the construction camp, servicing area and liquid fuel and lubes at storage areas.</li> <li>• Proper management of waste from labor camps and construction site</li> <li>• Proper disposal of wastewater generated from labor camp and construction site</li> </ul>
<b>Contamination of surface &amp; ground water</b>	<ul style="list-style-type: none"> <li>• Car washing/workshops near water bodies will be avoided.</li> <li>• Avoid excavation during the monsoon season</li> <li>• Loosened soil will be stabilized by the Contractor through landscaping and developing vegetation, wherever possible, once construction activity is completed at any site.</li> </ul>

Impact	Mitigation Measures
	<ul style="list-style-type: none"> <li>• Sanitation facility with septic tank followed by soak pit will be developed. Common toilets will be constructed on site during construction phase and the wastewater would be channelized to the septic tanks and soak pits in order to prevent waste water to enter into the water bodies.</li> <li>• Provision of oil &amp; grease traps upstream of storm water drains</li> <li>• Surface run off due to construction activity will not be discharged in open without treatment.</li> </ul>
<b>Loss of water bodies/ surface / ground</b>	<ul style="list-style-type: none"> <li>• No excavation should be carried out from the bund of the water bodies.</li> <li>• No debris disposal should take place near any water body.</li> <li>• Prior written permission from authorities is required for use of water for construction activity.</li> <li>• Construction labors to be restricted from polluting the source or misusing the source.</li> <li>• Labour camps will be located away from water bodies.</li> </ul>
<b>Drainage and runoff</b>	<ul style="list-style-type: none"> <li>• The Contractor will always clear all the cross-drainage structures and natural drainage before onset of the monsoon, in order to keep all drainage, unblocked Earth, stones, wastes, and spoils will be properly disposed of off, to avoid blockage of any drainage channel.</li> <li>• All necessary precautions will be taken to construct temporary or permanent devices to prevent inundation or ponding.</li> </ul>
<b>Noise from Vehicles, Plants and Equipment</b>	<ul style="list-style-type: none"> <li>• Construction activities would be carried out in the daytime only.</li> <li>• The construction equipment would be provided with adequate noise control measures and should comply with the noise standards as prescribed by DoE</li> <li>• Regular maintenance of vehicles and equipment would be carried out and corrective action taken in case of any deviation.</li> <li>• Earmuff/ear plug shall be given to the workers working around or operating plant and machinery emitting high noise levels.</li> <li>• DG sets if installed should be provided with acoustic enclosures</li> <li>• Labour working in noise-prone areas should be provided with ear plugs and job rotation should be practiced to prevent the prolonged exposure of any workers to high noise levels</li> </ul>
<b>Loss or damage to vegetation</b>  <b>Loss, damage, or disruption to fauna</b>	<ul style="list-style-type: none"> <li>• Plantation on the buffer zones as shown in the master plan and monitoring of its survival</li> <li>• The effort to plant mangrove species on the Char Land which is likely to be formed on the outer periphery of the proposed super dyke</li> <li>• Wildlife awareness programs among the workers (during the preconstruction, construction and operation phase) should be conducted. Workers should report a sighting of any uncommon species to the environmental expert, who immediately should inform the incidence to local forest/wildlife authority/ conservationists</li> <li>• Strict instruction to the workers must be passed on, so that they do not harm-catch-kill any wildlife or cut down trees for any reason</li> <li>• Awareness programs on wildlife conservation among the local community should be conducted so that they can also feel the necessity for the conservation of wildlife in the area</li> <li>• No waste shall be discharged into water bodies</li> <li>• The accidental spill management plan should be developed</li> <li>• No infrastructure development activities shall be encouraged close to the river/seashore line</li> <li>• A half-yearly ecological assessment (preferably in winter and monsoon) should be conducted through specialists to record the chronological trend of biodiversity in the project area surrounding</li> </ul>
<b>Accidents</b>	<ul style="list-style-type: none"> <li>• A safety officer should be appointed at the site to ensure all the safety guidelines are being followed on site</li> </ul>

Impact	Mitigation Measures
	<ul style="list-style-type: none"> <li>• Cautionary guidance should be provided at site to aware people about the associated risk with the area. Entry to the fuel storage room or machinery operation room should be restricted only to authorized trainer personnel</li> <li>• All Accidents shall be reported immediately and incident analysis, and preventive measures shall be implemented.</li> </ul>
<b>Clearing of Construction of Camps &amp; Restoration</b>	<ul style="list-style-type: none"> <li>• Contractors shall prepare site restoration plans. The plans shall be implemented before demobilization.</li> <li>• On completion of works, all temporary structures shall be cleared, all rubbish burnt, excreta or other disposal pits or trenches filled in and sealed and the site left clean and tidy.</li> </ul>
<b>Occupational Health &amp; Safety Plan</b>	<ul style="list-style-type: none"> <li>• All construction workers should wear PPEs including safety jacket, helmet, gloves, gum boots, ear plugs, and mask while working at the site</li> <li>• Workers should be made aware about the health issues related with open defecation</li> <li>• Training to workers should be provided for handling the construction equipment and machinery</li> <li>• Training to the workers should be provided to handle the emergencies like fire, floods etc.</li> <li>• A first aid facility and sufficient nos. of trained personnel should be available at all the time at the construction camp</li> <li>• Cautionary signage and notice should be displayed in local language and English at the required places like fuel storage area so that hazards can be avoided. A security guard should be deputed in these areas and entry should be restricted</li> <li>• A register of all toxic chemicals delivered to the site shall be kept and maintained up to date. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.</li> </ul>
<b>Disaster Management</b>	<p>Precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during work.</p>

*Table: Mitigation Measures Suggested for Individual Industries: Development of Industrial Units and Industrial Operation*

Impact	Mitigation Measures During Development (Construction) Phase	Mitigation Measures During Operation Phase
Air Pollution	<ul style="list-style-type: none"> <li>• A sprinkling of water during construction phase on all unpaved roads, site and haul roads</li> <li>• Avoiding excess piling of raw material and debris at site</li> <li>• Storage &amp; transportation of raw material and debris in covered conditions</li> <li>• Regular cleaning of site</li> <li>• Provision of adequate parking space at site to prevent idling of vehicles during construction phase</li> <li>• Up keeping and maintenance of all the construction vehicles, machinery and equipment used for construction purpose</li> <li>• Guiding signage should be provided at the site for vehicles entering the site to minimize the movement of vehicle within the site</li> <li>• Timings of the construction material vehicles should be fixed and should be during non-peak hours to prevent traffic congestion and traffic jams</li> <li>• Construction vehicles should follow the speed limits as set up for EZ zone</li> <li>• Usage of low energy intensive building material like fly ash mix cement and bricks</li> <li>• Usage of low Sulphur diesel for running DG sets, construction vehicles and equipments</li> <li>• Open burning of wood or any other material should be prohibited at site and all the workers should be made aware about the same</li> </ul>	<ul style="list-style-type: none"> <li>• Installation of air pollution control devices like Electro-static precipitators, bag filters, separators, cyclones, multi-level condensers &amp; evaporators, scrubbers, quenchers, stacks of height as per DoE norms</li> <li>• Disposal of the waste material at the designated site for waste disposal in covered condition</li> <li>• All the roads within the plot should be paved &amp; water sprinkling should be practiced minimizing dust generation.</li> <li>• Adequate stack height should be provided for dispersion of the emissions</li> <li>• Chemicals having potential to release VOCs should be stored, handled and used in closed system</li> <li>• Quarterly monitoring should be carried out for testing ambient air quality</li> <li>• Development of thick green belt of 10 m width all along the industrial plot periphery</li> </ul>
Water Pollution & water Conservation	<ul style="list-style-type: none"> <li>• Minimizing the run-off from the site by construction of temporary storm water drainage, sediment basins for collection of storm run-off and re-using that water for curing purpose and wheel washing</li> <li>• Curing of structures to be done by spraying and during early morning and evening hours only to minimize the water requirement</li> <li>• Maintaining the flow of water sprinklers so as to avoid wastage of water and ponding of water</li> <li>• No debris should be thrown or disposed off in any water body like river, pond, canal etc. or ground water source like functional or abandoned well</li> <li>• Excavation should not be carried out during monsoon</li> </ul>	<ul style="list-style-type: none"> <li>• Separation of the effluent streams depending on the nature of pollutants and connecting it to EZ's sewage/effluent network</li> <li>• Monitoring the quality of sewage, treated water, drinking water quality and ground water quality regularly</li> <li>• Tank alarms should be installed so as to prevent idle running of pumps</li> <li>• Provision of storm water drainage system at site and it should be connected to rainwater harvesting system. Storm water drains should also be connected to storm water drainage of EZ</li> <li>• Provision of rainwater harvesting system so that water can be collected and used to meet daily water demand.</li> <li>• Provision of oil &amp; grease traps with the storm water drains draining the parking and fuel storage area</li> </ul>



Impact	Mitigation Measures During Development (Construction) Phase	Mitigation Measures During Operation Phase
	<ul style="list-style-type: none"> <li>• Excavated pits should be provided with garland drains to prevent entrance of water inside the pit</li> <li>• Provision of septic tanks and soak pits at the site for disposal of sewage generated by construction labour</li> <li>• Waste generated during construction should be disposed off regularly at the identified site for debris disposal</li> </ul>	<ul style="list-style-type: none"> <li>• Leakage detection system should be provided, and the water supply system should be regularly inspected to detect leakages</li> <li>• Untreated effluent should not be discharged in open areas</li> <li>• No hazardous waste, municipal waste, industrial waste should be disposed off in the water bodies or in ground</li> <li>• Leachates, if any or untreated sewage should be stored only in lined ponds to prevent contamination of ground water</li> </ul>
Soil Quality	<ul style="list-style-type: none"> <li>• Topsoil, if excavated from the project site should be stored in covered condition and should be used later for landscaping purpose</li> <li>• Storage of raw materials, debris and fuel on paved surfaces</li> <li>• Training the workers to handle the material so as to minimize spillage of material on soil</li> <li>• Disposal of construction debris, municipal waste and hazardous waste at designated sites</li> </ul>	<ul style="list-style-type: none"> <li>• All industries should use best technologies for optimal utilization of the raw material and re-use &amp; recycling of waste material in the process to reduce waste generation as well as raw material demand for the project.</li> <li>• All industries should be responsible for management of the solid and hazardous waste generated from their plots. Industries should be liable to pay penalty in case of noncompliance of conditions laid down by DoE</li> <li>• It should be mandatory for all industries to provide storages for different category waste, its processing and safe disposal. Options for composting of compostable waste, segregation and selling recyclable waste should be opted</li> <li>• Waste storage area should be paved surfaces and covered</li> <li>• No open area should be left without the vegetation to protect the soil.</li> <li>• Hazardous Waste should be stored in designated area and should be disposed as per the best industrial practice.</li> </ul>
Noise Pollution	<ul style="list-style-type: none"> <li>• Construction vehicles, machinery and equipment used for construction purpose should meet the standards prescribed by DoE</li> <li>• Up keeping and regular maintenance of all the construction vehicles, machinery and equipment used for construction purpose</li> <li>• Speed limits should be restricted for all construction vehicles and equipment</li> <li>• Honking should be prohibited at the site</li> <li>• Provision of acoustic enclosures, noise mufflers, silencers etc. with the DG sets and any noise generating machinery</li> <li>• Provision of temporary noise shield/barrier in areas where more noise will be generated</li> </ul>	<ul style="list-style-type: none"> <li>• Usage of machineries of modern make and adoption of latest available technology which complies to noise levels standards laid by DoE</li> <li>• Provision of personal protective equipment to workers exposed to noisy operations. Audiometric tests should be carried out for workers exposed to high noise levels. Job rotation should be practiced preventing continual exposure.</li> <li>• Noise levels in industries should be monitored regularly using noise meters.</li> <li>• Minimal usage of horns within industrial plot.</li> <li>• Regular maintenance of vehicles &amp; construction machinery involved in industrial operation</li> <li>• Noisy operation should be taken up in covered conditions so that no disturbance due to noise is caused</li> <li>• Thick green belt should be developed within each industrial plot that will act as noise barrier.</li> </ul>

Impact	Mitigation Measures During Development (Construction) Phase	Mitigation Measures During Operation Phase
Ecology	<ul style="list-style-type: none"> <li>• Plantation should be carried out within individual industrial plots</li> <li>• Native plant species should be considered for plantation</li> <li>• Timber should be purchased only from authorized vendors</li> </ul>	<ul style="list-style-type: none"> <li>• Green belt of 10 m thickness should be developed all along the periphery of the industrial plot</li> <li>• Native plant species requiring should be considered for plantation</li> </ul>
Socio-economy and aesthetics	<ul style="list-style-type: none"> <li>• All proposed air, water, noise and soil pollution control measures should be taken</li> <li>• Provision of employment opportunity during construction phase to local people</li> <li>• Provision of personal protective equipment to all the workers</li> <li>• Job rotation should be practiced for workers exposed to high noise levels</li> <li>• Site should be covered from all the site during construction phase</li> <li>• Drinking water facility, adequate nos. of toilet, septic tank/soak pit, bathing facility, lighting should be provided for construction labour</li> <li>• Storm water drainage system should also be provided at site to prevent water ponding and breeding of mosquitoes</li> </ul>	<ul style="list-style-type: none"> <li>• Social welfare activities shall be carried out by each industrial owners in nearby areas of EZ like development of cattle sheds, arranging trainings for villagers for best agriculture practices, providing skill generation training to locals so as they can be employed in industries</li> <li>• Providing employment to local people preferably</li> <li>• Adoption of adequate air, noise, soil and water quality measures</li> </ul>
Disaster and Risk Management	<ul style="list-style-type: none"> <li>• Provision of first aid kit and first aid room and well trained first aid practitioner at the site all the time</li> <li>• Ambulance facility should be provided at the site</li> <li>• Tie-ups with local hospital should be made to handling emergency case, if any</li> <li>• Availability of safety officers and supervisors at all the time on the site</li> <li>• Workers should be given training for handling construction vehicles, equipment and handling emergency situations like fire, floods, earthquake and cyclone</li> <li>• Cautionary signage should be provided in the areas associated with risks like storage of explosives, fuels, heavy construction material etc. Entry for only trained authorized personnel should be allowed in such areas with adequate safety measures</li> <li>• Emergency handling cell &amp; room should be developed at the site and should be headed by project &amp; safety manager</li> <li>• Contact no. of nearest fire-station and hospitals should be displayed within the emergency handling room</li> </ul>	<ul style="list-style-type: none"> <li>• Provision of first aid kits at the site</li> <li>• Tie-ups with local hospital should be made to handling emergency case, if any</li> <li>• Regular medical check-ups of the employees</li> <li>• Training should be given to workers for handling the equipment and managing emergency situations</li> <li>• Material safety data sheets of chemicals to be used should be displayed on local languages at workstation</li> <li>• Provision of personal protective equipment to the workers as per requirement</li> <li>• Cautionary signage should be provided in the areas associated with risks like storage of chemicals, explosives, fuels etc. Entry for only trained authorized personnel should be allowed in such areas with adequate safety measures</li> </ul>

## ***Environmental Management Plan (EMP)***

The Environmental Management Plan (EMP) is the synthesis of all proposed mitigation and monitoring actions, set to a time frame with specific responsibility assigned and follow-up actions defined. EMP is a plan of actions for avoidance, mitigation and management of the negative impacts of the project. Environmental enhancement is also an important component of EMP. A detailed set of mitigation measures have been compiled in view of the likely impacts associated with the proposed off-site development in Feni EZ.

The EMP consists of a set of mitigation, monitoring and institutional measures to be taken during the design, construction and operation (post-construction) stages of the project. Besides EMP, Plan for Environmental Enhancement (covering green belt development, Community Development etc.) and Emergency Preparedness Plan has also been developed.

### **Monitoring Plan**

The objective of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and for the protection of the surrounding environment. To monitor the extent of environmental impact of the proposed EZ and proposed industries, it is advisable to periodically monitor the ambient environmental quality around the project location. Monitoring plan describes need for the environmental quality monitoring detailing number and location of sampling stations, parameters to be monitored, frequency of sampling, etc. The EZ authorities has to submit all the monitoring results to DoE, Bangladesh.

*Table: Environmental Monitoring Plan*

<b>S. No.</b>	<b>Aspect</b>	<b>Source of Impact</b>	<b>Monitoring Methods and Parameters</b>	<b>Frequency</b>	<b>Executing Agency</b>	<b>Enforcement Agency</b>
<b>1.0</b>	<b>Preconstruction and Construction Phase</b>					
1.1	Local Manpower Absorption	Construction Works	Contractor's report No. of people working in the project	Monthly	Contractor	BEZA
1.2	Soil Erosion	Excavation, disposal, cut & fill and site preparation activities for site levelling and internal roads, disposal	Survey & observation; Extent and degree of erosion; Structures for controlling soil erosion	Monthly	Contractor	BEZA
1.3	Greenbelt Development	-	Survival rate of species planted; Density of vegetation	Half Yearly	Contractor	BEZA
1.4	Air Quality	Transportation of construction materials, road construction, construction of utilities	as referred in 'Monitoring Indicator' section	Once in each season for two weeks at 2-3 locations	Contractor	BEZA
1.5	Waste Management	Restoration of disposal sites and construction areas	Status of protection measures	Weekly	Contractors	BEZA
1.6	Noise Level	various construction/site preparation work	as referred in 'Monitoring Indicator' section	Daily at 6-8 locations	Contractors	BEZA

S. No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency	Executing Agency	Enforcement Agency
1.7	Ground/Drinking Water	Accidental contamination	as referred in 'Monitoring Indicator' section	Monthly at 1 location	Contractor	BEZA
1.8	Surface Water	Transportation of construction materials, various construction works, runoff from camp	All physio-chemical & biological parameters	Quarterly at suitable locations	Contractor	BEZA
1.9	Soil	Accidental contamination	as referred in 'Monitoring Indicator' section	Quarterly at 1 location	Contractor	BEZA
1.10	Ecological Assessment of surrounding area covering terrestrial and marine ecosystem	Various construction activity	Status of floral & Faunal community, Species richness, species diversity,	6 monthly (winter and monsoon)	Contractor	BEZA
<b>2.0</b>	<b>Operation Phase</b>					
2.1	Noise Levels	Noise levels compliance with respect to industrial standards	as referred in 'Monitoring Indicator' section	Daily at adequate locations for individual units	Individual Industrial Units	BEZA
			as referred in 'Monitoring Indicator' section	Daily at 6-8 locations covering Plant periphery, residential area (inside EZ and in the vicinity) and near noise generation sources	BEZA	BEZA
2.2	Biological Environment	Horticulture/Greenbelt Development	Survival rate of plants and shrubs	Quarterly	BEZA	BEZA
			Survival rate of plants and shrubs at individual unit	Quarterly	Individual unit	BEZA
2.3	Ambient air quality	Ambient air quality levels compliance with respect to industrial standards	as referred in 'Monitoring Indicator' section	Daily at adequate (2-4 points) locations for individual units	Individual Industrial Units	BEZA
		Ambient air quality levels		Daily at 2-3 locations covering Plant periphery, residential area (inside EZ and in the vicinity) and pollution generating sources	BEZA	BEZA
2.4	Ground /Drinking water quality	water quality levels compliance with respect to industrial standards	Bore-wells installed/ Drinking water source at site (All physio-chemical &	Monthly	Individual Industrial Units/BEZA	BEZA
				Quarterly	BEZA	BEZA

S. No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency	Executing Agency	Enforcement Agency
			biological parameters)			
2.5	Surface water quality	To cross check accidental contamination	Nearby surface water resource (All physio-chemical & biological parameters)	Quarterly	BEZA	BEZA
2.6	Soil Erosion	River/water body	Survey & observation;	Monthly	BEZA	BEZA
2.7	Ecological Assessment of surrounding area covering terrestrial and marine ecosystem	Various industrial operation and traffic	Status of floral & Faunal community, Species richness, species diversity,	6 monthly (winter and monsoon)	BEZA	BEZA

# ***1. Introduction***

## ***1.1. Project Background***

The government of Bangladesh has envisaged organized industrialization for the country, which can help its competitiveness by encouraging investment from global manufacturers across sectors. The EZ model has been adopted and pushed to encourage industrialization in an organized manner, which can help the country gain a stronger foothold in manufacturing and diversify its export basket, which has been relying on the readymade garments sector (RMG).

GoB has adopted a proactive approach to promulgate investment within the country and foster organized industrialization. In tandem with this initiative, the economic zone (EZ) regime was ushered in, and Bangladesh Economic Zones Authority (BEZA) was conceptualized. BEZA is the nodal agency mandated for economic zone development in the country. BEZA in support of World Bank is implementing a Private Sector Development Support Project (PSDSP) to upkeep pilot EZ projects under the new EZ regime.

As part of this scheme, pre-feasibility studies for various sites for locating economic zones were undertaken of which, Feni being one of them. This assignment is in succession to the earlier studies, capturing the Environmental and Social Impact Assessment (ESIA) study for the Feni Economic Zone. The purpose of conducting the ESIA study is to carry out an assessment of the proposed projects to determine the magnitude of positive and negative impact likely to be caused by the proposed development and associated activities considering environmental, social, cultural, economic and legal considerations and to develop necessary plan to mitigate the negative impacts towards safeguarding environmental and social concerns.

PricewaterhouseCoopers Pvt. Ltd. (PwC) has been appointed by Bangladesh Economic Zones Authority (BEZA) to undertake an Environmental and Social Impact Assessment for Feni Economic Zone, Bangladesh. The report is pertaining to Environmental Impact Assessment (EIA).

## ***1.2. Project Site***

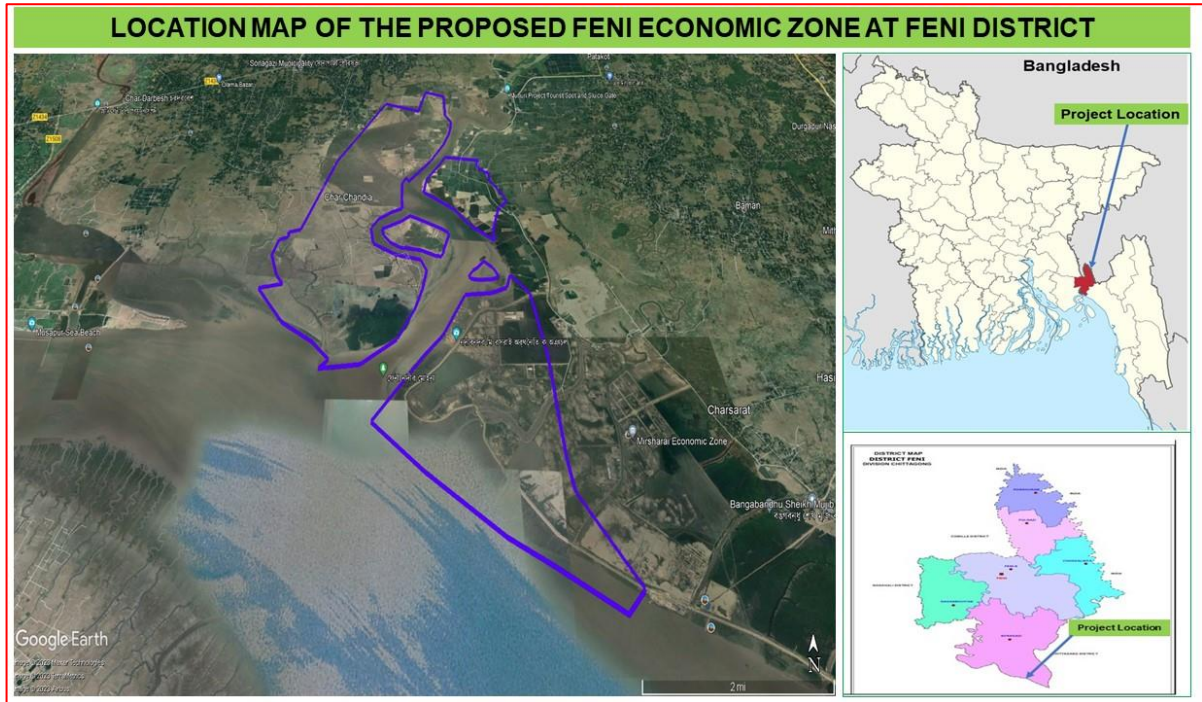
The proposed EZ is located in Sonagazi Upazila, Feni district of Chattogram division. Chattogram division, located in the southeastern part of the country is geographically the largest division of Bangladesh with industrial city of Chattogram being the primary driver of the division's economy. Chattogram division contributes to ~18.9% of overall GDP of the country and it houses various industrial units. Owing to the presence of Bangladesh's most important seaport, Chattogram Sea Port, this division has seen rapid industrialization with steel re-rolling mills, cement plants and other trade dependent industries being established in this area. Chattogram division has 11 districts (zilas) and 99 sub-districts (Upazilas).

Feni district is located in the middle of Chattogram division and shares border with India to its north and Bay of Bengal to its South. The following surround it –

- Comilla district – North-West
- India – North & East
- Chattogram district – South-East
- Sandwip Channel (Bay of Bengal) – South
- Noakhali - West

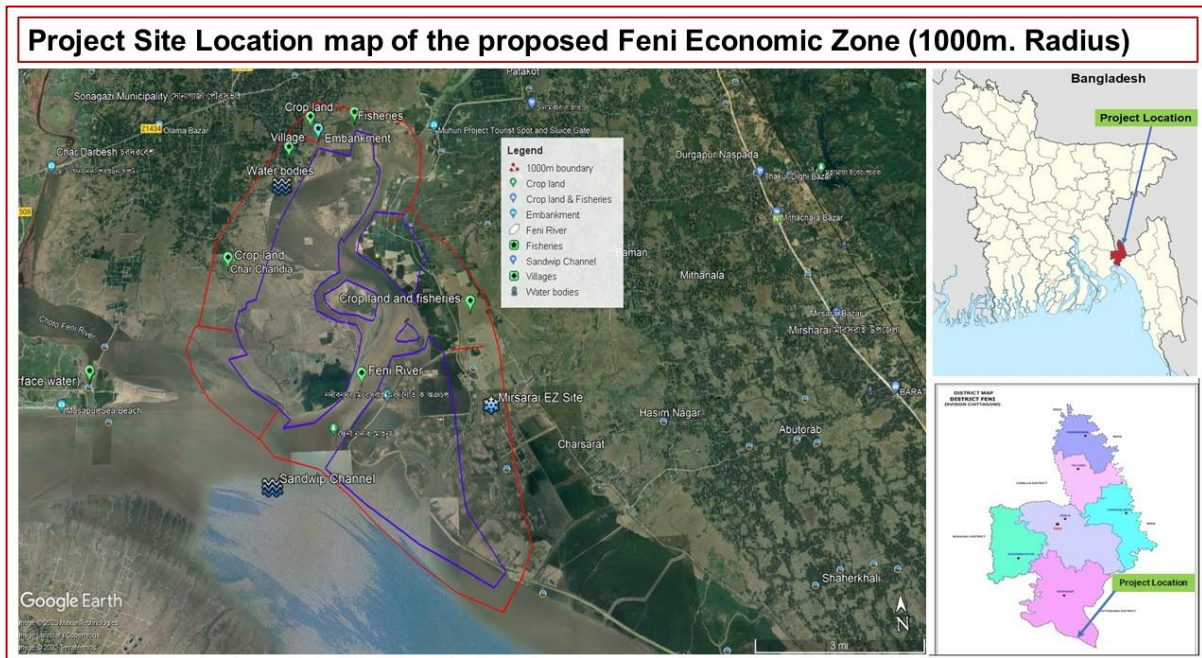
Feni district comprises 6 upazilas; proposed EZ is located in Sonagazi upazila.

Figure 3: Location of the Feni Economic Zone (Chattogram Division - Feni District - Sonagazi Upazila)



Source: Google earth

Figure 4: Project Site location map of the Feni EZ (1000m radius)



Source: Google earth

*Table 1: Snapshot of proposed EZ site*

<b>Parameters</b>		<b>Details</b>
<b>Site co-ordinates</b>		22°47'56.05"N, 91°26'45.04"E;  22°47'5.24"N, 91°22'48.94"E;  22°45'19.69"N, 91°27'14.22"E;  22°50'6.14"N, 91°25'56.84"E;
<b>Site Boundaries</b>	East	Proposed Mirsarai EZ (also within BSMSN)
	West	Proposed 100 MW Wind & 100 MW Solar power plants to be constructed by Electricity Generation Company of Bangladesh (EGCB), occupying 999.65 acres of land
	North	Muhuri Irrigation Project Dam
	South	Sandwip Channel; Bay of Bengal
<b>Total area of the EZ</b>		9,549.61 acres
<b>Connectivity &amp; linkage</b>		Dhaka – Chittagong highway by accessing Feni-Sonagazi Zilla Road, Z1034  The main connectivity to this EZ will be proposed Sheikh Hasina Avenue and the Mirsarai EZ of Bangabandhu Sheikh Mujib Shilpanagar (BSMSN)

*Source: PwC analysis*

Location of Proposed site is shown on google map in the following figure.

*Figure 5: Location of the proposed EZ on Google Earth*



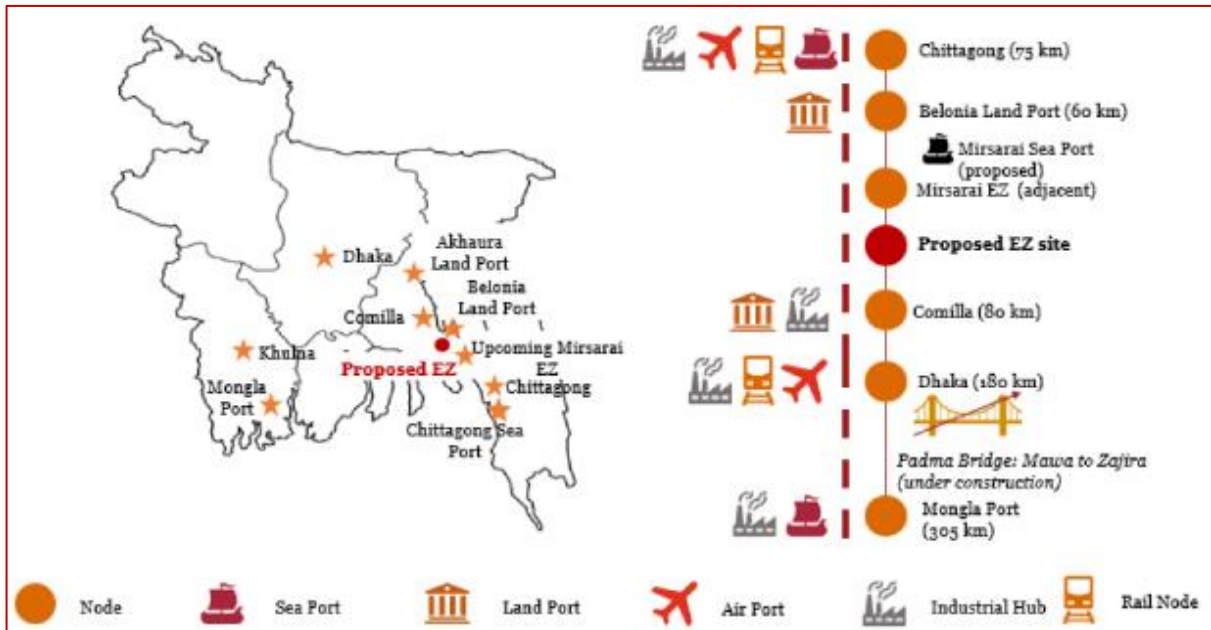


Source: Analysis of data from Draft Masterplan of BSMSN

### ***Transport Infrastructure in Proximity of Proposed EZ Site***

For any location to shape up as a potential EZ, access to multimodal connectivity is an important feature. Figure below depicts the site location juxtaposed with major trade gateways, industrial nodes, and transport infrastructure near the proposed EZ site.

Figure 6: Transport infrastructure in proximity of proposed EZ site



Source: Information obtained from site visit, Google Map, and PuC Analysis

Figure above elucidates that the proposed EZ is in proximity to Belonia Land Port, Comilla and upcoming EZ at Mirsarai. It is also located near the transit route from Dhaka to Chittagong. The locational advantage of proposed EZ site is expected to give a fillip to the industries which would be established at proposed EZ site.

### 1.3. Rationale for the Proposed Project

Bangladesh's economic landscape is evolving. Its' performance on several macro-economic factors is improving. This reflects the country's economic health, perception of investors, and the advantages of the country from an economic perspective.

- Bangladesh is gradually shaping as the next prominent investment destination in South Asia. The country has evolved into an attractive destination for manufacturing industry in recent years due to various reasons such as availability of cheap and trainable labour, low cost of land, various favourable trade treaties of Bangladesh with major economies such as US and EU, liberal FDI regime, and government's efforts to develop the industrial sector.
- Bangladesh has been exhibiting a growth trend of GDP, Exports and FDI. The country has easy availability of skilled or trainable cheap labour. Thus, the manufacturing sector holds huge growth potential in Bangladesh. The manufacturing sector is expected to play a key role in the development of the country and to lead the country from the status of developing nation to a developed nation in the coming future, in line with the country's goal for 2041.
- Government of Bangladesh is focused on increasing industrial proliferation within the country and it is undertaking various measures such as policy reforms and infrastructure development projects to support the increase in share of manufacturing from 28% at present to 37% by 2021 as per the Vision 2021 perspective plan of the country.
- Bangladesh has embarked into an ambitious journey of promoting the manufacturing sector in the country through several initiatives promoting organized industrialization to achieve inclusive growth.
- Organized industrialization in Bangladesh is majorly concentrated on the development of industrial clusters dedicated to exports (Export Processing Zones) and dedicated to overall industrial development (Economic Zones).

- Development of Economic Zones in the country is expected to play a key role in improving the business environment of Bangladesh. Economic Zones facilitates organized industrialization, with provisions for development of backward linkages, and an industrial ecosystem with all the required utilities and amenities.

## ***1.4. Scope and Methodology of the Study***

The scope and proposed methodology for carrying out the EIA of the proposed site are:

- Identification and review of applicable local, state, national and international environmental and social regulatory and institutional frameworks.
- Establishment of environmental baseline conditions of the site and surrounding area through the following:
  - Detailed surveys to observe environmental characteristics of the project area.
  - Discussions with the stakeholders and identification key issues during planning, construction and operation phase of the project.
  - Baseline data collection of the site and project area with respect to water and soil quality, ambient air and noise quality, environmental hazards and
  - Ecological assessment on flora and fauna of the site and project area through secondary data collection.
- Assessment of the socio-economic environment through collation of secondary information of the site, supplemented by consultations with the local communities to understand community perception regarding the project and its activities.
- Preparation of the EIA report which includes:
  - Project Description describing the proposed project and its geographic, ecological, social, health and temporal context, including any related facilities that may be required.
  - Applicable Environmental Regulatory Framework including host country regulations, obligations for implementing relevant international social and environmental treaties, agreements, and conventions and policies.
  - Environmental Baseline Conditions on the basis of the above-identified parameters to understand the profile of the area and describe relevant physical, biological, health and labour conditions in the project area of influence.
  - Impact Assessment and proposal for mitigation measures for environmental and social components for pre-construction/construction and operation phases to minimize the adverse impacts; and
  - Preparation of an Environmental Management Plan (EMP) and Management System which includes the following:
    - Mitigations for adverse environmental impacts and associated risks.
    - Institutional arrangement - management tools and techniques for the implementation of environmental impacts and risk mitigations.
    - Monitoring and reporting of requirements and mechanisms for the effective implementation of the suggested mitigations; and
    - Preparation of EMP.

## ***1.5. Limitation of the Study***

The present EIA Report has been prepared based on the Primary field investigations / assessment, and secondary data from data collected from Department of Public Health and Engineering (DPHE), Bangladesh Meteorological Department (BMD), Department of Environment, Bangladesh (DoE) and published journals - reports, public consultation, and site observations. The environmental assessment is based on the information collected from the various Agencies, community consultations and observations. Professional judgement and subjective interpretation of facts and observations has been applied for the preparation of the EIA Report.

## ***1.6. EIA Team***

A multidisciplinary team of professionals having experience of conducting Environment & Social Impact Assessment Studies for infrastructure development projects like Industrial Parks, Industrial Areas, Economic Zones, Area development etc. was involved in carrying out EIA study for this project. Details of the experts engaged in the assignment are given in the table below.

Table 2: EIA Team

Name of Professional	Position Assigned	Year of Relevant Experience
Deepak Malik	Team Leader	25+ Years
Satyajit Ray	Environmental Expert	12 + Years
Dr. Munir Ahmed	Ecology Expert	35 + Years
Md Abul Hashem	Environmental and Social Specialist	22+ Years
Ahmed Faruque	Environmental and Social Professional	5+ Years
Sabrina Mehzabin	Environmental Professional	0.6+ Years

## 1.7. ToR Compliance Matrix

The EIA study has been conducted following the approved ToR issued by DOE vide Memo No. 22.02.0000.018.72.013.20.38 Dated 09/02/2020. Below Table presents the point-wise compliance of the issued ToR. ToR issued by DOE is furnished in **Appendix A**.

Table 3: Compliance to DoE ToR

S. No.	ToR Points	Compliance
<b>I</b>	The project authority shall conduct a comprehensive Environmental Impact Assessment (EIA) study considering the overall activity of the said project in accordance with this ToR and following additional suggestions	EIA study has been carried out in line with the ToR Approved by DoE
<b>II</b>	The EIA Report should be prepared in accordance with following indicative outlines:	EIA Report has been prepared in accordance to the outline given in ToR
-	Executive Summary	Refer Executive Summary
<b>1</b>	Introduction: (background, brief description, rationale of the project, scope of study, methodology, limitation, EIA team, references)	Refer Chapter 1
<b>2</b>	Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)	Refer Chapter 2
<b>3</b>	Project Description	Refer Chapter 3
<b>i</b>	Introduction	Section 3.1.
<b>ii</b>	Project objective	Section 3.2.
<b>iii</b>	Project options	Section 3.3.
<b>iv</b>	Interventions under selected options	Section 3.4.
<b>v</b>	Project activities: A list of the main project activities to be undertaken during site clearing, construction as well as operation	Section 3.5
<b>vi</b>	Project Schedule: Phase and timing for development of Project	Section 3.6.
<b>vii</b>	Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project	Section 3.5.1. , 3.5.2, and Section 3.7
<b>viii</b>	Map and survey information Location map, cadastral map showing land plots (project and adjacent area), geological map showing geological units, fault zone, and other natural features	Section 3.8.
<b>ix</b>	Project Plan, Design Standard, Specification, Quantification etc.	Section 3.9
<b>4.</b>	Environmental and Social Baseline	Refer Chapter 4
<b>4.1.</b>	Meteorology	Section 4.3.1.
<b>4.1.1.</b>	Temperature	Section 4.3.1.1.
<b>4.1.2.</b>	Humidity	Section 4.3.1.2.
<b>4.1.3.</b>	Rainfall	Section 4.3.1.3.
<b>4.1.4.</b>	Evaporation	Section 4.3.1.4.
<b>4.1.5.</b>	Wind Speed	Section 4.3.1.5.

<b>S. No.</b>	<b>ToR Points</b>	<b>Compliance</b>
<b>4.1.6.</b>	Sunshine hours	Section 4.3.1.6.
<b>4.2.</b>	Air Quality & Noise	Section 4.3.2.
<b>4.2.1</b>	Ambient Air Quality of the project site with respect to Standards of ECR,1997	Section 4.3.2.1.
<b>4.2.2</b>	Ambient Noise Level of the project site with respect to Standards of Noise Pollution (Control) Rules, 2006	Section 4.3.2.2.
<b>4.2.3.</b>	Air Pollutant and noise sources from existing and known source	Section 4.3.2.3
<b>4.3.</b>	Water Resources	Section 4.3.3.
<b>4.3.1.</b>	Surface Water System	Section 4.3.3.1. and 4.3.3.8.
<b>4.3.2.</b>	Tropical cyclones and Tidal Flooding	Section 4.3.3.2.
<b>4.3.3.</b>	Salinity	Section 4.3.3.3.
<b>4.3.4.</b>	Drainage Congestion and Water Logging	Section 4.3.3.4.
<b>4.3.5.</b>	Erosion and Sedimentation	Section 4.3.3.5.
<b>4.3.6.</b>	River Morphology	Section 4.3.3.6.
<b>4.3.7.</b>	Navigation	Section 4.3.3.7.
<b>4.3.8.</b>	Ground Water System	Section 4.3.3.9. and 4.3.3.10.
<b>4.4.</b>	Land Resources	Section 4.3.4.
<b>4.4.1.</b>	Agroecological Regions	Section 4.3.4.2.
<b>4.4.2.</b>	Land Types	Section 4.3.4.3.
<b>4.4.3.</b>	Soil Texture	Section 4.3.4.5.
<b>4.4.4.</b>	Land Use	Section 4.3.4.1.
<b>4.5.</b>	Agriculture Resources	Section 4.3.5.
<b>4.5.1.</b>	Farming Practice	Section 4.3.5.1.
<b>4.5.2.</b>	Cropping Pattern and Intensity	Section 4.3.5.2.
<b>4.5.3.</b>	Cropped Area	Section 4.3.5.3.
<b>4.5.4.</b>	Crop Production	Section 4.3.5.3.
<b>4.5.5.</b>	Crop Damage	Section 4.3.5.4.
<b>4.5.6.</b>	Main Constraints of Crop Production	Section 4.3.5.4.
<b>4.6.</b>	Livestock and Poultry	Section 4.3.6.
<b>4.6.1.</b>	Feed and Fodder Shortage	Section 4.3.6.1.
<b>4.6.2.</b>	Livestock/Poultry Diseases	Section 4.3.6.2.
<b>4.7.</b>	Fisheries	Section 4.3.7.
<b>4.7.1.</b>	Introduction	Section 4.3.7.1.
<b>4.7.2.</b>	Problem and Issues	Section 4.3.7.5.
<b>4.7.3.</b>	Habitat Description	Section 4.3.7.2.
<b>4.7.4.</b>	Fish Production and Effort	Section 4.3.7.3.
<b>4.7.5.</b>	Fish Migration	Section 4.3.7.4.
<b>4.7.6.</b>	Fish Biodiversity	Section 4.3.7.4.
<b>4.7.7.</b>	Fisheries Management	Section 4.3.7.5.
<b>4.8.</b>	Ecological Resources	Section 4.3.8.
<b>4.8.1.</b>	Bio-ecological Zone/Protected Areas	Section 4.3.8.1.
<b>4.8.2.</b>	Common Flora and Fauna	Section 4.3.8.3.
<b>4.8.3.</b>	Ecosystem Services and Function	Section 4.3.8.4.
<b>4.9.</b>	Socio Economic Condition	Section 4.3.9.
<b>4.9.1.</b>	Socio Economic Condition	Section 4.3.9.1.
<b>4.9.2.</b>	Quality of Life Indicators	Section 4.3.9.5.
<b>4.9.3.</b>	Income and Poverty	Section 4.3.9.6.
<b>4.9.4.</b>	Gender and Women	Section 4.3.9.
<b>4.9.5.</b>	Common Property Resources	Section 4.3.9.7.
<b>4.9.6.</b>	Conflict of Interest and Law and Order Situation	Section 4.3.9.8.
<b>4.9.7.</b>	Historical, Cultural and Archaeological Sites	Section 4.3.9.9.
<b>5</b>	Identification and Analysis of Key Environmental Issues (Analysis shall be presented with Scenarios, Maps, Graphics, etc. for the Case of Anticipated Impacts on Baseline)	Refer Chapter 5
<b>5.1</b>	Environmental Sensitivity Investigation	Section 5.1.
<b>5.2</b>	Environmental Asset	Section 5.2.
<b>5.3</b>	Environmental Hot Spots	Section 5.3.
<b>5.4</b>	Likely Beneficial Impacts	Section 5.4.
<b>5.5</b>	Community Recommendations	Section 5.5.
<b>5.6</b>	Alternate Analysis	Section 5.6.
<b>6.</b>	Environmental and Social Impacts	Refer Chapter 6
<b>6.1.</b>	Introduction	Section 6.1.

S. No.	ToR Points	Compliance
<b>6.2.</b>	Impact on Air Quality and Noise	Section 6.3. and 6.4
<b>6.2.1.</b>	Pre-construction Phase	Section 6.3. and 6.4
<b>6.2.2.</b>	Construction Phase	Section 6.3. and 6.4
<b>6.2.3.</b>	Post-construction Phase	Section 6.3. and 6.4
<b>6.3.</b>	Impact on Water Resources	Section 6.5.
<b>6.3.1.</b>	Pre-construction Phase	Section 6.5.
<b>6.3.2.</b>	Construction Phase	Section 6.5.
<b>6.3.3.</b>	Post-construction Phase	Section 6.5.
<b>6.4.</b>	Impact on Land Resources	Section 6.6.
<b>6.4.1.</b>	Pre-construction Phase	Section 6.6.
<b>6.4.2.</b>	Construction Phase	Section 6.6.
<b>6.4.3.</b>	Post-construction Phase/Operation	Section 6.6.
<b>6.5.</b>	Impact on Agriculture Resources	Section 6.9.
<b>6.5.1.</b>	Pre-construction Phase	Section 6.9.
<b>6.5.2.</b>	Construction Phase	Section 6.9.
<b>6.5.3.</b>	Post-construction Phase	Section 6.9.
<b>6.6.</b>	Impact on Fisheries	Section 6.10.
<b>6.6.1.</b>	Pre-construction Phase	Section 6.10.
<b>6.6.2.</b>	Construction Phase	Section 6.10.
<b>6.6.3.</b>	Post-construction Phase	Section 6.10.
<b>6.7.</b>	Impact on Ecosystem	Section 6.11.
<b>6.7.1.</b>	Pre-construction Phase	Section 6.11.
<b>6.7.2.</b>	Construction Phase	Section 6.11.
<b>6.7.3.</b>	Post-construction Phase	Section 6.11.
<b>6.8.</b>	Socio Economic Impact	Section 6.12.
<b>6.8.1.</b>	Pre-construction Phase	Section 6.12.
<b>6.8.2.</b>	Construction Phase	Section 6.12.
<b>6.8.3.</b>	Post-construction Phase	Section 6.12.
<b>7.</b>	Public Consultation and Disclosure	Refer Chapter 7
<b>7.1.</b>	Introduction	Section 7.1.
<b>7.2.</b>	Objectives of Public Consultation and Disclosure Meeting	Section 7.2.
<b>7.3.</b>	Approach and Methodology of Public Consultation and Disclosure Meeting	Section 7.3.
<b>7.4.</b>	Public Consultation Meetings (PCMs)	Section 7.4.1. and 7.4.2.
<b>7.5.</b>	Public Disclosure Meetings (PDMs)	Section 7.4.1. and 7.4.2.
<b>8.</b>	Environmental Management Plan and Monitoring Indicators	Refer Chapter 8
<b>8.1.</b>	Introduction	Refer Section 8.1.
<b>8.2.</b>	Mitigation Plan	Refer Section 8.2.
<b>8.3.</b>	Enhancement Plan	Refer Section 8.3.
<b>8.4.</b>	Contingency Plan	Refer Section 8.4.
<b>8.5.</b>	Compensation Plan	Refer Section 8.8.
<b>8.6.</b>	Monitoring Plan	Refer Section 8.7.
<b>8.7.</b>	Monitoring Indicators	Refer Section 8.6.
<b>9.</b>	Cost Estimation for Environmental Mitigation Measures and Monitoring	Refer Chapter 9
<b>10.</b>	Emergency Response Plan and Disaster Impact Assessment	Refer Chapter 10
<b>11.</b>	Conclusions and Recommendations	Refer Chapter 11
<b>III</b>	Without obtaining approval of EIA report by the Department of Environment, the Project authority shall not be allowed to conduct earth filling or any kind of physical intervention in the proposed project site and also not be able to start the physical activity of the project.	Agreed
<b>IV</b>	This approval of the Terms of Reference (ToR) would not mean any acceptance or site clearance of the Project.	Agreed
<b>V</b>	The proposed EIA study would not establish any claim, right in favour of the proponent for getting site clearance or environmental clearance.	Agreed
<b>VI.</b>	Without obtaining Environmental Clearance, the project authority shall not be able to start the operation of the project.	Agreed
<b>VII.</b>	The project authority shall submit the EIA along with -	Submitted separately

S. No.	ToR Points	Compliance
	<ul style="list-style-type: none"> <li>the filled in application for Environmental Clearance in prescribed form,</li> <li>the feasibility study report,</li> <li>the applicable environmental clearance fee in a treasury chalan,</li> <li>the applicable VAT on clearance fee in a separate treasury chalan,</li> <li>the No Objection Certificate (NOC) from the local authority,</li> <li>NOC in favour of cutting /dressing (if it is required) of Hill/Hillock from concerned authority and NOC from other relevant agencies for operational activity etc.</li> <li>to the Chattogram District Office of DOE with a copy to the Head Office of DOE in Dhaka.</li> </ul>	

## ***1.8. Structure of the Report***

The EIA report contains project features, baseline environmental conditions, assessment of environmental impacts and formulation of mitigation measures along with environmental management and monitoring plan.

The report includes the following chapters:

### **Executive Summary**

The executive summary gives the synopsis of the EIA Report.

### **Chapter 1: Introduction**

This chapter provides background information of the project proponent, rationale of the project, scope and methodology, Location and brief background of the project, Experts involved in the assignment and structure of the report.

### **Chapter 2: Legislative, regulation and policy consideration**

This chapter deals with the details of the potential legal, administrative, planning and policy framework which have been used in the preparation of the EIA Report.

### **Chapter 3: Project Description**

This chapter deals with the details of the proposed project such as project objective, proposed interventions and activities, project requirements, Infrastructure development, environmental consideration, project cost, implementation schedule, etc.

### **Chapter 4: Environmental and Social Baseline**

This Chapter describes the baseline environmental conditions around the project site for various environmental attributes, viz. physical, biological and socio-economic, within the 10 km radial zone, which is termed as the study area. Topography, soil, water, meteorology, air, noise, and land constitute the physical environment, whereas flora and fauna constitute the biological environment. Demographic details and occupational pattern in the study area constitute socio-economic environment. Baseline environmental conditions are based on the information collected from the various agencies and the secondary data collected from published sources.

### **Chapter 5: Identification and Analysis of Key Environmental Issues**

This chapter details the analysis of the key environmental issues.

### **Chapter 6: Environmental and Social Impacts**

This chapter details the inferences drawn from the environmental impact assessment of the proposed project. It describes the overall impacts of the project activities and underscores the areas of concern, which need mitigation measures.

### **Chapter 7: Public Consultation and Disclosure**

This Chapter provides an insight into the process & methodology followed for carrying out the public consultation meetings (with institutional stakeholders and community) in study area and outcome of public consultations

#### Chapter 8: Environmental Management Plan and Monitoring Indicators

This Chapter provides mitigation and control measures to attenuate and/or eliminate environmental impacts, which are likely to be caused by the proposed project. An Environmental Management Plan (EMP) has been developed to mitigate the potential adverse impacts and to strengthen the beneficial impacts. This chapter also provides the environmental monitoring plan proposed for the project.

#### Chapter 9: Cost Estimation for Environmental Mitigation Measures and Monitoring

This chapter concludes on the findings that emerged from the environmental assessment study and summarizes the key points to be addressed to ensure the environmental sustainability of the project during the preconstruction, construction and operation phases.

#### Chapter 10: Emergency Response Plan and Disaster Impact Assessment

The chapter envisages potential onsite and offsite emergency situation and suggest mitigation measures to combat such situation.

#### Chapter 11: Conclusions and Recommendations

This chapter concludes on the findings that emerged from the environmental assessment study and summarizes the key points to be addressed to ensure the environmental sustainability of the project during the preconstruction, construction and operation phases.

## 1.9. References

List of secondary data used for carrying out EIA study and preparation of EIA report is given in the following table.

*Table 4: Reference Used for EIA Study*

S. No.	Reference
<b>Government Departments</b>	
1.	Bangladesh Bureau of Statistics
2.	Bangladesh Department of Agriculture
3.	Bangladesh Economic Zone Authority
4.	Bangladesh Forest Department
5.	Bangladesh Meteorological Department
6.	Bangladesh Water Development Board
7.	Bangladesh Department of Environment
8.	Department of Fisheries
9.	Department of Forest
10.	Department of Disaster Management
11.	Department of Livestock
12.	Geological survey of Bangladesh
13.	Land & Revenue Department
14.	Soil Resource Development Institute (SRDI)
15.	Department of Public Health and Engineering (DPHE)
<b>Reports, Journals &amp; Books</b>	
1.	District Statistics 2011, Feni
2.	Population & Housing Census-2011, Feni
3.	Pre-Feasibility Study Report of Feni Economic Zone
4.	Draft Master Plan Report - BSMSN
5.	Common Names of plants growing in Bangladesh and West Bengal (Bengali), Govt. of Bangladesh
6.	Environmental and Social Management Framework, BEZA



S. No.	Reference
7.	Flood Response Preparedness Plan of Bangladesh,
8.	Islam, I, 2012, Temporal pattern of Fish Assemblage of Feni River, Feni, Bangladesh- Fish Biodiversity of Feni River
9.	IEE Report, BAN: Irrigation Management Improvement Project, Muhuri Irrigation Project
10.	Fisheries Statistical Yearbook 2017-18, Bangladesh
<b>Website</b>	
1.	<a href="http://www.gsb.gov.bd/">http://www.gsb.gov.bd/</a>
2.	Google map
3.	<a href="http://www.doe.gov.bd/">http://www.doe.gov.bd/</a>
4.	<a href="http://www.landzoning.gov.bd/">http://www.landzoning.gov.bd/</a>
5.	<a href="http://www.barc.gov.bd/">http://www.barc.gov.bd/</a>

## 2. Legislative, Regulation and Policy Consideration

### 2.1. Regulatory Requirements for the Proposed Project

The Government of Bangladesh has framed various laws and regulation for protection and conservation of natural environment. These legislations with applicability to this project are summarized below.

*Table 5: Applicability of Key Environmental Legislation at a Glance*

Name	Key Requirement	Applicability	Remarks
	<b>Acts/Rules</b>		
The Environment Conservation Act, 1995 and subsequent amendments in 2000 and 2002 and 2010	Mandatory requirement of prior environment clearance for certain category of project for conservation and improvement of environment and control and mitigation of pollution of the environment  To ascertain responsibility for compensation in case of damage to ecosystem	Applicable. The project classified under red category. EIA study required to be undertaken	Site approval certificate is to be obtained from DoE
Environment Conservation Rules, 1997 (Subsequent Amendments in 2002 and 2003)	Restriction on polluting automobiles, sale and production of environmental harmful items  Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes  Declaration of ecologically critical areas  Promulgation of standard limit for discharging and emitting waste  Formulation and declaration of environmental guidelines.  Categorization of industries, development projects and other activities on the basis of pollution activities of the existing or proposed industries/ development projects/ activities.		
Environment Court Act, 2000 and subsequent amendments in 2002	To give high priority to environment pollution prevention	Applicable as the project shall have environmental impacts	All the developments to be carried out as per the act, 1995 & ECR, 1997 and subsequent amendments
Bangladesh Wildlife Preservation Act, 1974 and Revision 2008 (Draft)	No person shall damage or destroy any vegetation in any wildlife sanctuary & the wild Animals shall not be hunted or captured. For preservation of Wildlife Sanctuaries, parks, reserves.	Not Applicable. Project site is not located within any wildlife sanctuary/national park or any	Development activity will not have any interface with wildlife or wild habitat at any stage. Regulatory authority is Ministry of

Name	Key Requirement	Applicability	Remarks
		other protected area under this act.	Environment and Forest Bangladesh Wildlife Advisory Board
The Forest Act 1927 and Forest Amendment Act 2000 (Protected, village Forests and Social Forestry)	<p>Declare any forests land or waste land as protected forests.</p> <p>May stop public or private way or watercourse in the interest of preservation of the forest</p> <p>Declare a reserved forest area as Village Forests</p> <p>Declare an area as social forests or launch a social forestry programme in Govt. land or private land with permission</p>	BEZA may ask clarification from Forest Dept. about requirement of Forest Diversion	Permission may be required if diversion of forest land is involved
The Private Forests Ordinance Act, 1959	Conservation of private forests and for the afforestation on wastelands.	Applicable as the tree cutting is involved in development of proposed project	Tree cutting to be carried out after taking permission from Forest Department
The Protection and Conservation of Fish Act, 1950 and The Protection and Conservation of Fish Rules, 1985	Prohibit or regulate the construction, temporary or permanent of weirs, dams, bunds, embankment and other structures	Applicable. The project involves construction of super dyke and other structures.	Necessary permission would need to be taken for Construction of superdyke and other structures. Regulatory authority is Ministry of Fishery
The Explosive Act, 1884	To prevent any accident due to explosive storage, use or transportation due to careless handling/management	May be Applicable depending on quantity of fuel storage	Fuel will be stored and used at site for running various construction machinery and equipment
Water Pollution Control Ordinance 1970. which was replaced by the Environmental Pollution Control Ordinance 1977	An Ordinance to provide for the control, prevention, and abatement of pollution of the environment of Bangladesh.	Applicable from the perspective of prevention of pollution.	Applicable primarily during the construction stage (e.g., sewage and equipment washing and maintenance liquid waste discharges at construction camps)
Water Supply and Sanitation Act, 1996. National Policy for Water Supply and Sanitation, 1998.	Management and Control of water supply and sanitation in urban areas. The key objective of the National Policy for Safe Water Supply and Sanitation improve the standard of public health and to ensure an improved environment. The need for building the institutional capacity of local governments and communities and promoting sustainable water and sanitation services is recognized. The policy also acknowledges the ensuring proper storage, management, and use of surface water.	Applicable for all development projects.	The regulatory authority is the Ministry of Local Government, Rural Development and Cooperatives.
The ground Water Management Ordinance 1985.	This Ordinance prohibits the placing of tubewells in any place without a license granted by the Thana Parishad. The	Applicable, if tube wells will be dug to	Permission should be taken if groundwater

Name	Key Requirement	Applicability	Remarks
The Ground Water Management Act, 2018 has repealed the previous Ground Water Management Ordinance, 1985	<p>Thana Parishad shall conduct an inquiry before releasing the license on the points listed in article 5 namely: soil condition, distance to another well, benefiting area, suitability of site, conditions to be attached, etc. The license may be granted if the Thana Parishad is satisfied that the installation of a tubewell is beneficial, will not harm the surrounding area and is otherwise feasible.</p> <p>The groundwater management Act 2018. They cover a wide range of issues such as water resources management; waterworks; irrigation; drainage/land reclamation; water supply; freshwater quality/freshwater pollution; pollution control; water rights; potable water; groundwater; surface water; sustainable use; flood.</p>	develop a water supply system during the operation phase.	is used, before digging tube wells
The Embankment and Drainage Act of 1952	An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal, and control of embankments and water courses for the better drainage of lands and their protection from floods, erosion and other damage by water.	will be applicable in case of construction of an embankment or any other structures	Regulatory authority Ministry of Water Resources
Wetland Protection Act 2000	<p>Adhere to a formal environmental impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects or related to alteration of natural drainage.</p> <p>No construction of roads is likely to affect the flow of navigable waterways without clearance from concerned authorities</p> <p>Upland flow in water channels to preserve eco-system</p> <p>Protection against degradation and resuscitation of natural waterbodies such as lakes, ponds, beels, khals, tanks, etc. affected by man-made interventions or other causes.</p> <p>Completely stop the filling of publicly owned water bodies and depressions in urban areas for the preservation of the natural aquifers and environment.</p> <p>Stop unplanned construction on riverbanks and indiscriminate clearance of vegetation on newly accreted land.</p>	Applicable, feni River and several canal flow within the proposed project area. Few waterbodies are also present in the project area	Permission to be taken from the Ministry of Water Resources and DOE
Antiquities Act 1968	Governs preservation of the national cultural heritage, protects and controls ancient monuments, regulates antiquities as well as the maintenance, conservation and restoration of protected sites and monuments, and controls planning, exploration and excavation of archaeological sites.	Not applicable as no structure of national cultural heritage will be affected due to project development	The regulatory authority is the Ministry of Cultural Affairs

Name	Key Requirement	Applicability	Remarks
The Building Construction Act 1952 (with amendments)	An Act to provide for the prevention of haphazard construction of buildings and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh	Applicable as the project involves the development of infrastructure	The regulatory authority is the Ministry of Works
Bangladesh Economic Zones (Construction of Building) Rules, 2017	The rule states overall economic zone design requirements including zoning, open space requirement, green area, building orientation, accessibility, infrastructural requirements, access to fire appliances etc. The rule also elaborates on the design requirements for an individual building in the EZ, the requirement of necessary permits, duties and responsibilities of the developer, required qualification and responsibilities of the technical personnel involved, the requirement of timely inspection etc.	Applicable as the project involves the construction of buildings in the economic zones	In the exercise of the powers conferred under section 38 of the Bangladesh Economic Zones Act, 2010, GoB made this rule
The Vehicle Act, 1927 The Motor Vehicles Ordinance, 1983 The Bengal Motor Vehicle Rules, 1940	To regulate vehicular exhaust emissions	Applicable as heavy vehicle movement is involved both during the construction and operation phase	Regular maintenance and up keeping of the vehicles should be carried out. Regulatory authority is Bangladesh Road Transport Authority
The Land Acquisition Act, 1894 The Acquisition and Requisition of Immovable Property Ordinance 1982 and subsequent amendments in 1994, 1995, 2004 & 2017	To provide appropriate compensation for the land acquired	Applicable as the project requires land acquisition	Regulatory authority is Deputy Commissioner
The Factories Act, 1965 Bangladesh Labour Law, 2006	This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions.	Applicable as the workers will be employed during the construction and operation phase of EZ	The regulatory authority is the Ministry of labor
<b>Policies</b>			
National Environment Policy, 1992, and subsequent amendments in 2018	The National Environment Policy envisaged environment conservation, pollution control, biodiversity conservation, and mitigation of the adverse effect of climate change to ensure sustainable development.	Applicable for all development projects in Bangladesh.	Usage of energy-efficient building materials, fuel etc. should be encouraged.
National Environment Management Action Plan 1995	Conservation of natural habitats, biodiversity, energy, sustainable development and improvement of the life of people	Applicable for all development projects	Usage of energy efficient material, green building techniques, reduction of carbon footprints etc.
National Conservation Strategy	Sustainable development of the Industrial Sector	Applicable for all development projects	Usage of energy efficient material, green building techniques,

Name	Key Requirement	Applicability	Remarks
			reduction of carbon footprints etc.
The National Forest Policy (1994)	conserve the existing forest areas and increase the forest cover of the country and increase the reserve forest	Not Applicable, no diversion of forest land is involved	Not applicable
The National Energy Policy, 1995	Protecting the environment by requiring an EIA for any new energy development project, and introduction of economically viable and environment-friendly technology.	Not Applicable. EIA study is to be carried out	Energy-efficient materials and techniques should be explored
The National Water Policy, 2000	To ensure efficient and equitable management of water resources, proper harnessing, and development of surface and ground water, availability of water to all concerned, and institutional capacity building for water resource management	Applicable. Ground/surface water is required to be withdrawn for fulfilling the water requirement	Conjunctive use of water should be explored
The National Water Management Plan, 2001	Addresses options for water quality, considerations behind measures to clean up industrial pollution, where effluent discharge monitoring and zoning regulations for new industries are emphasized	Applicable as it is an industrial project and will involve the generation of effluent and sewage	Installation of effluent treatment facility within the premises
Bangladesh Water Act 2013	Addressed the issues for integrated development, management, extraction, distribution, usage, protection, and conservation of water resources in Bangladesh. Bangladesh Water Act (BWA) is a framework Law to integrate and coordinate the water resources management in the country.	Applicable as it is an industrial project and will involve the use of water in the facility during the construction and operation phase and the generation of effluent and sewage.	Water quality would be maintained to certain set standards as per Environmental conservation rules (ECR) 2006. The industrial effluent discharge would be monitored, and necessary enforcement would be done as per ECA and ECR.
Air pollution control rules 2022	255-Law/2022, on “The Air Pollution Rules 2022”, dated 25 July 2022. Aiming to protect environmental health, the government has published a new rule based on section 20 of The Bangladesh Environment Conservation Act, 1995. The main objectives of this rule are to prevent, control, and reduce air pollution.	Applicable as it is an industrial project and during the land development, construction, and operation phase, the air pollutants will release into the air.	For details, please see section 8.2.3. Mitigation Plan Suggested to Individual Industries.
Noise Pollution rules 2006	The Noise Pollution (Control) Rules 2006 says that the acceptable sound limit in silent areas is 50 dB for the daytime and 40dB for the night; in residential areas 55dB for the day and 45dB for the night; in the mixed areas 60dB for day and 50dB for the night; in commercial areas 70dB for day and 60dB for the night; and in the industrial areas 75dB for day and 70dB for night. The guidelines say exceeding the	Applicable as it is an industrial project and during the land development, construction, and operation phase, will involve noise pollution.	For details, please see section 8.2.3. Mitigation Plan Suggested to Individual Industries.

Name	Key Requirement	Applicability	Remarks
	maximum noise level in certain areas is a punishable offense.		
Solid waste management rules 2021	This regulation covers the separation, reuse, recycling, processing and disposal process of biodegradable and nonbiodegradable solid waste. The act also specifies the responsibilities of waste generators, consumers, and users which includes disposal of the waste following the regulations of authorities including local government and required waste segregation measures. The regulations also define the responsibilities and obligations according to Extended Producer Responsibility (EPR) on manufacturers of non-biodegradable products	Applicable as it is an industrial project and during land development, construction and operation phase will involve the generation of waste materials.	For details, please see section 8.2.3. Mitigation Plan Suggested to Individual Industries.
<b>Environment &amp; Social Management Framework (ESMF)</b>			
Environment & Social Management Framework (ESMF) of BEZA	Describes all the mandatory environmental and social clearances and purpose of the same required to be taken before development of the project. Describes mitigation plan to be followed to safeguard environmental and social concerns that may arise due to project development.	Applicable	The framework sets out mitigation, monitoring and institutional measures to be taken during design, implementation and operation of the project activities to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.
<b>World Bank's Safeguard Policies</b>			
OP 4.01 Environmental Assessment	Ensures sustainability and environmental feasibility of the project. Projects are classified into A, B & C category depending on the nature and extent of the impact.	Triggered	Project classified as Category A considering impacts of project
OP 4.12 Involuntary Resettlement	Ensures safeguards to address and mitigate risks due to involuntary resettlement such as economic, social and environmental risks.	Triggered	The proposed project requires acquisition of private land and assets

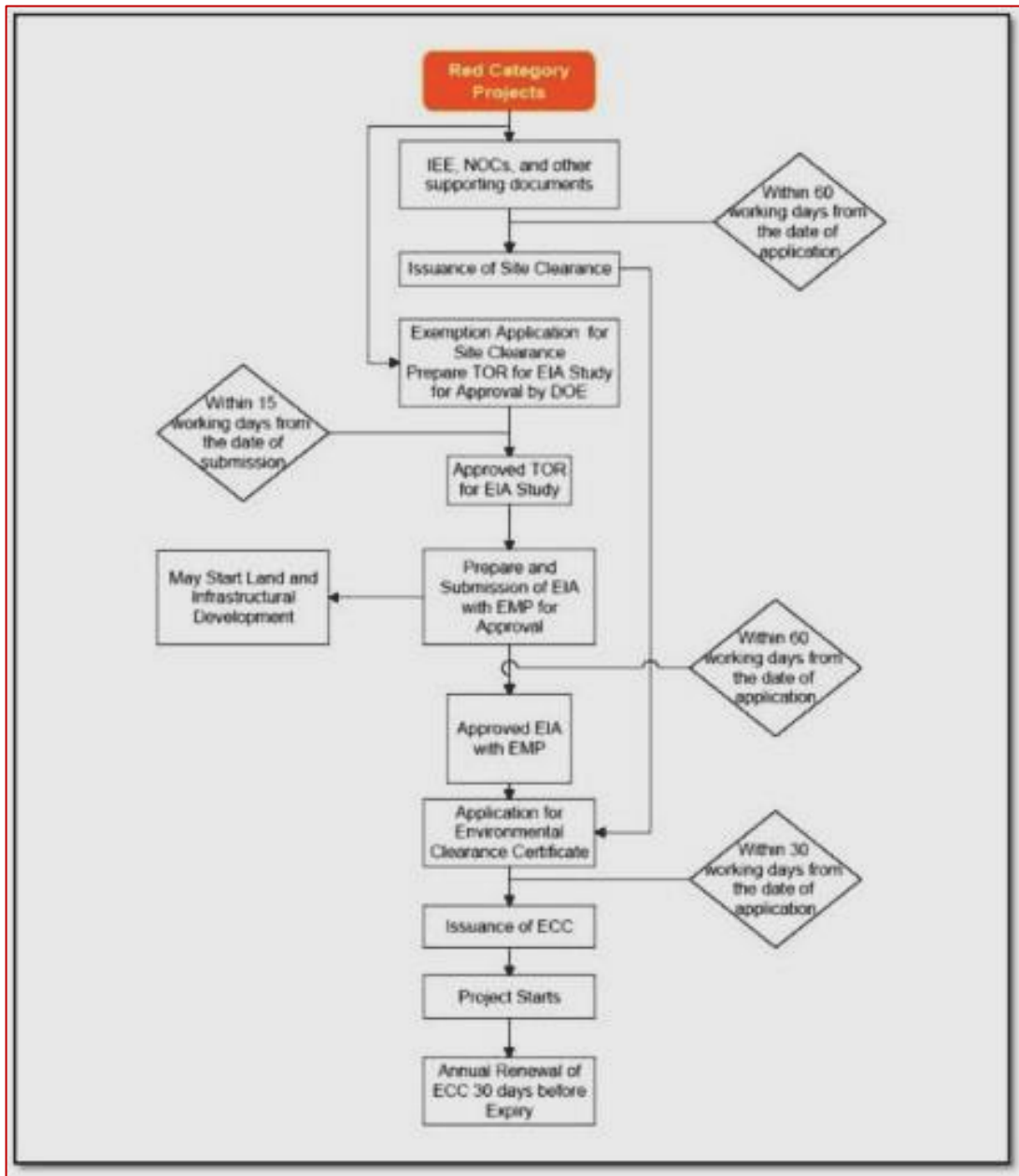
## ***2.2. Procedure for Obtaining Environmental Clearance from DoE, Bangladesh***

Bangladesh has very simple administrative framework regarding environmental aspect. It has strong interface between local government and federal Government. Department of Environment is responsible for grant of environmental clearance to a project. In addition to three are other ministries to deal with specific area of importance to the country like Forests, Water.

According to the Section 12 of the Environment Conservation Act 1995 no project will be established or undertaken without obtaining permission, in the manner prescribed by the Environment Conservation Rules 1997, an Environmental Clearance Certificate from the Director General. Therefore, every development projects/industry which are specified under the Schedule – 1 of the Environment Conservation Rules 1997 require obtaining site and environmental clearance from the Department of Environment. According to the Rule 7 (1) of the Environment Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every project, in consideration of their site and impact on the environment and will be classified into the four categories, i.e., green, orange A, orange B and red. Development of industrial estate will fall under red category. Thus, EIA study is required for the project. Focused group stakeholder consultation has also been conducted to discuss the environmental issues associated with the project. Outcomes of stakeholder consultation have also been

included in the report. A schematic representation of the various steps involved in obtaining the Environment Clearance certificate from DoE for red category projects is given in Figure below.

*Figure 7: Steps for Obtaining Environment Clearance from DoE*





# 3. Project Description

## 3.1. Introduction

Proposed EZ is spread over an area of 9,549.61 acres and it is located in Sonagazi upazila, Feni district of Chattogram division. A key location attribute of the proposed EZ site is its location along the Dhaka-Chattogram industrial and transport corridor, Bangladesh's most important highway Dhaka-Chattogram Highway (N1) passes in proximity to this site. According to an Asian Development Bank (ADB) study conducted in 2013, 90% of Bangladesh's goods for export and import passes through this highway. Around 30,000 vehicles (highest among all road alignments in the country) pass through this road daily<sup>2</sup>, which includes trucks carrying cargoes of apparels, light machinery, chemicals, steel roads, agricultural produce, processed food, cement etc.

This strategic location will help industries in proposed EZ site, cater to the consumer market in Dhaka and form upstream and downstream linkages with industries along Dhaka-Chattogram Highway. Industries in proposed EZ will also have access to markets and industries in Northeast India due to its proximity to the Indian state of Tripura.

## 3.2. Project Objective

The objective of the Feni EZ within BSMSN is to develop a multi sector Economic Zone in Feni within the proposed Bangabandhu Sheikh Mujib Shilpa Nagar Area (BSMSN). The aim of setting up the EZ in Feni is to develop light and medium industries in the region along with excellent state-of-the art infrastructure facilities and professional management to attract and support investments in industrial sectors.

All facilities required for target industries have been planned and identified. This will enable the proposed EZ to function as an integrated package having the required facilities and service activities with sufficient provision for future growth and expansion.

Given the industrial base and the concept of EZ which has evolved to leverage the cluster advantage of industries, the proposed project will strengthen district's position in the industrial sector map of Bangladesh and will contribute to the economy. A careful planning exercise has been undertaken to position the project considering the geographic, demographic, raw material resources, industrial, economic and social characteristics of region and it is in this context that master planning of the project assumes significance.

## 3.3. Project Options

A site suitability analysis was carried out for the development of EZ for assessing environment and social feasibility of the proposed project. As per the analysis, both limitations and benefits associated with the land for developing EZ at the proposed site location has been furnished. However, identified weakness and threats can be overcome by adopting alternative technologies and preventive measures.

Identified strength and weakness of the proposed site location are provided in the table below.

*Table 6: Strength and Weakness of Site*

Parameters	Strength	Weakness
<b>Location, Contiguity &amp; surroundings</b>	<ul style="list-style-type: none"><li>Does not lie within any city Corporation, Municipality and Cantonment Board Area as per requirement of sub-section 3 of section 5 of Economic Zone Act, 2010</li><li>Location within coastal area, proximity Dhaka Chittagong Highway and the railway line</li></ul>	<ul style="list-style-type: none"><li>Region prone to flooding due to presence of Feni River</li><li>Threats of cyclones associated due to the close proximity to Bay of Bengal</li></ul>

<sup>2</sup> <http://www.thedailystar.net/editorial/highway-growth-1249747>

Parameters	Strength	Weakness
	<ul style="list-style-type: none"> <li>• Proximity to Feni River and other channel; so well-developed inland water transport</li> <li>• Availability of the waterfront for industrial operations</li> </ul>	<ul style="list-style-type: none"> <li>• Requirement of high dikes and strong storm water management system</li> <li>• Vegetation clearance (including Mangrove Species) involved to some significant extent</li> </ul>
<b>Accessibility</b>	<ul style="list-style-type: none"> <li>• Proposed site can be reached from Dhaka-Chattogram highway by accessing proposed Sheikh Hasina Avenue.</li> <li>• The site has access to river-based ferry ghat at Chandpur on the Meghna River which is around 130 km from the site and is accessible from road via Dhaka-Chattogram highway followed by Comilla-Chandpur Highway which is a 2-laned bituminous road.</li> <li>• Proposed EZ at Feni has access to a waterfront in Sandwip Channel, where berthing facilities can be developed for vessels carrying raw material for heavy industries and clinker for cement factories.</li> <li>• Chattogram Sea port is the nearest seaport, which is located approximately 75 km from the proposed EZ. This port is also accessible via National Highway, N1. This seaport is the most important trade-facilitating infrastructure in Bangladesh.</li> <li>• Belonia Land Port (under development) is the nearest land port located at around 60 km north of the proposed EZ site. As per current information available, this port is yet to be operationalized although a Development Project Proposal (DPP) has been passed and land acquisition is in progress.</li> <li>• Nearest international airport to the EZ site is Shah Amanat International Airport located in Chattogram at a distance of 75 km from the EZ site. It is Bangladesh's second largest airport.</li> <li>• Chattogram railway station is the nearest junction railway station from the proposed EZ, located at around 75 km, where cargo-handling facility is present currently. Access to Chattogram junction railway station takes place through Dhaka-Chattogram highway and time of travel is ~2.5 hours.</li> <li>• A Dry Port is also proposed at about 3Km away from Sheikh Hasina Avenue to the southern side. The proposed Dry Port is in Shayer Khali Mouza of Mirsarai Upazila.</li> </ul>	
<b>Available Infrastructure Facility</b>	<ul style="list-style-type: none"> <li>• Availability of land for EZ development</li> <li>• Land is flat and can be elevated using sea sand</li> <li>• Easy transportation of goods due to proximity of highway, sea and Feni River</li> </ul>	<ul style="list-style-type: none"> <li>• Existing drainage pattern may be affected as the site gets inundated during monsoon although adequate storm water drainage network</li> </ul>

Parameters	Strength	Weakness
	<ul style="list-style-type: none"> <li>Setting up of all infrastructure facilities, residential areas will induce setting up of new townships and other developments</li> <li>Developed flood protection infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>will be developed all around the EZ site to collect &amp; drain the storm water from site</li> <li>Tidal effect of the canals at site may hamper the drainage system</li> <li>Absence of urban living and recreational facilities in nearby areas at present.</li> </ul>
<b>Availability of Raw Material</b>	<ul style="list-style-type: none"> <li>Raw material can be supplied from Dhaka or from Chittagong port through Dhaka Chittagong Highway</li> <li>Large nos. of unskilled and semi-skilled labour available</li> <li>Department of Public Health and Engineering (DPHE) had already developed the water supply network to serve the Bangabandhu Sheikh Mujib Shilpa Nagar Area.</li> <li>Since the site is situated adjacent to Bay of Bengal on its Southern side, it is proposed to provide desalination plant adjacent to site to meet the water demand of EZ on a long-term basis. Thus, stress on Ground Water resource may be avoided.</li> </ul>	
<b>Eco-sensitivity and threat to biodiversity</b>	<ul style="list-style-type: none"> <li>Adequate consideration in masterplan for development of green areas. Significant part of proposed site not considered for development due to presence of mangrove species</li> </ul>	<ul style="list-style-type: none"> <li>Mangroves located close to the site may be affected due to cumulative impact likely to be caused from various EZ in the neighbourhood</li> <li>Proposed Super Dyke structure may hinder tidal flow if adequate mitigation measures not taken</li> </ul>
<b>Quality of life &amp; Employment generation</b>	<ul style="list-style-type: none"> <li>Creation of large nos. of direct and indirect jobs for skilled, semi-skilled and un-skilled labour due to construction and operation of EZ</li> <li>Enhanced infrastructure facilities</li> <li>Developments in nearby area after development of EZ</li> </ul>	

### 3.4. Project Description

Table 7: Details of project description

Feni Economic Zone	
Location and district	Union: Sonagazi, Charchandina; Upazila: Sonagazi, District: Feni and division: Chattogram
Mouza	Seven mouzas; Dakhin Char Khondaker; Char Khowajer Namchi; Char Nasrin ; Bahir Char ; Thak khowajer Namchi; Char Khondaker; Char Ram Narayan.
Development area	9,549.61 acres
Land use	Waterbodies, lowland (char land), Farmland, and bare land
Site preparation	The average natural ground level for the proposed EZ is +6 m level. The finished ground level for the proposed EZ will be around +11 m from above Mean Sea Level.

Environmental and Social conditions	Need resettlement of houses and peoples; RS1 is located in Precinct A in Char Khondakar mouza in Sonagazi thana of Feni Zila with an approximate area of 13.19 acres of land. No precious ecology and cultural heritage sites exist.
Development concept and advantages	This strategic location will help industries in the proposed EZ site, cater to the consumer market in Dhaka and form upstream and downstream linkages with industries along Dhaka-Chittagong Highway. Industries in the proposed EZ will also have access to markets and industries in Northeast India due to its proximity to the Indian state of Tripura. The EZ shall be developed as a competitive EZ against similar facilities in the neighboring countries and equipped with a full line of the infrastructure of global standard, competitive business environment, highest investors satisfaction by One-stop-services (OSS), due consideration to environment and society, and low-cost operations.
Industries to be promoted	Heavy Machinery, iron & steel; Shipbuilding and ship breaking; Petroleum and petroleum products; Other industries; Textile & RMG; Leather & Leather Products; Electrical & Electronics; Automobile & Accessories; Light Machinery, Equipment & Furniture; Non-Metallic Mineral products.
Road	Approach Roads Approach Road 1: Sonagazi – Muhuri Project road (Z1034) runs to the northern side of the proposed EZ at a distance of 2.1km establishing Approach Road 2: Sonagazi –Olmabazar- Chardarbeshpur- Companiganj road (Z1434) runs to the northern side of the proposed EZ at a distance of 6.5 km trunk connectivity adjacent to the proposed EZ. Approach Road 3: Sonagazi-Muhuri Project Road starts from Sonagazi “o” point and ends at Muhuri Project. Hierarchy of roads •An Emergency Road - Super Dyke (100m ROW); Sub Arterial Roads – Type A (40m ROW); Sub Arterial Roads – Type B (30m ROW); Collector Street – (20m ROW).
Canal	There have been proposed 5 canal pumping stations that will be constructed within Feni EZ area of precincts A, A1, J, and precinct F. The stormwater canal pumping station will receive water and attenuate the flow rate through the drainage channels which then discharge to sea. In addition, in Precinct F, zone 6, there will be constructed a large lake or water body named “Sheikh Hasina sarobor”, which stores water.
Retention Pond/water reservoir/Lake	There have been proposed 5 canal pumping stations that will be constructed within Feni EZ area of precincts A, A1, J and precinct F. The stormwater canal pumping station will receive water and attenuate the flow rate through the drainage channels which then discharge to sea. In addition, in Precinct F, zone 6, there will be constructed a large lake or water body/water reservoir name of “Sheikh Hasina sarobor”, which stores water. Theses lakes will promote tourist attractions assuring environmental protection of the zone. Thus 3 water reservoirs or lakes will be constructed at BSMSN having size approximately 100 acres each. The details of the canal pumping station and large lake/water body are added in Annex G.
Utilities	Electricity Demand for the proposed Feni EZ is 3248.17MW. In the present scenario, BSMSN may take 2,000 MW (without contingency) from the grid network against the demand of 3,248 MW through an existing, dedicated 400 kV transmission linked with the grid system. For reliable power and to meet the demand, generating units around the capacity of 1500 MW should be planned; onsite as well as more HV links should be developed to connect the zone HV network to the grid system. Feni EZ, being a large part of BSMSN will receive a good amount of share of this electricity.
Water Supply	Industrial Usages: The unit rate of water demand is considered to be 162 m <sup>3</sup> /day/ha (0.066 MLD/acre) of operating industrial land. The operating industrial land is considered to be about 60% of gross industrial land.

	Domestic and Non-domestic (other than Industrial) Usages; Residential: 150 litres / per capita / day Non-domestic usage in different industries: 45 liters/head/day Water demand for other miscellaneous usages: 5% of non-domestic demand.
Sewage treatment Plant (On-site infra.)	Domestic sewage will be treated in 2 STPs proposed in suitable locations within the Industrial city premises. The details capacity requirement of STP, Estimated Sewage Generation, recommended guidelines for treated sewage for discharge into surface water, and treatment technology is given in Tables 18, 19, 20, and Figure 19.
Industrial waste treatment	Two types of waste will be generated from both industrial as well as non-industrial areas – Solid waste and Liquid waste. Domestic sewage will be treated in 2 STPs proposed in suitable locations within the Industrial city premises. and four central effluent treatment plants (CETPs) aided by intermediate pumping stations. The facility will have 5 Sewage Pumping Stations giving coverage to these precincts. The details of capacity have given in table 18.
Solid waste management	BSMSN has a central Solid waste treatment facility in Precinct H, under Zone 23, and 24, south side of the Sheikh Hasina Saroni. The details of the SWM treatment facility are added in Annex G.
Super dyke and embankment	The super dykes are designed and constructed with crest elevations at MSL10+9.0 m to protect the site against a 100-year return period coastal flood. A super dyke is under construction (dyke top level is fixed at 9.0m MSL) to prevent ingress of sea water to the BSMSN, even during the event of any cyclonic storm. The tentative length of the super dyke portion falling under Feni EZ is 11.12 km along the western coast of Feni River and the sea. The total length of the super dyke is tentatively 30 KM.

### ***3.5. Interventions under selected options***

The site for the EZ has been selected for the the development of the economic zone. The scope of the proposed project is to develop the EZ site and on-site -offsite facilities for the upcoming EZ zone. These EZ facilities will be developed by BEZA. Proposed off-site facilities will help in improving the infrastructure of the area and will attract developers. The proposed development will help in improving the infrastructure of the EZ area. Proposed interventions at the selected site are given below:

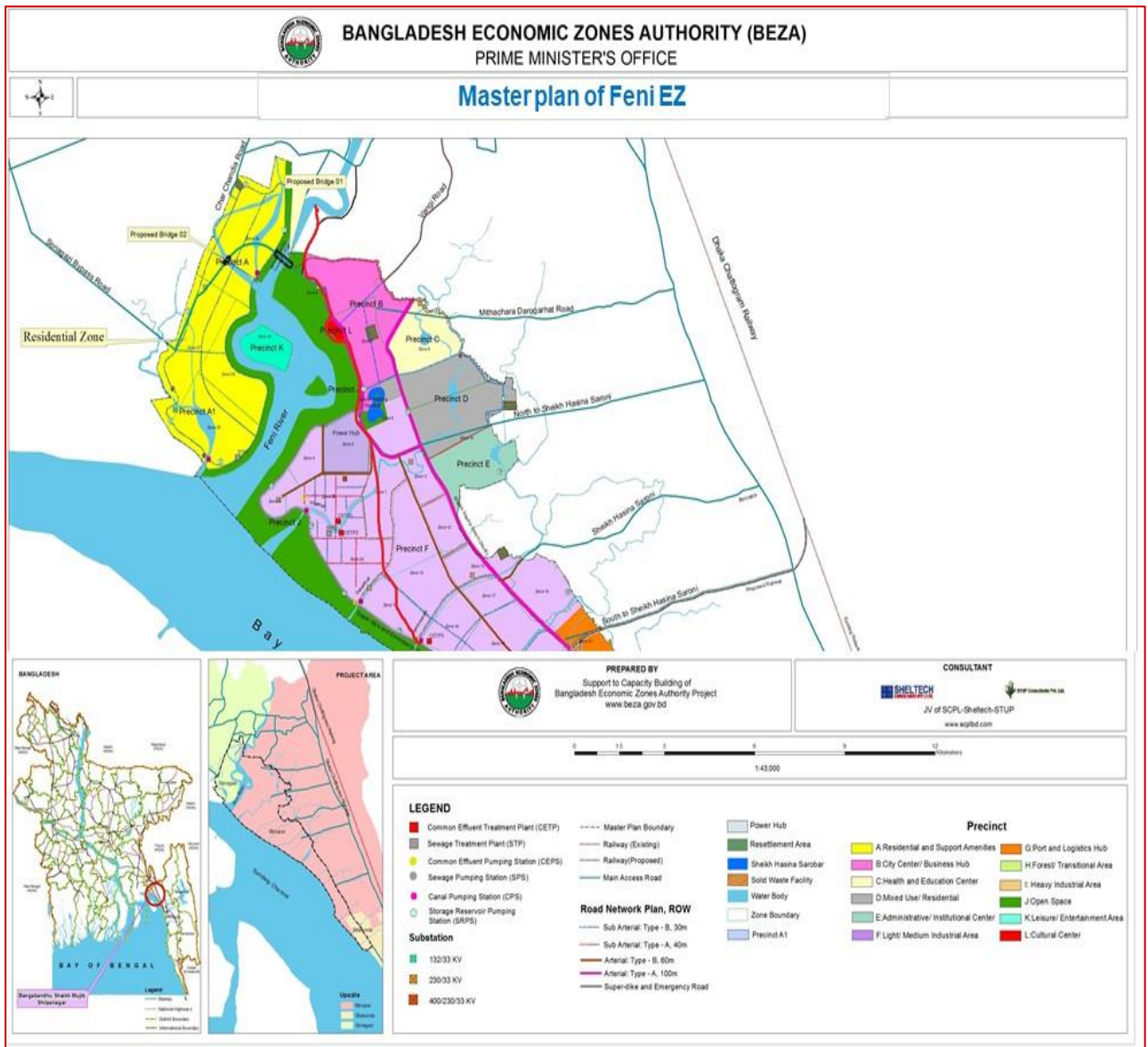
- Site development
- Land Filling
- Approach Roads & Internal Road Network
- Creation of industrial Plots
- Administrative & residential building
- Development of water supply network
- Development of sewer and effluent system network
- Development of CETPs & STPs
- The power supply system and substation at the project site
- Super Dyke (length of 30km)
- Boundary Wall
- Embankment for River Feni
- Power Generation (a power plant is proposed – partially falls in Feni.

#### ***3.5.1. Project Layout Plan***

The BSMSN Master Plan sets out: i) land uses, ii) access and transport networks, iii) precinct boundaries and characteristics, iv) zoning and permitted uses, v) development guidelines, and iv) environmental and green resilient rules to follow when implementing the zone.

The BSMSN site has been divided into 12 separate precincts, which have their land uses. Although specific plots have not been assigned in the master plan (except for within the industrial areas), it is intended that real estate projects following the designated/assigned land use and design guidelines will be constructed over time and sold/leased at competitive market rates. The precincts, (their land use and size) for BSMSN are identified below.

Among the 12 separate precincts, precincts A, A1, J, and K fall within Feni EZ. The associated plan set is outlined in the below master plan. The details master plan of Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) is added in Annex G.



Source: Master plan of BSMSN, 2020

### 3.6. Project Activities: Infrastructure and Utility Development

All the necessary infrastructure facilities for the development are designed to create an ideal ambience and best environment.

### **3.6.1. Site Development**

**Site filling** – The average natural ground level for the proposed EZ is +6 m level. To avoid inundation during monsoon season, the land filling of 5 m above the existing natural ground level is considered.

The finished ground level for the proposed EZ will be around +11 m from above Mean Sea Level. An average depth of 16 feet to 17 feet of land filling has been envisaged for the proposed EZ area.

**Dyke and Embankment:** The super dykes are designed and constructed with crest elevations at MSL+9.0 m to protect the site against a 100-year return period coastal flood. A super dyke is under construction (dyke top level is fixed at 9.0m MSL) to prevent the ingress of sea water to the BSMSN, even during the event of any cyclonic storm. The tentative length of the super dyke portion falling under Feni EZ is 11.12 km along the western coast of Feni River and the sea. The total length of the super dyke is tentatively 30 KM.

A river embankment is proposed along the eastern side of the Feni River adjacent to Precinct A.

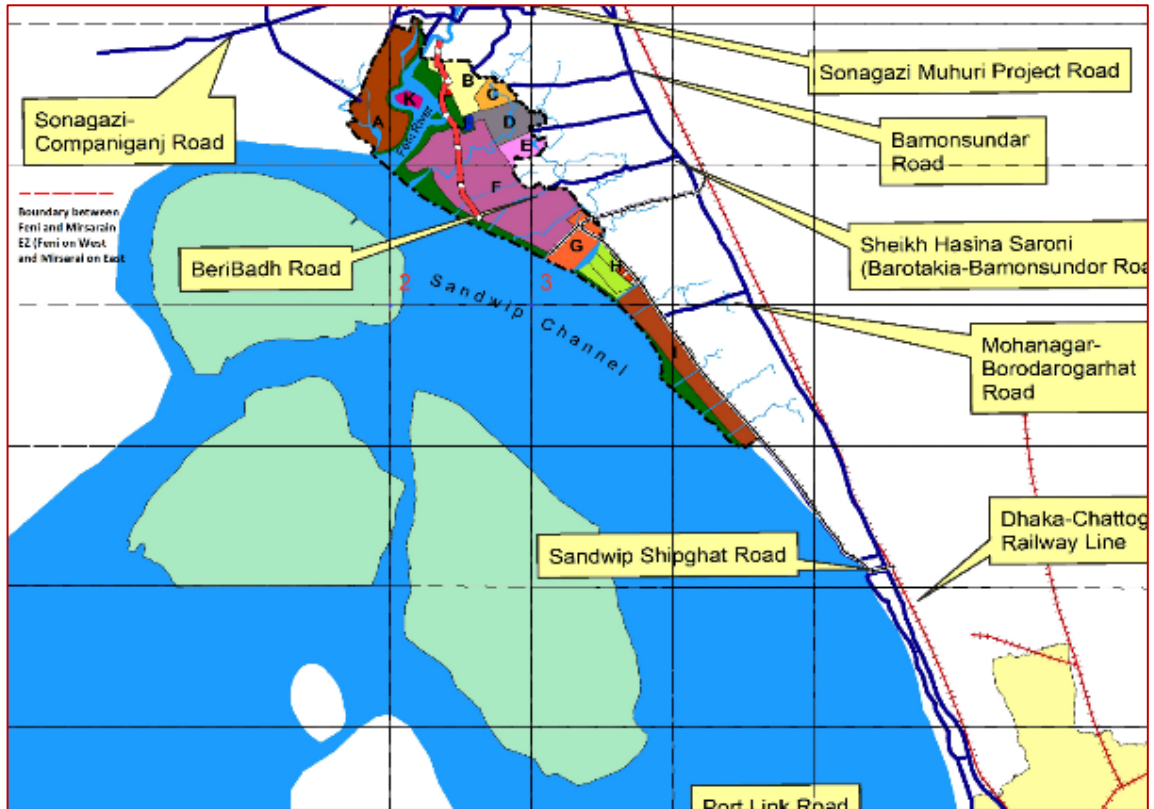
### **3.6.2. Roads**

#### **Approach Roads**

- **Approach Road 1:** Sonagazi – Muhuri Project road (Z1034) runs to the northern side of the proposed EZ at a distance of 2.1km establishing trunk connectivity adjacent to the proposed EZ. Hence, Major approach roads from the Sonagazi – Muhuri Project road of 24 m wide for a length of 2100 m have been proposed connecting the industrial area of EZ.
- **Approach Road 2:** Sonagazi –Olmabazar- Chardarbeshpur- Companiganj road (Z1434) runs to the northern side of the proposed EZ at a distance of 6.5 km establishing trunk connectivity adjacent to the proposed EZ. Hence, Major approach roads from the Sonagazi –Olmabazar- Chardarbeshpur- Companiganj of 45 m wide for a length of 6500 m have been proposed connecting the industrial area of EZ.
- **Approach Road 3:** Sonagazi-Muhuri Project Road starts from Sonagazi “o” point and ends at Muhuri Project. It has 95 residential structures and 550 commercial structures. In the future, RHD may construct this road.
- **Bridge 1:** There is a river crossing for a distance of 1300 m along the proposed road alignment connecting the two land parcels of EZ. Hence, a bridge for a length of 1300 m has been proposed to cross Feni River.
- **Bridge 2:** There is a river crossing for a distance of 800m along the proposed road alignment connecting the Bangladesh Water Development embankment (Super Dyke). Hence, a bridge for a length of 800 m has been proposed.

No significant link is found on the northern side connecting Feni Sonagazi Road / Sonagazi Companyganj Road. The connectivity and linkages for the proposed EZ are shown below.

*Figure 8: Map of last mile connectivity to proposed EZ*



Source: Draft Master Plan Report of BSMSN

### Hierarchy of roads

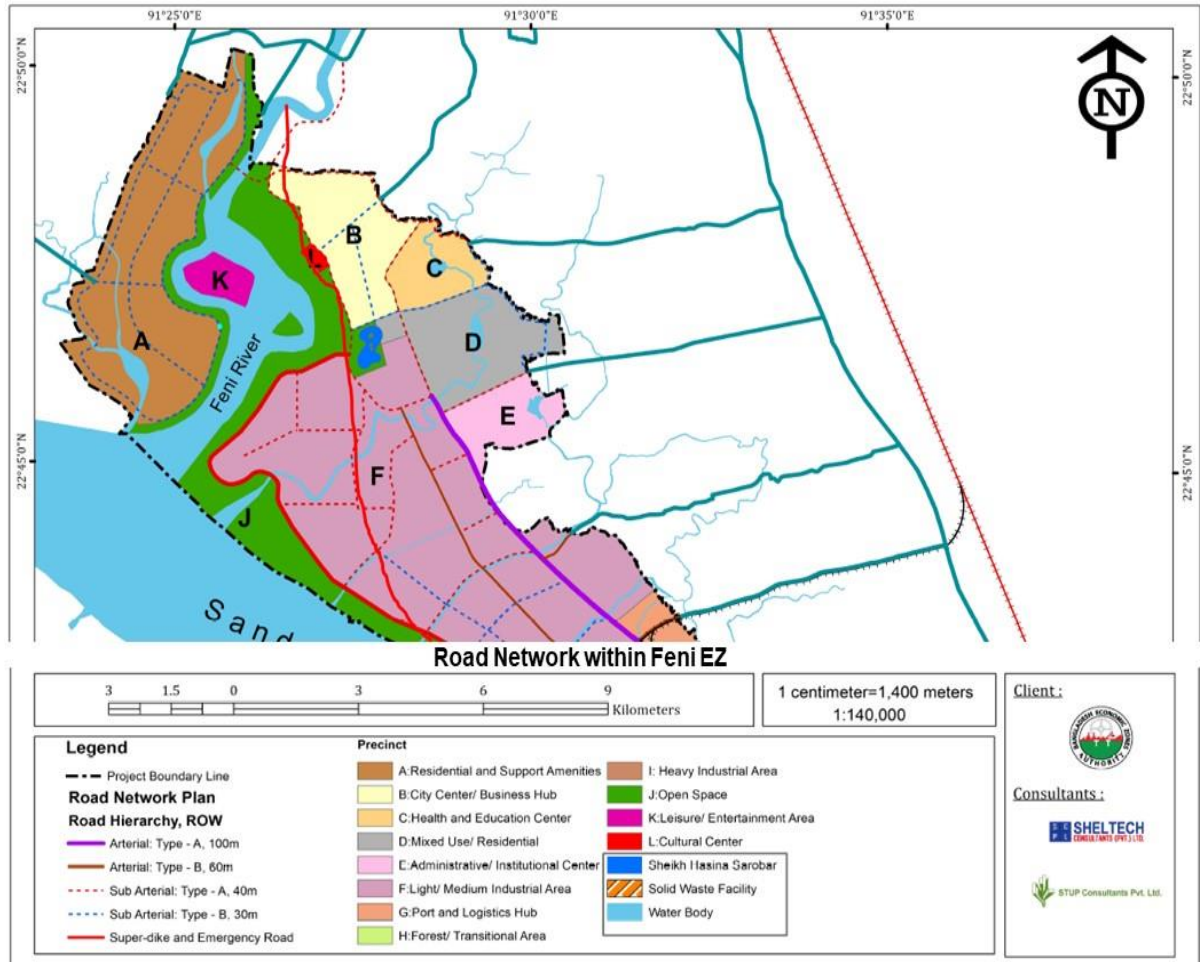
The hierarchy of roads planned within EZ is provided below

- **An Emergency Road** - Super Dyke (100m ROW). The road on the high embankment along the seaside offers limited access and acts as an emergency exit from BSMSN if required.
- **Sub Arterial Roads – Type A** (40m ROW). For collection and distribution of traffic connecting to the arterial road network, however, offering a lower level of service than an arterial road.
- **Sub Arterial Roads – Type B** (30m ROW) For collection and distribution of traffic connecting to the arterial road network, however offering a lower level of service than an arterial road. Providing access to large plots of land within Precincts F, G, H, and I.
- **Collector Street** – (20m ROW) For collection and distribution of local traffic and providing access to arterial and sub-arterial roads. Most common in Precincts A, B, C, D, E, and K. A portion of Feni economic zone falls under Precinct A.

The road network layout for the proposed EZ is shown below. The detailed road network of BSMSN is added in Annex G.

Figure 9: Internal road network

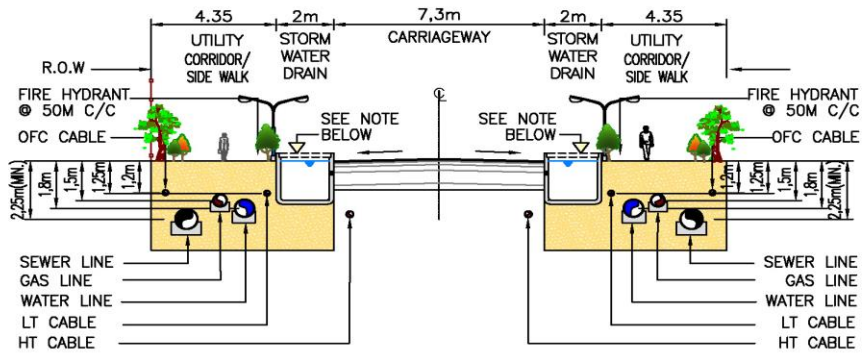




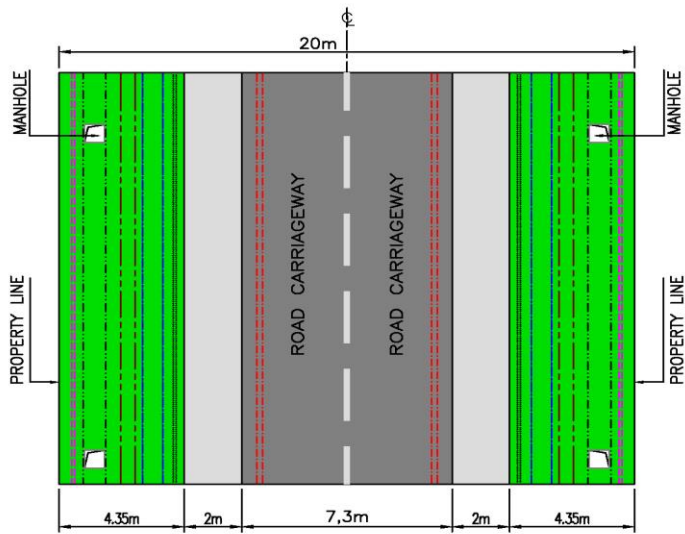
Source: Draft Masterplan of BSMSN

The figure above outlines the top view of the road network diagram. As evident from the diagram above, a road plan has been created to ensure last-mile connectivity to all units inside the EZ site. The figure on the next page outlines the cross-sectional view of the road structure.

Figure 10: Road cross-sections



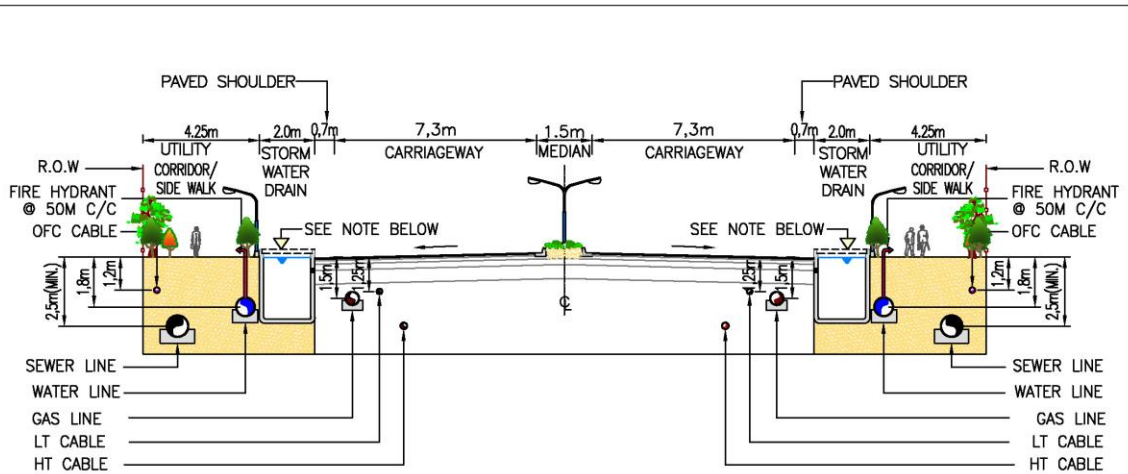
**CROSS SECTION OF COLLECTOR STREET**  
(20m WIDTH)



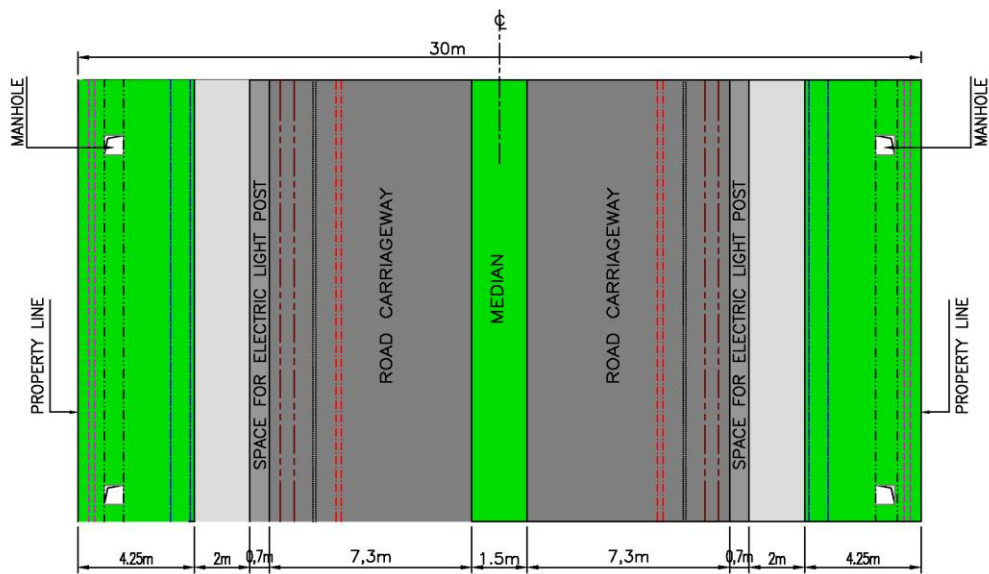
**PLAN OF COLLECTOR STREET**  
(20m WIDTH)

NOTE: DRAIN WITH COVER TO BE PROVIDED.

LEGENDS	
	SEWER LINE
	WATER LINE
	OFC CABLE
	GAS LINE
	LT CABLE
	HT CABLE



CROSS SECTION OF SUB-ARTERIAL TYPE ROAD  
(30m WIDTH)



PLAN OF SUB-ARTERIAL TYPE ROAD  
(30m WIDTH)

LEGENDS	
	SEWER LINE
	WATER LINE
	OFC CABLE
	GAS LINE
	LT CABLE
	HT CABLE

NOTE: DRAIN WITH COVER TO BE PROVIDED.

The typical cross-sectional view of the road structure is shown in the above figure. As elaborated in the figure, provision has been kept for riding surface, drainage, and street lighting facilities.

### 3.6.1. Power and Utility

#### 3.5.3.1. Overview

BSMSN has well-established power and utility network. The 20-Year Power Infrastructure Master Plan for BSMSN is an overview of both the current and proposed state of power plus the necessary interventions required to support all types of land uses and activities within BSMSN. As Feni EZ is a major part of BSMSN, information on the power and utility of BSMSN is important to get an overview of the power and utility of Feni EZ.

#### 3.5.3.2 Electricity Demand Assessment

##### a. Electricity Demand

The following electricity demand has been determined for the industrial precincts within BSMSN by using a data analysis method for clustering daily load requirements in industrial zone environments, classifying days in different groups with recognizable load patterns, and identifying meaningful characteristics for a proximity output.

Additionally, the electric power infrastructure for the remaining precincts within BSMSN depends on plot size, land use and building density (residential, commercial, institutional etc.). There electrical power demand is determined by kW/km<sup>2</sup> or kW/Acre.

##### b. Demand Assessment

Without an actual power design, the power demand of BSMSN is assessed and estimated by the careful application of kVA/Area rules. Demand assessment for BSMSN is given in the following table:

*Table 8 Demand assessment of electricity for BSMSN*

Precinct	Area in Acres	kVA/Acre	Demand KVA		Demand Factor	Max. Demand (MW)
			KVA	KW		
A	4606.57	182	958439.30	862595.37	0.6	517.56
B	1682.91	182	323930.88	291537.79	0.7	204.08
C	837.35	182	148202.60	133382.34	0.7	93.37
D	1778.59	182	367710.98	330939.88	0.6	198.56
E	880.68	182	159082.56	143174.30	0.7	100.22
F	10043.12	182	1836875.04	1653187.54	0.8	1322.55
G	1802.29	121	217591.88	195832.69	0.7	137.08
H	1778.75	121	213014.45	191713.01	0.7	134.20
I	3956.35	182	720055.70	648050.13	0.8	518.44
J	6030.42	-	0.00	0.00	0	0.00
K	350.89	100	35089.00	31580.10	0.7	22.11
L	56.85	-	0.00	0.00	0	0.00
<b>Total</b>	<b>33804.76</b>					<b>3248.17</b>

The demand assessment specific for Feni EZ is given in the table below:

*Table 9 Demand assessment of electricity for Feni EZ*

Precinct	Area in Acres	kVA/Acre	Demand KVA	
			KVA	KW
A	4606.57	182	958439.3	862595.37
B	178	182	34012.74	30611.47
F	2,393.00	182	440850.01	396765.01
J	2013.69	-	0	0
K	350.89	100	35089	31580.1
L	7.46	-	0	0
<b>Total</b>	<b>33804.76</b>			

### 3.5.3.3. Source of Power

#### a. Power Generation

The Government of Bangladesh formulated Power System Master Plan 2016, which has estimated peak demand to reach 13,300 MW by 2020 and 19,900 MW by 2025 respectively. Therefore, to meet annual demand growth of about 13% during 2018–2020 and 10% during 2020–2030, about 25,000 MW of new generating capacity is required during 2018–2030. Capacity of powerplants as per fuel type is given in the following table.

*Table 10 De-rated capacity of Power Plants as of May 2020*

Fuel Type	Capacity (Unit)	Total (%)
Coal	444.00 MW	2.32 %
Gas	10,261.00 MW	53.7 %
HFO	5,206.00 MW	27.25 %
HSD	1,771.00 MW	9.27 %
Hydro	230.00 MW	1.2 %
Imported	1,160.00 MW	6.07 %
Solar	35.00 MW	0.18 %
<b>Total</b>	<b>19,107 MW</b>	<b>99 %</b>
	<b>20,383 MW</b>	<b>100 %</b>

\*\* Source: BPDB and NLDC

The total Generation capacity of Bangladesh up to May 2020 is 19107 MW, most of the generating units are directly connected to the Nation Grid. The government set a target to reach 24,000 MW by 2021, 40,000 MW by 2030, and 60,000 MW by 2041 including 10% of energy from renewable resources.

#### b. System Generation and Demand Scenario

Presently in the power system, electricity demand is less than the installed generation capacity. The surplus or available electricity of the power system could meet the demand of the growing industrial sector in the different economic zone. The power generation and demand scenario of the network is shown in the table.

*Table 11 System Generation and Demand Scenario*

Generating Capacity (MW)	Demand (MW)		Balance Generation {MW}
	Day Peak	Evening Peak	
20,383	10,500	12,500	7,883

\*\* Source: NLDC, PGCB

### c. On-Site Generation

Economic Zones cannot rely solely on the national grid for power. To be successful, a zone requires clean, consistent, and stable access to power and back-up power in cases of emergency. For tenants/residents of BSMSN, they will receive high quality power from a variety of sources. As such, a percentage of total demand may be met by on-site generation facilities, which use large natural gas turbines (CCPT/CCPP) that have capacities of several hundred megawatts. Smaller on-site generation systems, however, can be installed at delicate basic facilities, such as schools, hospitals and hotels.

In the present scenario, BSMSN may take 2,000 MW (without contingency) from the grid network against the demand of 3,248 MW through an existing, dedicated 400 kV transmission linked with the grid system. For reliable power and to meet the demand, generating units around the capacity of 1500 MW should be planned; onsite as well as more HV links should be developed to connect the zone HV network to grid system. Feni EZ, being a large part of BSMSN will receive a good amount of share of this electricity.

### d. Fuel Diversification and the Renewal of Source

Power plants within BSMSN are perfect for the use of liquefied petroleum gas (LPG), natural gas, and/or liquefied natural gas (LNG). In some cases, in areas where natural gas will be available in the future, as an alternative option, exploring LPG as a 'bridge' fuel or an interim strategy until LNG infrastructure can be built over the longer term. Besides that, aim to reduce the industry sector's increasing demand for fossil fuels and the related CO<sub>2</sub> emissions, a provision of renewable also be planned to install in the form of floating, rooftop and panel along the inner slop of the dike. There might be some potential of offshore wind turbines too.

Renewable energy source will be the best option for minimizing pollution, increasing economy, energy security. Clean energy development is a fundamental requirement for addressing climate change and mankind's sustainable development as well as to maintain environmental sanctity of this world class industrial city.

In the table existing and planned on-site generation source for the mega economic zone with timeline for future references.

*Table 12 Expected on-site generation*

Plants and Utilities	Phase I (MW)	Phase II (MW)	Phase III (MW)	Total (MW)
<b>Power Hub A, Precinct F (Zone 5)</b>				
Combined Cycle Power Plant (BR PowerGen)	150	250		400
Combined Cycle Power Plant (RPCL)			200	200
Combined Cycle Power Plant (BSRM)			150	150
Renewable Energy Source (EGCB)	50			50
Renewable Energy Source	70	60		130
<b>Power Hub B, Precinct I (Zone 25)</b>				

Combined Cycle Power Plant (HFO/LPG/LNG Cired)		150	350	500
Renewable Energy Source			70	70
<b>Total</b>	<b>270</b>	<b>460</b>	<b>770</b>	<b>1500</b>

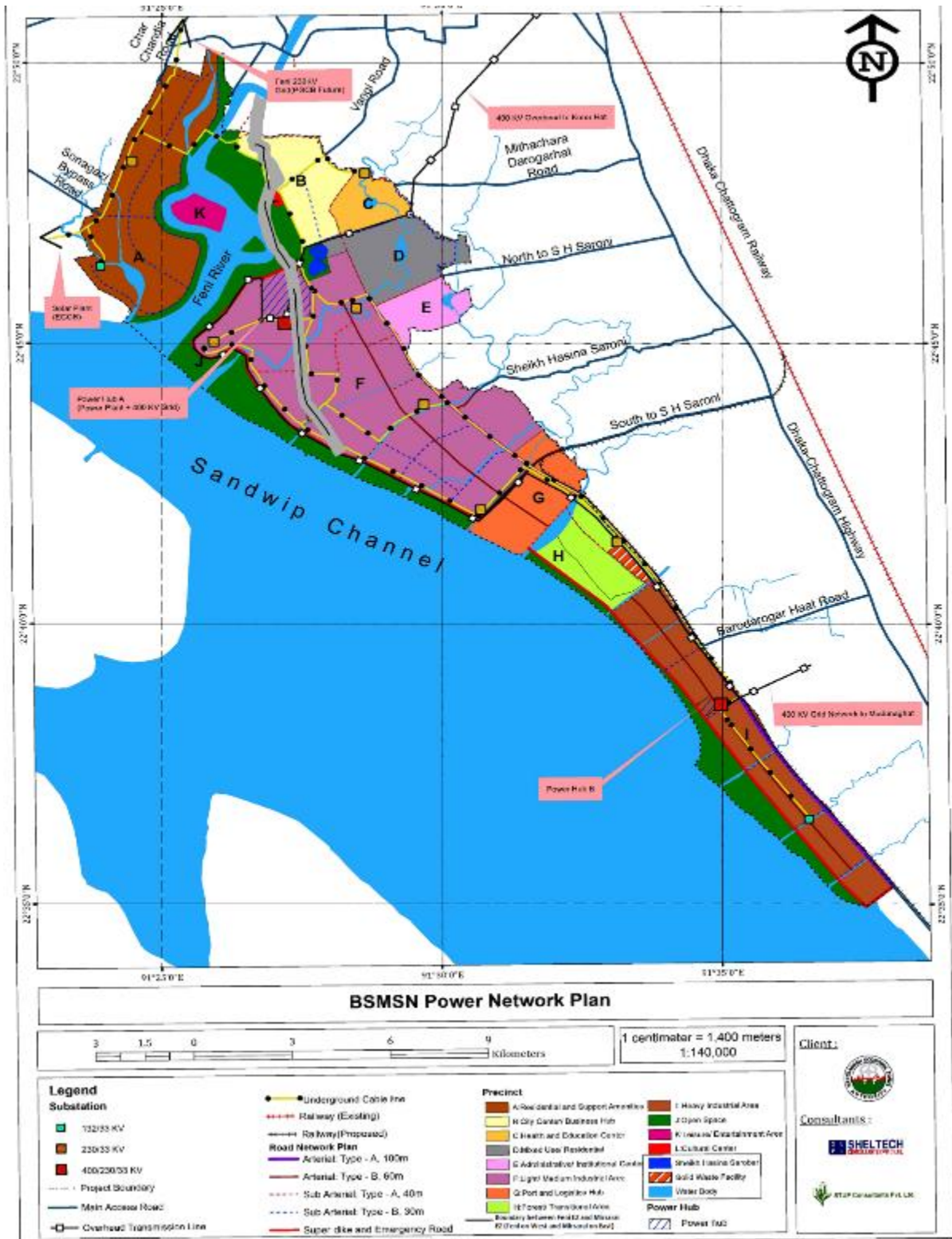
Power Hub A is located in Precinct F, 24% of which falls under Feni EZ. Expected on-site generation for Precinct F is summarized in the below table:

*Table 13 Expected on-site generation for Feni EZ*

<b>Plants and Utilities</b>	<b>Phase I (MW)</b>	<b>Phase II (MW)</b>	<b>Phase III (MW)</b>	<b>Total (MW)</b>
<b>Power Hub A, Precinct F (Zone 5)</b>				
Combined Cycle Power Plant (BR PowerGen)	150	250		400
Combined Cycle Power Plant (RPCL)			200	200
Combined Cycle Power Plant (BSRM)			150	150
Renewable Energy Source (EGCB)	50			50
Renewable Energy Source	70	60		130

System providers should plan the network at BSMSN in the manner some to be installed to satisfy and frequency and voltage control for maintain the quality of power and Black Start capability in extreme power outage. In each Variable Renewable Energy (VRE) generating unit is capable to generate maximum power output, depending on the availability of the primary resource, within the frequency range of 49.5 to 50.5 Hz. Generators and VRE unit shall be connected after facing a series of assigned tests.

Figure 11 BSMSN power network map



Source: Master Plan of BSMSN, 2020



### 3.5.3.5. Gas Supply

The 24 inches Bakhrabad-Chattogram Transmission line of GTCL passes along the Dhaka-Chattogram Highway, about 10 km from the site is expected to be the source of natural gas for BSMSN. The estimated natural gas demand for industrial use in the BSMSN area is 584.03 million cubic feet per day (MMcfd). Proportionate Feni EZ demand for natural gas is 70.08 MMcfd. <sup>3</sup>

## 3.6.2. Water

The water demand and supply network of BSMSN is also related with Feni EZ. Therefore, the water demand and water supply network of BSMSN is detailed out in the chapter with focus on Feni EZ.

### 3.6.2.1. Water Demand in BSMSN

#### Water Demand Assessment

##### a. Unit Rate for Water Demand

**Industrial Usages:** Unit rate of water demand is considered to be 162 m<sup>3</sup>/day/ha (0.066 MLD/acre) of operating industrial land. The operating industrial land is considered to be about 60% of gross industrial land.

**Domestic and Non-domestic (other than Industrial) Usages:** The unit water demand for various categories of residential and non-residential usages adopted to arrive at the net water demand is summarized below:

- Residential: 150 litres / capita / day
- Non-domestic usage in different industries: 45 litres / head / day
- Water demand for other miscellaneous usages: 5% of non-domestic demand

##### b. Gross Water Demand

The loss on account of unaccounted for water (UFW) is considered to be 20% (*loss along the clear water transmission main and distribution system: 15% + loss at water treatment plant and along the raw water transmission main: 5%*), with break-up as given below:

Raw water transmission	0.5%
Water treatment plant	4.5%
Clear water transmission	5.0%
Distribution network	10.0%
Total	20.0%

For desalination plants, the loss in the treatment process is considered to be 150% of the production rate. The loss quantity is brine water, which shall be returned back to the sea.

For a well-managed water supply system, the UFW losses is typically in the range of 10-12% of the net water demand at the consumer end. With metered water supply connection to all the consumers within BSMSN and good water management practices, the UFW losses (which is considered to be 20% at this stage) can be reduced further down. It is suggested to carry out “water loss management study” once the industrialisation pattern of BSMSN is substantially developed and water requirement of the area can be assessed more realistically to arrive at a firmer figure for the water losses. Requirement for further upgrading of the water supply sources including treatment requirement can be decided accordingly.

The estimated phase-wise net and gross water requirement to meet the water demand for BSMSN considering 20% losses, as indicated above, is summarized below.

<sup>3</sup> Considering 12% of the total industrial area of BSMSN to be the industrial area within Feni EZ.

Table 14 Estimated phase-wise net and gross water requirements of BSMSN

Row #	Description	Water Demand (MLD)			
		2025	2030	2035	2040
1	Industrial water demand	242	337	474	665
2	Domestic and non-domestic water demand	57	82	119	174
3	Net water requirement at consumer end	299	419	593	839
4	Water requirement at inlet of distribution network considering losses in distribution network	332	466	659	932
5	Water requirement at inlet of clear water transmission main considering losses in clear water transmission	350	490	694	981
6	Water requirement at inlet of water treatment plant considering inter-plant losses	366	513	726	1028
7	Quantum of raw water to be drawn inclusive losses in raw water transmission	368	516	730	1033

Row 3: Net water requirement at consumer end = Row 1 + Row 2  
 Row 4: Water requirement at inlet of distribution network = Row 3 / [(100 - 10.0)%]  
 Row 5: Water requirement at inlet of clear water transmission main = Row 4 / [(100 - 5.0)%]  
 Row 6: Water requirement at inlet of water treatment plant = Row 5 / [(100 - 4.5)%]  
 Row 7: Quantum of raw water to be drawn = Row 6 / [(100 - 0.5)%]

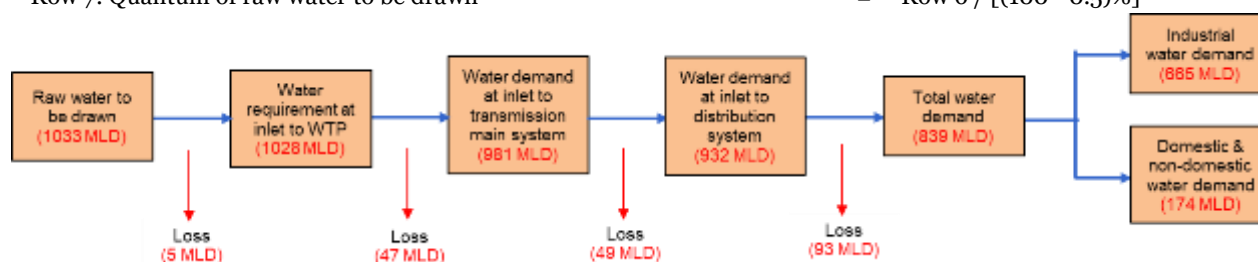


Figure 4-15: Representation of Ultimate Water Demand for Year 2040 For BSMSN

Effort shall be made to recycle/ reuse the wastewater to the extent possible and reduce unaccounted for water (UFW) losses. In the process, the water demand calculations may undergo changes, likely to get reduced. It is suggested to carry out “water balance study” in the year 2030. By that time, it is expected that the industrialisation pattern of BSMSN will be substantially developed, and water requirement of the area can be assessed more realistically. Moreover, the industrial demand for recycled wastewater after treatment will be clearer. Capacity requirement of various functional units of the water supply system beyond year 2030 to be further reviewed based on the findings of water balance study.

An assessment has been made under this study to evaluate the extent of water treatment necessary and quantum of raw water required to be drawn if 60% of the wastewater generated can be recycled after necessary treatment. Considering wastewater generation as 80% of the net water demand, the quantum of recycled water after treatment works out to about 333 MLD. In the process, the quantum of raw water to be treated works out to about 700 MLD.

### 3.6.2.2. Water Demand in Feni EZ

The water demand of Feni EZ can be estimated based on the following assumptions:

- Feni EZ constitutes 28% of the entire BSMSN area. Approximately 1 million people are expected to populate Feni EZ in 2040<sup>4</sup>. (Total BSMSN expected population in 2040 – 4.41 million). Hence, domestic and non-domestic water consumption may be estimated through this proportionate figure.
- Feni EZ constitutes only 12% of the total industrial area of BSMSN. Industrial development in BSMSN will be made in 20,144.10 acres and only 2,393 acres fall in Feni EZ. Therefore, only 12% of the industrial water demand is from Feni EZ.

*Table 15 Estimated Water Demand Forecast for Feni EZ*

SL	Description	Water Demand (MLD)			
		2025	2030	2035	2040
1	Industrial water demand*	29	40	57	80
2	Domestic and non-domestic water demand**	41	59	86	125
3	Net water requirement at consumer end	70	99	143	205
4	Water requirement at inlet of distribution network considering losses in distribution network	78	111	158	228
5	Water requirement at the inlet of clear water transmission main considering losses in clear water transmission	82	116	167	240
6	Water requirement at the inlet of water treatment plant considering inter-plant losses	86	122	175	251
7	Quantum of raw water to be drawn inclusive of losses in raw water transmission	86	122	175	252
	Total	472	669	961	1381

### *3.6.2.3. Source of Water Supply*

#### **Source of Raw Water**

Extensive studies and analyses have been carried out to identify the potential sources of raw water to meet the water demand for BSMSN. Various potential sources of raw water and the expected quantum of raw water that can be utilized/ withdrawn to meet the water requirement of BSMSN are summarized below.

- **Reservoir Upstream of Muhuri Dam with Regulator constructed over Feni River:** 100 MLD of raw water can be withdrawn from the reservoir upstream of Muhuri Dam with 20 Vent Regulators constructed under Muhuri Irrigation project.
- **Reservoir Upstream of Musapur Regulator constructed over Little Feni River:** 40 MLD of raw water can be withdrawn from the Musapur Regulator location to meet the water demand of BSMSN.

<sup>4</sup> 28% of 4.41 million ~ 1 million.

- **Mohra Treatment Plant Phase 2:** The water treatment plant, located at a distance of about 65 km from BSMSN is under construction with Halda River in Chittagong as source of raw water. About 90 MLD of treated water is available to supply to BSMSN.

- **Ground Water:** Total volume of ground water resources is estimated to be around 200 MLD considering 10m drawdown in the aquifer. Maximum 100 wells are proposed be installed with 20 hours operation/ day and considering withdrawal rate of 1 cusec (28.3 litre/sec) for each production well.

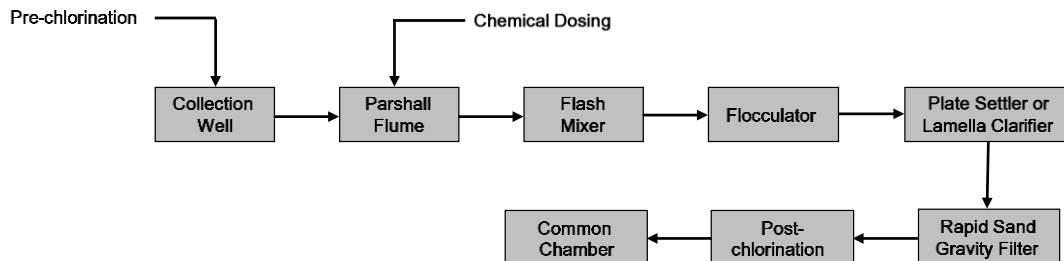
- It is further suggested to provide observation wells (at least 1 number per 1000 acres area) for obtaining water level, water temperature, or quality data.
- To prevent dwindling of ground water table due to the over-extraction of ground water, rainwater harvesting to recharge the ground water is suggested.

- **Recycled Wastewater After Treatment:** About 333 MLD of wastewater generated from BSMSN is suggested to be recycled to meet the industrial demand after treatment in the proposed common effluent treatment plants (CETPs) and sewage treatment plant (STP).

- **Sea Water:** About 678 MLD of raw water shall be withdrawn from the Sandeep Channel (sea water) and to be treated by constructing desalination plant to meet the total water requirement of BSMSN.

Two Desalination Plants are proposed for the BSMSN Master Plan Area. The locations of the plants shall be carefully selected depending upon the land use planning and bathymetry of the drawal position at sea.

*Figure 12: Desalination Process Flow Diagram*



Construction of a **Coastal Reservoir** is a possible alternative to be considered as a potential source of raw water in lieu of seawater. A coastal reservoir is a freshwater reservoir located in the sea at the mouth of a river with a sustainable annual flow which otherwise gets lost to the sea. All a coastal reservoir needs to be effective is an impermeable barrier between the fresh river water and the salty sea water.

### Rainwater Harvesting for Artificial Recharge to Groundwater

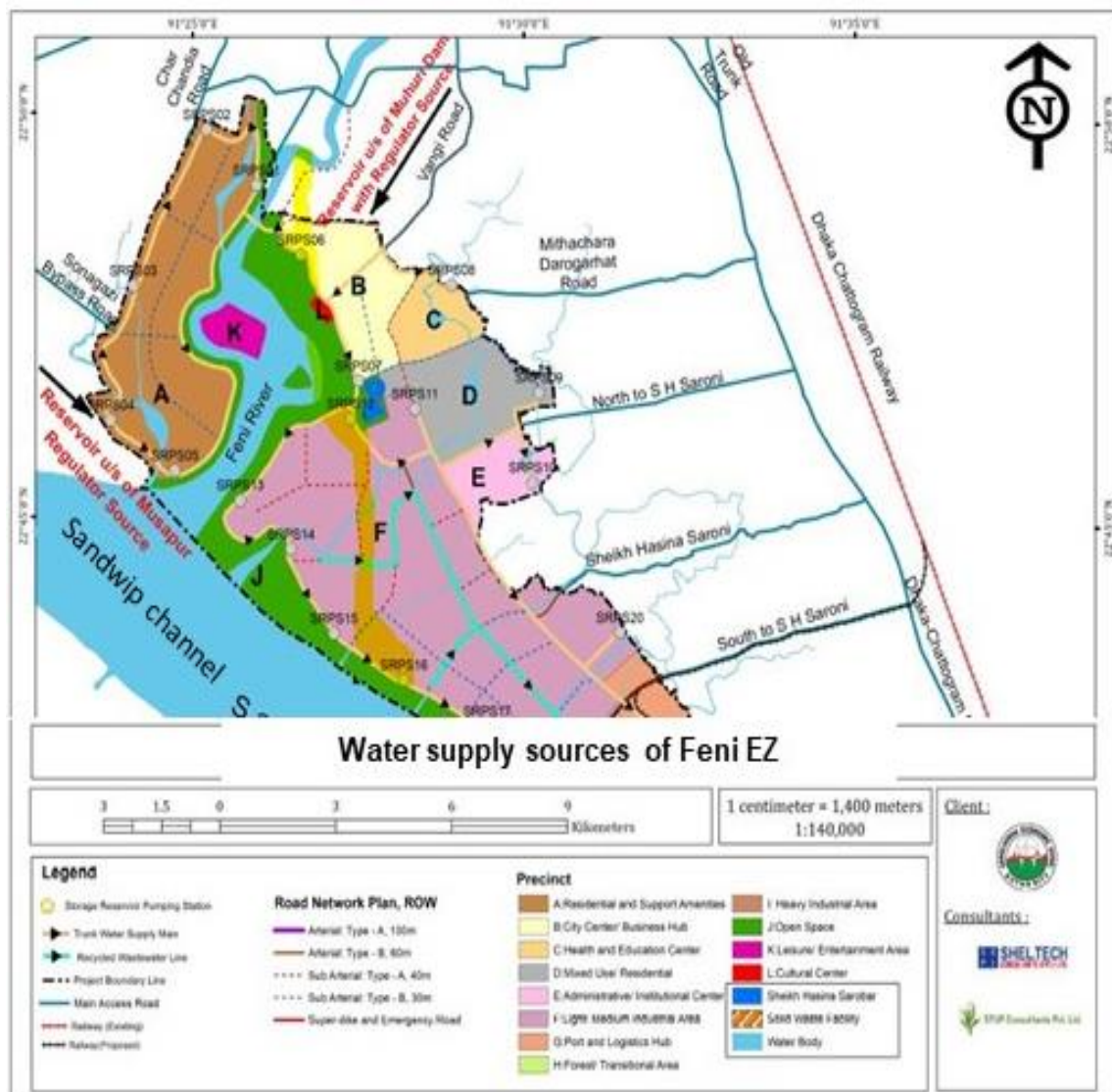
It is well known that excess ground water abstraction can lead to dwindling of the ground water table or even intrusion of saline water due to imbalance in ground water recharge and abstraction volume. Such situation should be avoided either by decreasing the dependency on ground water or gradually increasing the ground water storage volume by artificial recharge to the aquifer systems.

### Actions to be taken for Effective Rainwater Harvesting Programme

Actions to be taken for effective rainwater harvesting and recharging of ground water are:

- Rainwater harvesting must be widely practiced all over the BSMSN to effect large scale replenishment.
- Directives may be issued to all the investors to carry out rainwater harvesting and make it mandatory to charge rooftop rainwater to the productive aquifer.
- Runoff generated from first flush of rain should be directed to drainage outlet, instead of recharging to prevent possibility of any contamination to ground water.
- Harvesting schemes must be prepared and implemented under expert technical care and proper maintenance must be ensured. Or else, instead of improvement, there would be adverse impact. It may be worth to mention here that any degree of pollution caused to the aquifer is irreversible. The detailed water supply source and demand are added in Annxure G.

Figure 13: Water Supply sources of Feni EZ



Source: Master Plan of BSMSN, 2020

### 3.6.3. Stormwater Drainage system

The entire area of BSMSN, which is mostly low-lying, is currently in the process of infilling to a level of about 7.0m mean sea level (MSL). Average height of in-filling is about 3.4m. The project area is cyclone

prone. A super dyke is under construction (dyke top level is fixed at 9.0m MSL) to prevent ingress of sea water to the BSMSN, even during the event of any cyclonic storm.

With infilling of the entire project area and construction of the super dyke, natural drainage system of the area will get affected. Development of proper drainage network with optimum utilization of the existing natural drainage channels is of utmost importance, without which severe and prolonged water logging all over the project area is anticipated.

To encourage ground water recharging and to attenuate the flow rate through the drainage channels, a number of water bodies are going to be established for the entire BSMSN. This, in addition, will have the advantage of storage of water to meet fire demand, in case of exigency.

All the existing drainage channels, passing through BSMSN are connected to the sea and have got strong tidal influence. To prevent ingress of sea water to the drainage channels during high tide condition, at all the existing outlet positions sluice gates are to be installed. Consequently, gravity discharge of storm water to the sea will not be possible during the time of closure of the gates owing to high tide condition. Under such situation the only left out option will be to pump out the storm runoff generated to the sea.

### ***Rainfall Pattern***

For the most realistic assessment of the rainfall pattern, it is essential to have 15-30 minutes interval rainfall records based on rainfall histograms for a prolonged period (preferably not less than 15 years). The higher the period of availability of historical rainfall records, the more realistic will be the rainfall analysis findings. Historical rainfall records will be collected from Sitakunda meteorological station which is in proximity to BSMSN.

### ***System Planning***

The drains shall be of rectangular RCC section. In the residential/ commercial locations and all other non-industrial areas, the proposed storm drains shall be fully covered. Arrangements for the removal of slabs or providing manhole covers at an interval not exceeding 30m shall be provided to facilitate regular cleaning/ desilting of the drains. For other areas, it may be kept open considering easier maintenance. Suitably designed culverts need to be provided at all road crossings. Stormwater inlet arrangement needs to be provided at an interval not exceeding 10m to allow ingress of storm runoff into the system.

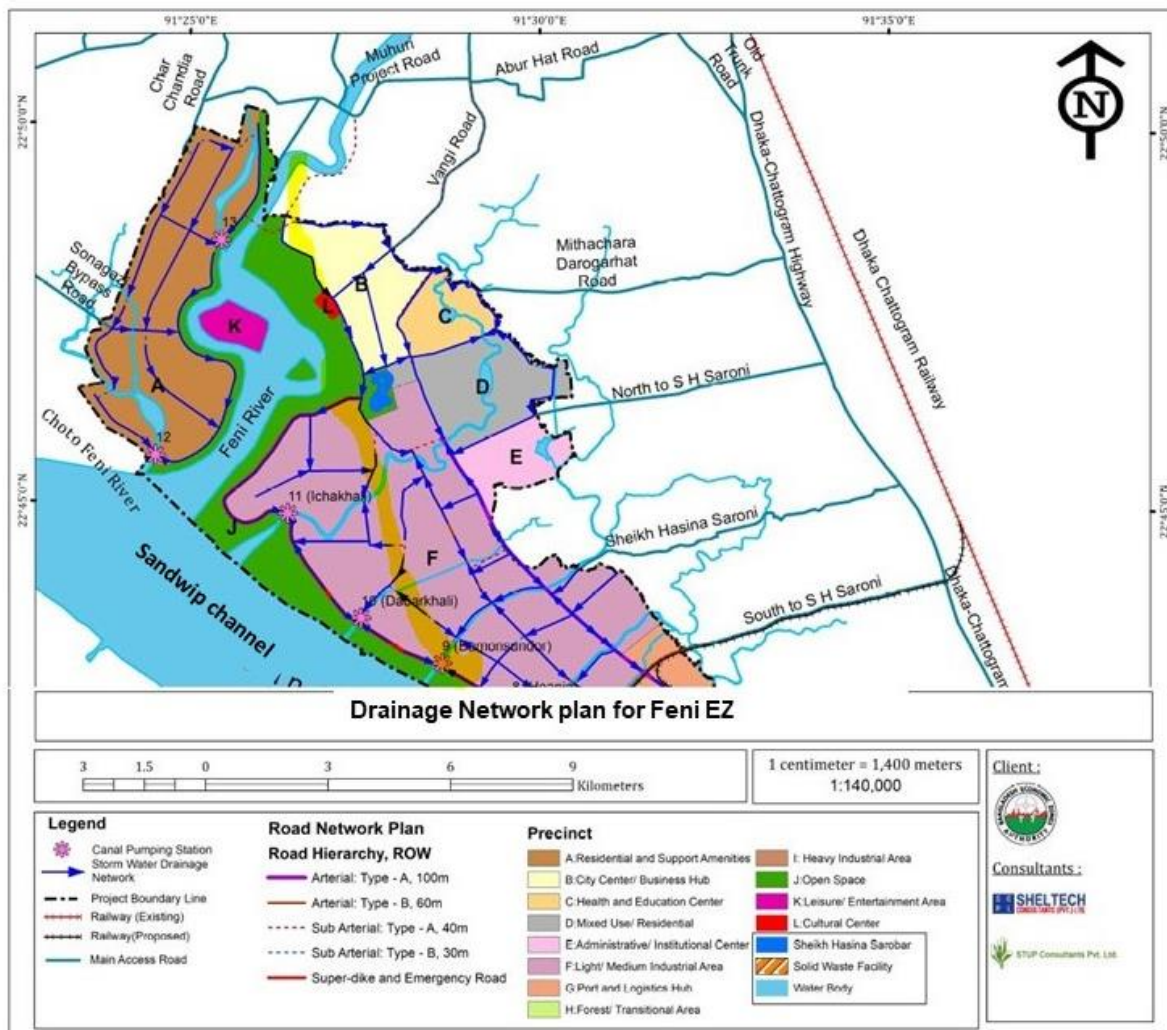
In addition, stormwater outlets to natural drainage channels are proposed at intervals varying between 250-400m depending on the proposed road network of the area to facilitate direct discharge of storm runoff for the plots adjoining the drainage channels, which in turn will reduce the load to the drainage network being developed. Wherever applicable, individual plot owners may be encouraged to provide a greater number of outfalls to the natural drainage courses while developing a stormwater drainage network within their premises.

### ***Proposed Storm Water Drainage System***

For Feni economic zone, the proposed drainage network system shall be on either side of the proposed road network of the area to collect the stormwater/runoff generated from the catchment area and get it discharged to the drainage channel for ultimate disposal to the sea. In addition, the indicative command area (catchment area) for each of the existing drainage channels passing through BSMSN with locations of the pumping stations, is proposed at the location close to its outfall to the sea. Figure 11, and 12 shows the drainage network plan and catchment area of drainage across Feni EZ, where mentioned stormwater discharge network and canal pumping station. There have been proposed 5 canal pumping stations that received stormwater from the catchment area and store the water and discharge it to the sea.

An assessment of storm runoff contribution from BSMSN and areas outside BSMSN for individual drainage catchment areas has been made considering rainfall intensity of 34.4 mm/hr. and average runoff coefficient of 0.60 (keeping into consideration that rainwater harvesting will be extensively practiced in BSMSN) for the area within BSMSN and an average runoff coefficient of 0.40 for the area outside BSMSN. The land area requirement for the different drainage pumping stations is also given in the same Annexure.

Figure 14: Drainage Network Plan for Feni EZ



Source: Final Master plan of BSMSN

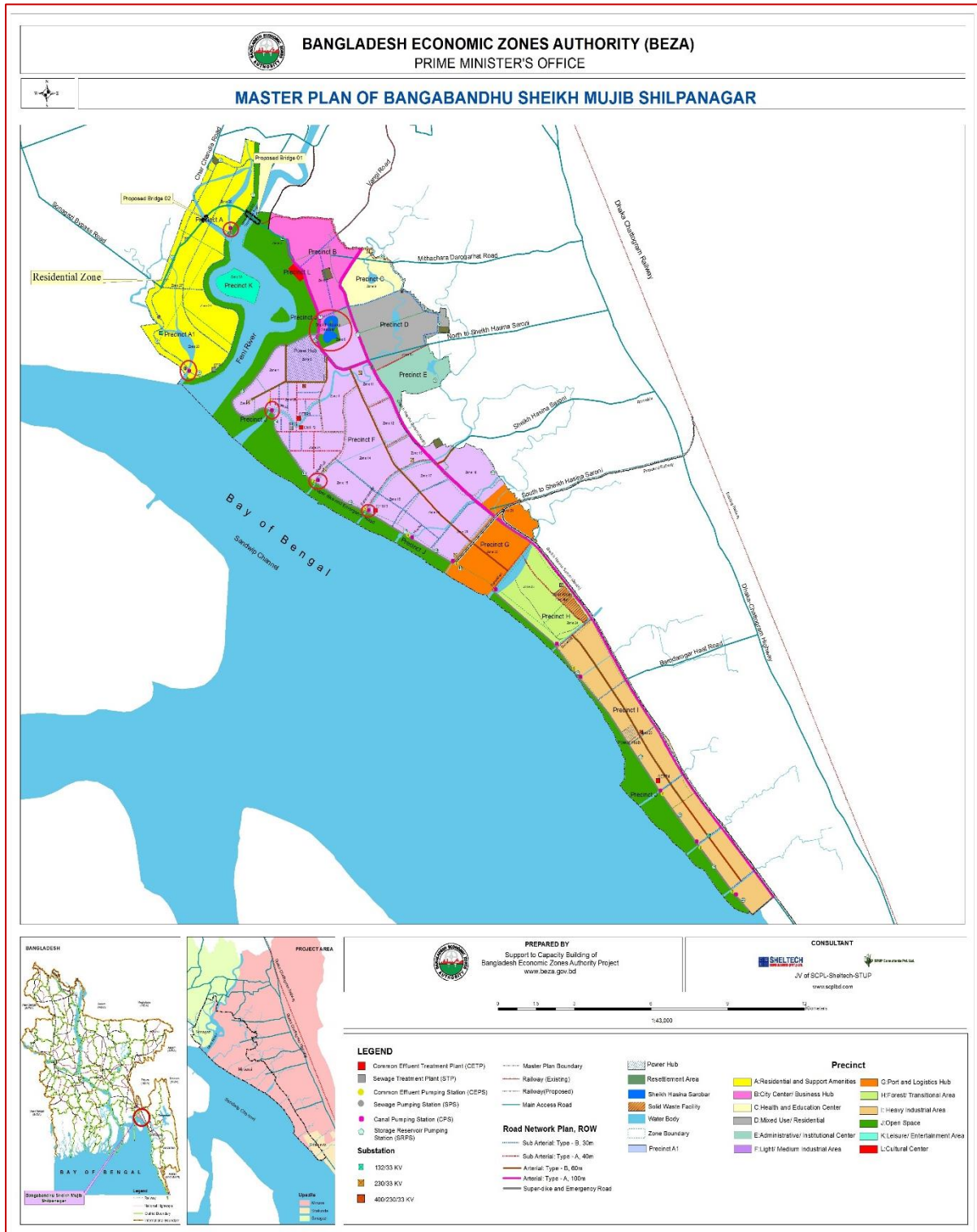
### 3.6.3.1 Retention Pond and Canal:

The entire area of BSMSN, which is mostly low-lying, is currently in the process of infilling to a level of about 7.0m MSL. There will have been constructed 13 canal pumping stations among them 5 canal pumping stations will be constructed within Feni EZ area of precincts A, A1, J, and precinct F. The stormwater canal pumping station will receive water and attenuate the flow rate through the drainage channels which then discharge to sea.

BEZA has taken initiative to ensure maintenance of existing water body and create new water reservoir and lakes in Mirsarai EZ. Three lakes, each one having sizes of approximately 100 acres of land, are going to be developed in this zone and the first one is in implementation stage. The lakes have been named after Prime Minister Sheikh Hasina as Sheikh Hasina Sarobar and these lakes will promote tourist attractions assuring environmental protection of the whole zone.

In addition, in Precincts F, zone 6, there will be constructed a large lake or water body named “Sheikh Hasina sarobar”, stores water and this, in addition, will have the advantage of storage of water to meet fire demand, in case of exigency. Thus, the Feni EZ will take advantage of this large lake or water body in “Sheikh Hasina sarobar” as a retention pond to meet the requirement. Figure 15, the red circle has mentioned the canal pumping station and ‘large lake or water body’ The rainfall estimation of the area has been already discussed in the earlier section and details of the canal pumping station area, and capacity is added in Annex G.

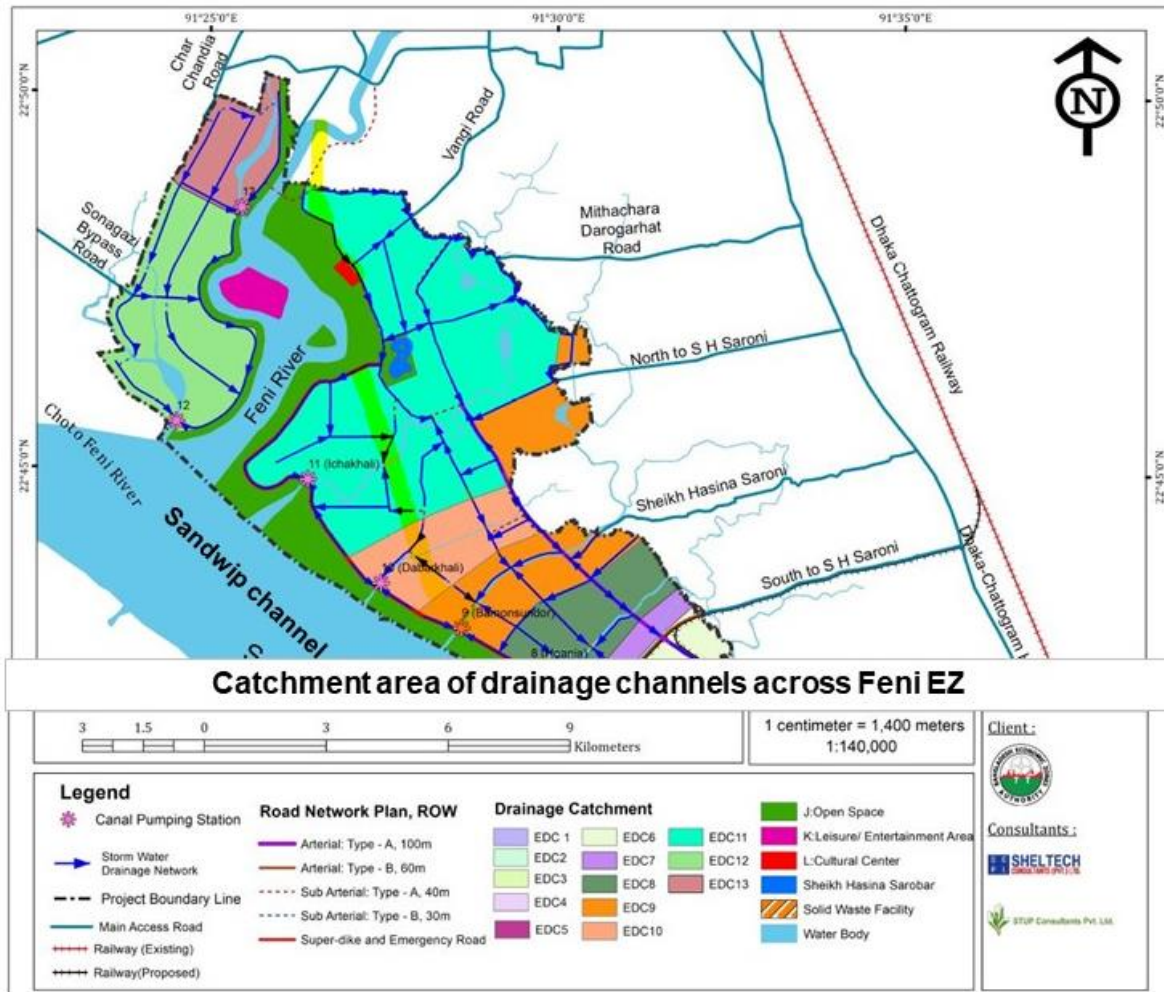
Figure 15: Canal pumping station and water pond



Source: Master Plan of BSMSN, 2020



Figure 16: Catchment area of drainage across of Feni EZ



Source: Final Master plan of BSMSN

### 3.6.4. Telecommunication Network

Telecommunications and associated applications have long been recognized as key enablers of the three dimensions of sustainable development-economic growth, environmental balance and social inclusion. Bangladesh Telecommunication Regulatory Commission (BTRC) has been functioning to regulate the activities of Telecommunication and Internet Service Providers.

In Bangladesh, both, landline and mobile phone networks are available. Landline facilities including connections and maintenance are done by BTCL (Bangladesh Telecommunications Company Ltd.). At present no landline communication is available at the site or its immediate surroundings.

There are 5 mobile phone operators in Bangladesh, operating under the names of Airtel, Banglalink, Grameenphone, Robi and TeleTalk. The BSMSN area has 3G internet coverage of Grameenphone and 4G coverage of Robi, two leading operators in Bangladesh. Both these companies have voice call availability at the site.

### ***3.6.5. Developing Green Areas***

There are several ways to make green BSMSN in order to create pleasant environments, which are sustainable and resilient to climate change. Some options are presented below:

#### ***3.6.5.1 Green Streets: The Core concept***

Planting trees along the street edge to create a 'Green Street' is important to enhance both the traffic and pedestrian experience. A green street or green Infrastructure (GI) can be defined as combination of natural and human-made elements that provide ecological and hydrological functions and processes etc. Green Streets help to build a city that is resilient to climate change and contributes to an improved quality of life.

##### ***Options for Creating Green Streets:***

- Urban Forest Canopy
- Native Herbaceous Planting
- Street Trees
- Green Walls
- Trees in Soi Cells
- Trees in Open Planters

#### ***3.6.5.2 Plantation Along with Roads, Railway and Natural Channels***

A comprehensive plantation plan has been proposed along the road and rail networks, natural water channels, coastal area along the Bay of Bengal and the Feni River, open spaces, and in Precincts K and L of the BSMSN Master Plan.

##### ***Specific Plantation Guidelines for Precincts J (Feni EZ):***

Precinct J, fall under the Feni EZ area, contains lands along the Bay of Bengal to the super dyke. This area has been reserved for open space and is to remain mainly as a forest of mangroves. This area will act as a prime barrier to any future cyclonic storms and will keep BSMSN resilient and protected from climate change calamities

This site should be planted according to the coastal afforestation guidelines. According to FAO's 'Coastal Forest Rehabilitation Manual', the number of trees per hectare can vary greatly between different planting densities. For example, planting trees at 0.5 x 0.5 m spacing requires 40,000 trees per hectare, while at 1 x 1 m spacing 10,000 trees are required and at 1 x 2 m only 5,000 trees are required. The spacing of trees has been determined by the typology of mangrove trees. Choice of spacing of trees has been determined by the canopy coverage of mangrove trees. Tree having larger canopy coverage requires more spacing.

This plantation will provide multiple climatic advantages for the city, such as:

- Conservation of mangrove forest
- Minimize effect of climate change
- Protect BSMSN site from cyclonic storm
- Protect the site from erosion
- Biodiversity restoration
- Allow linear parkland for active and passive experiences
- Create a positive effect on the microclimate
- Control temperature for BSMSN

Existing land use of the project area (BSMSN) indicates the fact that currently about 9,550 acres of plantation existing within the premises of the said industrial city which will be impacted (lost) due to

development of the city Detailed consultation with DFO Coastal Plantation, Chittagong it was suggested that BEZA can take initiative for plantation in other potential areas.

**List of Trees for Precinct J:**

There is an opportunity to create a very important green environment along the coastline of BSMSN as long as it is comprehensively planned and implemented in phases. The area should be a mix of forest and mangroves to support biodiversity and flora/fauna in the region as well as provide a series of linear park spaces (both active and passive) for BSMSN residents, investors, workers, and visitors. This Coastal Green Plan should be designed by BEZA and approved by the Bangladesh Forest Department. It should also follow coastal afforestation guidelines of Food and Agriculture Organization (FAO) and International Union for Conservation of Nature (IUCN). Some of the preferred local species for this Precinct are:

Sl.	Common Name	Scientific Name
1	Sundari	<i>Heritiera fomes</i>
2	Gewa	<i>Excoecaria agallocha</i>
3	Passur	<i>Xylocarpus mekongensis</i>
4	Dhundul	<i>Xylocarpus granatum</i>
5	Kankra	<i>Bruguiera sexanula</i>
6	Khalshi	<i>Aegiceras corniculatum</i>
7	Shingra	<i>Cynometra ramiflora</i>
8	Goran	<i>Ceriops decandra</i>
9	Kirpa	<i>Lumnitzera racemosa</i>
10	Hantal	<i>Phoenix paludosa</i>

Source: Master Plan of BSMSN 2020.

Figure 17: Greening management plan

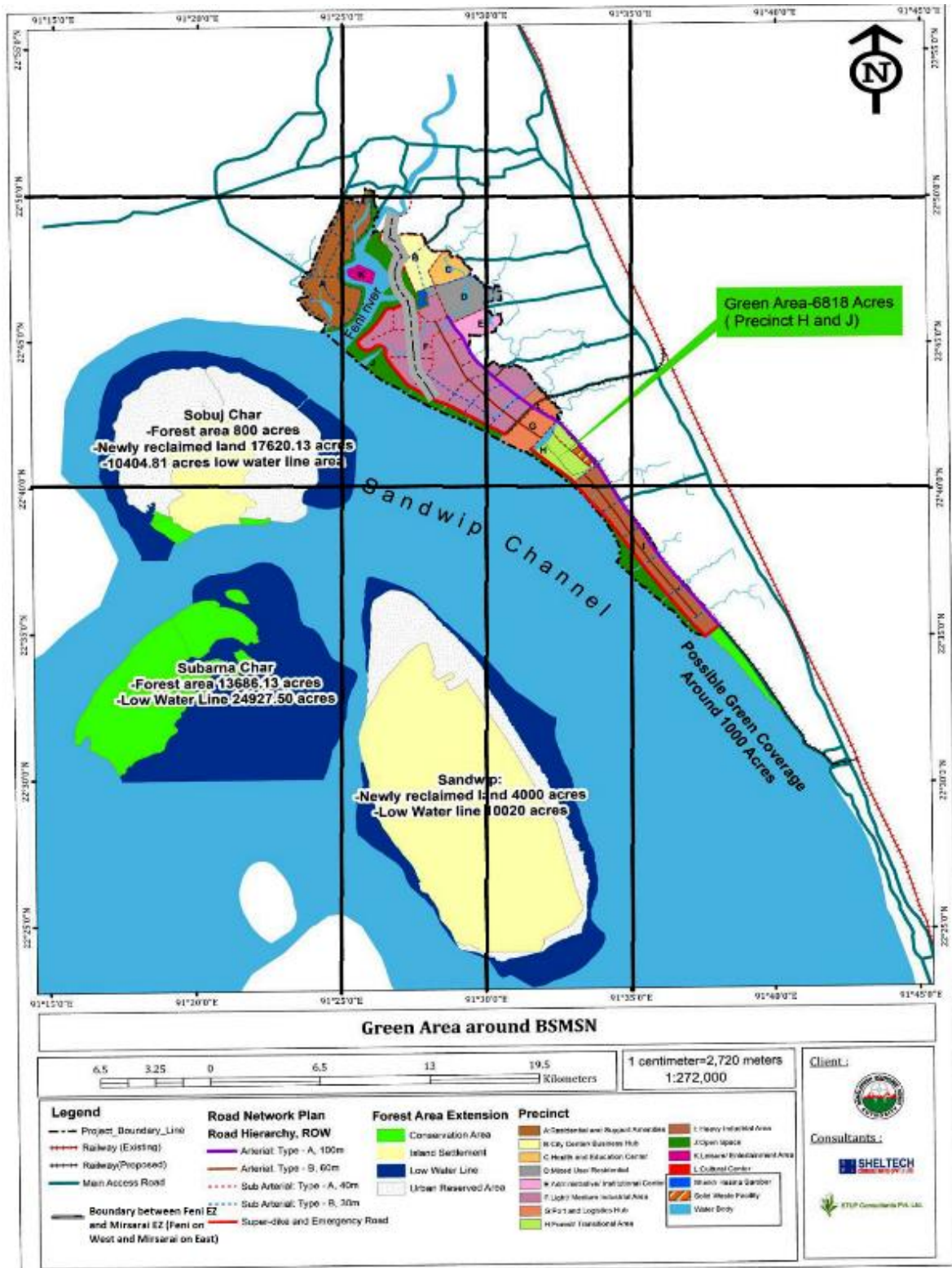


16: Other Potential Areas for Plantation

<b>Plantation Locations:</b>	<b>Area to be Planted in Acres</b>
<b>Total Subarna Char - low line water line area of Subarna Char will be kept for green coverage.</b>	24,924.00
<b>40% of the reclaimed Sabuj – Char</b>	7048.00
<b>Sabuj Char - low line water line area of Sabuj Char will be kept for green coverage.</b>	10,404 .00
<b>60% - low line water line area of Sandeep Char will be kept for green coverage</b>	6,000.00
<b>Total Proposed Plantation Area</b>	<b>48,376 Acres</b>

Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

Figure 18: Green Areas in BSMSN (including Feni)



### 3.6.6. Liquid and Solid Waste Management

In the proposed industrial city 33,805 acres of land has been proposed for development of BSMSN out of which Feni EZ constitutes 9549.61 acres. In BSMSN 15,781 Acres has been proposed exclusively for industrial activities which will include Light Industrial Area, Port and Logistics Hub and Heavy

Industrial Area. Land area of 18,024 acres has been proposed for non-industrial activities like - Residential Area, Center /Business Hub, Health and Education Centre, Mixed Use/Residential, Institutional and Administrative Centre, Forest Conservation Area, Open Space and Leisure/Entertainment Area.

Two types of waste will be generated from both industrial as well as non-industrial areas – Solid waste and Liquid waste. Municipal solid waste (MSW) will be generated from household activities, commercial activities, institutions and from health care units. Industrial solid waste (ISW) will generate from industries. Both MSW and ISW may be hazardous and non-hazardous in nature. The table below indicates the type of waste to be generated from various activities of the industrial city.

*Table 17: Type of Waste Generation in BSMSN*

Land Use of Precincts	Area in Acres (BSM SN)	Area in Acres (Feni EZ)	Types of Solid Waste Generation						
			Municipal Solid Waste (MSW)		Industrial Solid Waste		Biomedical Waste	Domestic Sewage	Industrial Waste Water
			Non-Hazardous	Hazardous	Non-Hazardous	Hazardous			
<b>Residential and Support Amenities</b>	4606.57	4606.57	√	√				√	
<b>City Center/Business Hub</b>	1682.91	178	√	√				√	
<b>Health and Education Center</b>	837.35	-	√	√			√	√	
<b>Mixed Use/Residential</b>	1778.59	-	√	√				√	
<b>Administrative/Institutional Center</b>	880.68	-	√					√	
<b>Light/Medium Industrial Area</b>	10043.12	2,393.00	√		√	√		√	√
<b>Port and Logistics Hub</b>	1802.29	-	√		√	√		√	√
<b>Forest/Transitional Area</b>	1778.75	-	√					√	
<b>Heavy Industrial Area</b>	3956.35	-	√		√	√		√	√
<b>Open Space</b>	6030.42	-	√					√	
<b>Leisure/Entertainment Area</b>	350.89	350.89	√					√	
<b>Cultural Center</b>	56.85	7.46	√					√	

Source: Analysis of Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

### **3.6.6.1 Waste Management Approach**

Considerations for preparation of the Waste Management Plan are:

- Liquid waste in the form of Domestic Sewage and Effluent (Wastewater) from industries has not been considered in this section of the report. It has been explained in Chapter 3 of this report that Domestic sewage will be treated in 2 STPs proposed in the suitable locations within the Industrial city premises. Wastewater discharged by individual industries will be treated in the individual ETPs of the industry as per the guideline provided by the Industrial City authority and will be discharged in to CETPs suitably located within the Industrial city premises for final treatment and will be discharged into nearby River / Canal as per DOE, GOB national wastewater discharge standard.

- Waste Management Plan for the Industrial city has been prepared based on the relevant Acts, Laws, Rules, Circular, Guidelines and document related to Bangladesh and international practices.

### ***3.6.6.2 Wastewater (Domestic and industrial liquid waste) Generation Potential & Sewer Network***

The entire quantum of liquid waste (domestic and industrial liquid waste) likely to be generated from BSMSN shall be catered to two sewage treatment plants (STPs) and four central effluent treatment plants (CETPs) aided by intermediate pumping stations.

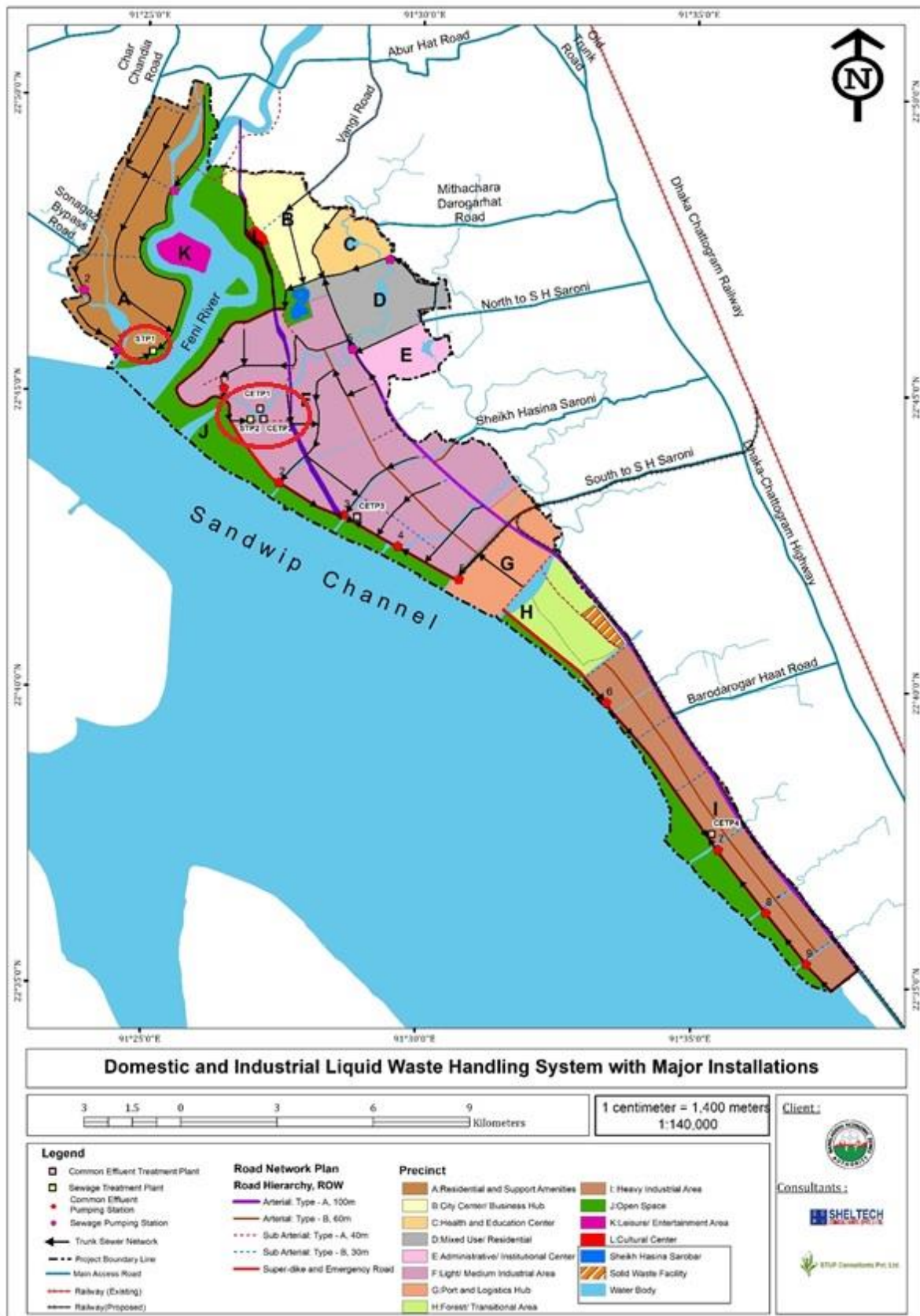
The prime purpose of providing the intermediate pumping stations is to restrict the depth of the sewers and to facilitate the crossing of the different natural drainage channels passing through BSMSN. Strategically the pumping stations shall be in proximity to natural drainage channels to minimize the lengths of pumping mains. The different drainage channel crossings shall be affected by pipe supporting structures. In addition, terminal pumping stations shall be provided at location of all the treatment plants (STPs/ CETPs).

Considering the landuse characteristics, Precincts A, B, C, D, E and K will produce predominantly biological liquid waste i.e., where content of hazardous liquid wastes is insignificant. Precincts F and I are ear-marked for industrial use (light, medium and heavy). Precinct G is ear-marked for port and logistics. Such areas will produce industrial liquid wastes, with varied degree of toxicity. In addition, such areas will also produce biological liquid waste (generated from residential population accommodated within the zone). The pipe material suggested to be used (uPVC/ GRP) that are resistant to corrosion and the same pipeline may be used to cater all types of flow generated from the industrial areas.

The Quantum of liquid waste likely to be generated from industrial areas is not expected to exceed 5% of the quantum of industrial flow. As such, the combined flow generated from such areas is not likely to pose any functional problem to the CETPs to be constructed. A separate set of pipelines to carry industrial liquid waste and domestic liquid waste, as such, is not felt necessary.

Feni EZ, which constitutes 28 percent of the area earmarked for BSMSN development. Feni EZ area houses 72% of the residential area within BSMSN. The nature of wastewater and sewage generation from the precincts in Feni EZ are detailed below:

Figure 19: Domestic and Liquid waste treatment by STP, CETP installment location



Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan



Table 18: Nature of Liquid Waste Generated from Feni EZ

Precincts	Function	Total Area	Area under Feni EZ	Nature of Liquid Waste
A	Residential and Support Amenities	4,606.57	4606.57	Predominantly biological liquid waste i.e, where the content of hazardous liquid wastes is insignificant.
B	City Center/Business Hub	1,682.91	178.00	Predominantly biological liquid waste i.e., where the content of hazardous liquid wastes is insignificant.
F	Light/Medium Industrial Area	837.35	2,393.00	Will generate industrial liquid wastes, with varied degrees of toxicity. In addition, such areas will also produce biological liquid waste from residential housing within the zones.
J	Open Space	1,778.59	2013.69	Unlikely to generate liquid waste.
K	Leisure/Entertainment Area	880.68	350.89	Predominantly biological liquid waste i.e., where the content of hazardous liquid wastes is insignificant.
L	Cultural Center	10,043.12	7.46	Unlikely to generate liquid waste.

### 3.6.6.1. Sewage Treatment Plant (STP)

Raw sewage generated from areas which produces predominantly biological liquid waste i.e., the content of hazardous liquid wastes is in insignificant amount shall be treated using conventional biological treatment processes. The precincts which fall under Feni EZ and will predominantly generate biological liquid waste are Precinct A: Residential Area, Precinct B: City Center/Business Hub and Precinct K: Leisure/ entertainment area.<sup>5</sup>

The raw sewage generated from the areas as mentioned above is predominantly (almost 99%) water-carrying domestic wastes originating in kitchen, bathing, laundry, toilets etc. A portion of these goes into solution. The remaining goes into colloidal or suspended stages. It also contains salts used in cooking, sweat, bathing, laundry and human excreta. Waterborne pathogenic organisms from the human excreta of already infected persons are also present in raw sewage.

Sewage generated from industrial areas like Precinct F will contain predominantly hazardous chemical wastes with a limited quantity of biological wastes and not suitable for treatment using a conventional biological treatment process alone. Raw sewage generated from such areas is proposed to be taken to a common effluent treatment plant (CETP) for treatment.

The design period for the sewage treatment plant (STP) is planned to meet the requirements upto the project horizon of 2040. The development works for STP is planned to take into consideration the phased increment in demand.

### Capacity Requirement for Sewage Treatment Plants

For the BSMSN area two Sewage Treatment Plants (STPs) are to be provided in the system, each with provision of modular development. Command area of the two STPs are:

- STP 1: to serve entire portion of Precinct A

<sup>5</sup> Precinct B will fall partially under Feni EZ.

- STP 2: to serve entire portion of Precincts B, C, D and E

The facility will have 5 Sewage Pumping Station giving coverage to these precincts. Capacity requirement for the two STPs based on water demand assessment are as follows:

Table 19 Capacity Requirements of BSMSN for the STPs

STP	Estimated Sewage Flow (MLD)				Proposed STP Capacity (MLD)			
	2025	2030	2035	2040	2025	2030	2035	2040
1	13.68	19.68	28.56	41.76	15	20	30	45
2	25.07	36.07	52.36	76.56	25	40	55	80

Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

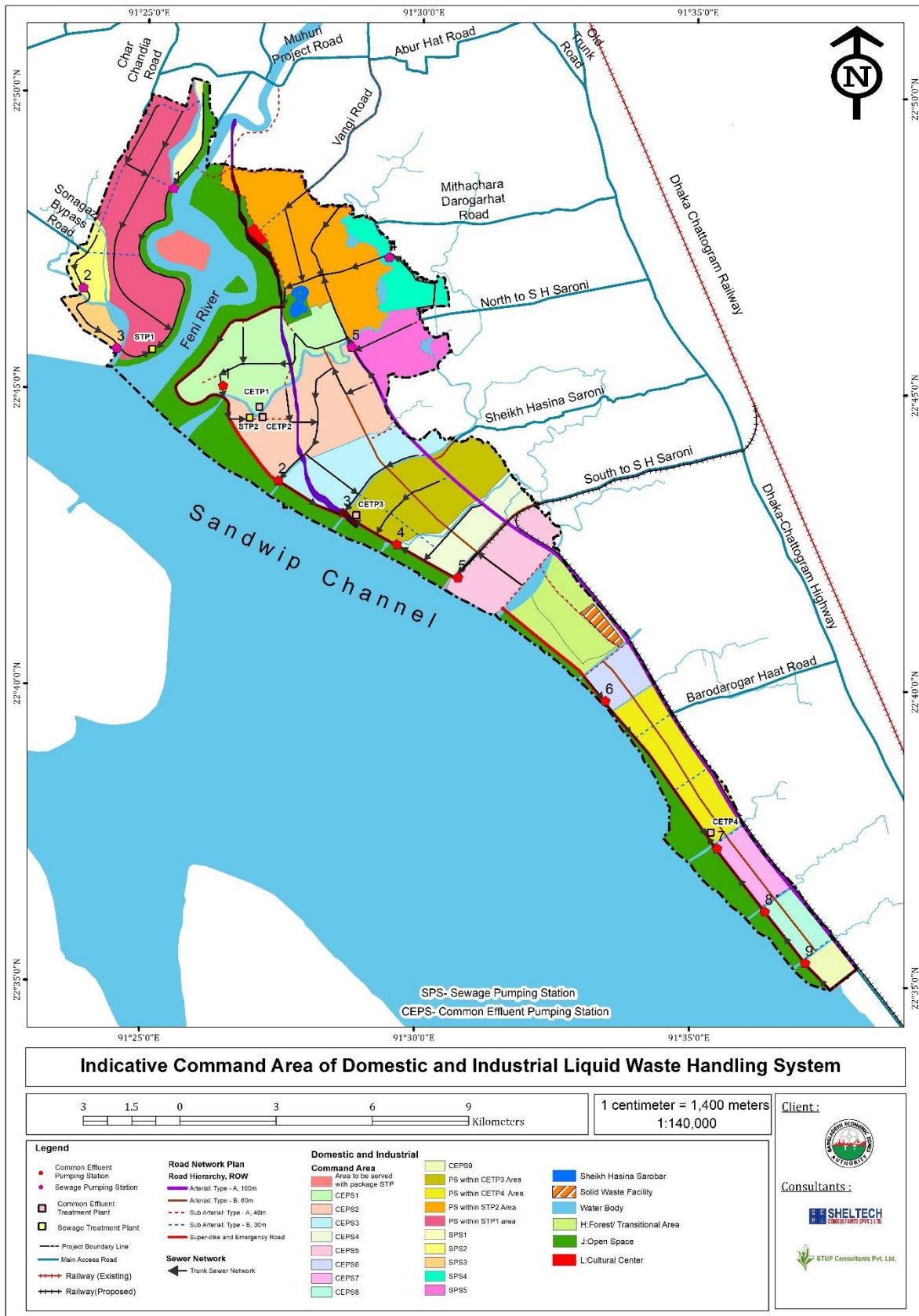
Feni EZ constitutes 72 percent of the residential area in BSMSN. Precinct A, which falls under Feni EZ, is the largest residential zone in BSMSN. Feni EZ will take support of both the proposed STPs. STP 1 will cater to Precinct A and STP 2 will cater to the partial portion of B which falls under Feni area. Significant proportions of the estimated sewage flow are generated from Feni EZ as detailed out below:

Table 20 Estimated Sewage Generation for BSMSN and Feni EZ (Sewage Pumping Station Wise)

Sewage Flow	BSMSN				FENI Zone			
	2025	2030	2035	2040	2025	2030	2035	2040
Within the command of Sewage Treatment Plant 1								
SPS 1	0.795	1.143	1.659	2.426	0.795	1.143	1.659	2.426
SPS 2	1.311	1.886	2.737	4.002	1.311	1.886	2.737	4.002
SPS 3	1.172	1.687	2.448	3.579	1.172	1.687	2.448	3.579
Terminal PS within STP 1 Area	10.14	14.587	21.169	30.953	10.14	14.587	21.169	30.953
Within the command of Sewage Treatment Plant 2								
SPS 4	5.81	8.36	12.14	17.5	-	-	-	-
SPS 5	6.61	9.51	13.8	20.18	-	-	-	-
Terminal PS within STP 2 Area	12.65	18.2	26.42	38.63	0.759	1.092	1.5852	2.3178
Total Estimated Sewage Flow	38.488	55.373	80.373	117.27	14.177	20.395	29.5982	43.2778

Source: Analysis of Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

Figure 20: Sewerage Network



Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

## Recommended Quality Standards for Treated Effluent (from STPs)

Recommended guidelines for treated sewage for discharge into surface water to be used as source of drinking water is as follows:

Table 21 Sewage Quality

Parameters	Recommended Values
Biochemical oxygen demand, BOD <sub>5</sub> (mg/l)	Less than 1
Suspended solids (SS) (mg)	Less than 1
Total nitrogen (TN) (mg/)	Less than 1
Dissolved phosphorous (mg/l)	Less than
Faecal coliform (MPN/100 m)	Less than 23

Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

## Sewage Treatment Plant Technology

Of the different sewage treatment technologies available, extended aeration (oxidation ditch) system is suggested considering the degree of complexity, ease in operation and past performance record.

In this system sewage is treated in large aeration basins (large round or oval ditches) with one or more horizontal aerators which drive the mixed liquor around the ditch for aeration. Alternatively, air can be introduced to the sewage by bottom mounted diffusers driven by large compressors. Oxidation ditches have the advantage that they are relatively easy to maintain and are resilient to shock loads. Oxidation ditches have typical design parameters of a hydraulic retention time of 20 - 30 hours and a sludge age of 20 - 40 days. These systems are more robust and easier to operate and produce a sludge which is easy to digest from clarifiers located after the aeration basin.

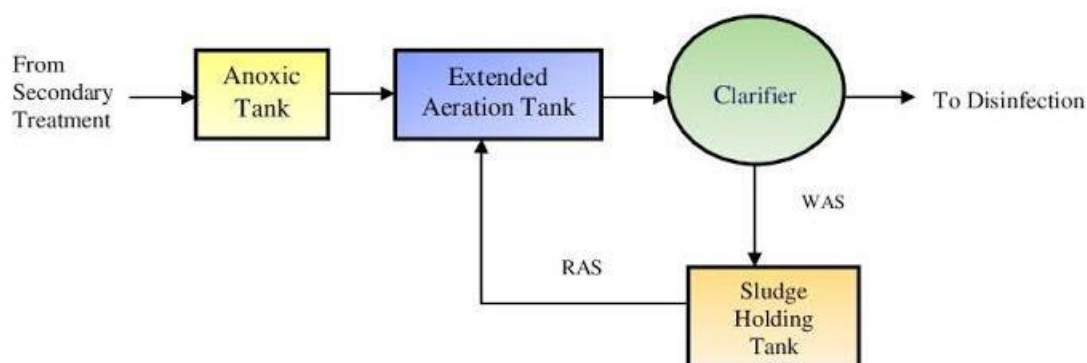


Figure 21: Process Flow Diagram of Oxidation Ditch System

Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

## Sludge Treatment

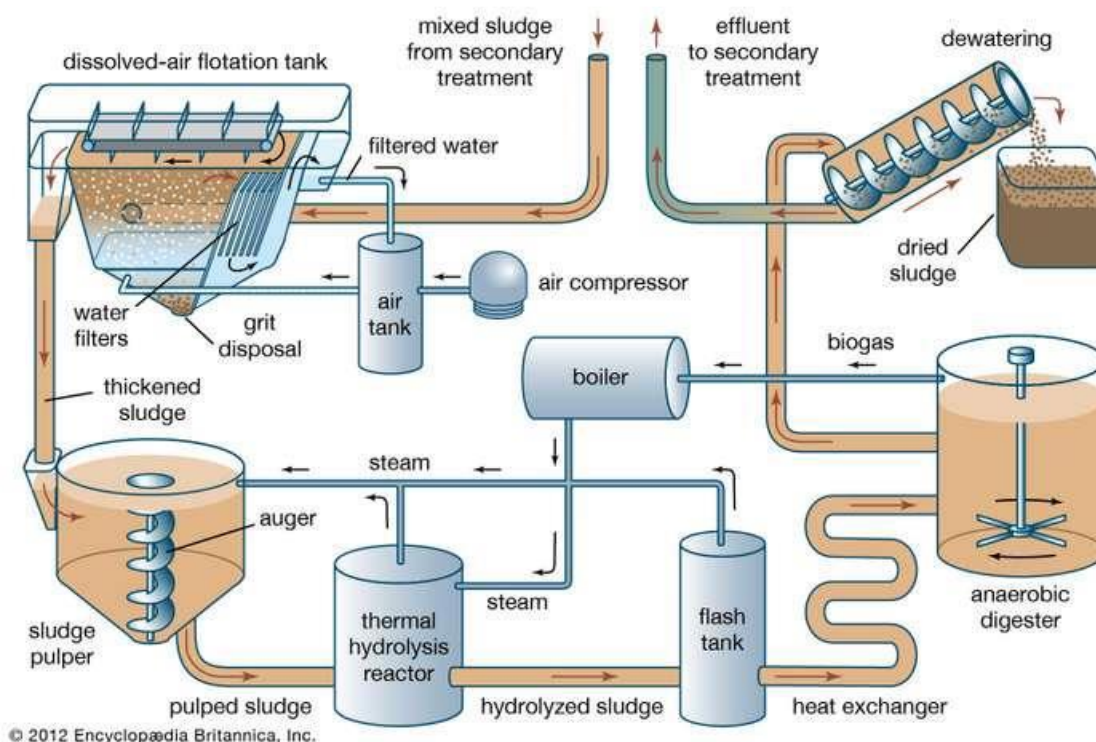
Sewage sludge is the solid, semi-solid, or slurry residual material that is produced as a by-product of wastewater treatment processes. This residue is commonly classified as primary and secondary sludge. Primary sludge is generated from chemical precipitation, sedimentation, and other primary processes, whereas secondary sludge is the activated waste biomass resulting from biological treatments. The two types of sludge will be combined for further treatment and disposal.

Treatment of sewage sludge will include a combination of thickening, digestion, and dewatering.

Thickening is the first step in sludge treatment because it is impractical to handle thin sludge, a slurry of solids suspended in water and will be accomplished by dissolved-air flotation method. In this method, air bubbles carry the solids to the surface, where a layer of thickened sludge forms.

Sludge digestion is a biological process in which organic solids are decomposed into stable substances. Digestion reduces the total mass of solids, destroys pathogens, and makes it easier to dewater or dry the sludge. Digested sludge is non-offensive, having the appearance and characteristics of a rich potting soil. The nutrient rich bio-solids may be used as a natural fertilizer.

Figure 22: Process Flow Diagram for Sludge Treatment



Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

### Reuse of Treated Water

Initially a portion of treated effluent (say 20%) may be reused with minimum chlorination for street washing and later effort may be made to recycle maximum quantum of treated wastewater for various purposes including industrial usages. The local body shall have to make necessary arrangement for transportation of this water from STP sites to designated locations. For this a separate pipeline is to be planned along with installation of hydrants at various locations.

### Land Area Requirements for Construction of Sewage Treatment Plant

The two STPs are located one on either side of Feni River, falling under the jurisdiction of Feni District. However, these STPs will cater to the sewage treatment demand for the entire BSMSN area. Indicative location of the STPs is shown in the figures given above for sewerage system. The location, as shown may undergo changes depending on micro-level landuse planning of the area.

Table 22: Land Area Requirement for STP

Unit	Capacity Requirement at Ultimate Stage (2040)	Land Area Requirements
STP 1	45 MLD	7.0 ha (17 acres)
STP 2	80 MLD	12.5 ha (31 acres)
<b>Total land area required</b>		<b>19.5 ha (48 acres)</b>

Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

### 3.6.6.2. Effluent Treatment Plant

There will be four Central effluent treatment plants (CETPs) for the entire BSMSN area, each with provisions of modular development. The command area of the four CETPs are:

- ✓ CETP 1: to serve portion of Precinct F (zones 2A and 2B)
- ✓ CETP 2: to serve portion of Precinct F (zones 2A, 2B, 3 and 5)
- ✓ CETP 3: to serve entire portion of Precinct G and portion of Precinct F
- ✓ CETP 4: to serve entire portion of Precinct I

CETP 2, and CETP 3 will cater to the demand from Feni EZ. Although Feni EZ will have very limited demand considering a very small portion of the industrial development in the BSMSN is in Feni portion.

The capacity requirements of the CETPs are assessed based on the following considerations:

- 80% of the net water demand of the users (industrial/ residential) will come out of the system as liquid wastewater
- 15% of the domestic wastewater generation per day will be generated from the area ear-marked for industrial usages (considering that either they will live in the industrial area or will be industrial workers)

Capacity requirements for the four CETPs based on the water demand assessment and above considerations, are as follows:

*Table 23: Estimated Effluent Demand of BSMSN*

CETP	Estimated Effluent Flow (MLD)				Proposed ETP Capacity (MLD)			
	2025	2030	2035	2040	2025	2030	2035	2040
1	16	16	16	16	16	16	16	16
2	32	32	32	32	32	32	32	32
3	52.51	73.21	103.09	144.85	30	75	105	150
4	133.35	185.86	261.65	367.54	50	190	270	370

Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

CETPs are potential source of pollution and adequate care needs to be provided to minimize the risk environmental degradation. More the number of CETPs proposed in a system, greater is flexibility operating the system. Simultaneously, with increase in number of CETPs, the number of polluting poin increases. Also operating cost increases as the number of operating point increases. Four locations withi the BSMSN shall be ear-marked for construction of CETP, three for small and medium scale industries and port area (precincts F and G); the other for heavy industries (precinct I). Of the three CETPs require Precinct F, two CETPs (CETP 1 and CETP 2) are going to be constructed to meet the requirements for zone 2A and 2B as priority works. The other two CETPs (CETP 3 and CETP 4) are suggested to be developed a phased manner with modular approach of development. Suitable modification in the technology o treatment for each module may be made depending on the characteristics of sewage flow for individual streams. Length of sewer lines to carry the industrial/ domestic sewage generation is likely to be less i a greater number of CETPs is provided. However, considering the benefit of having lesser number of CET long run, only four CETPs (including the CETPs to be constructed under priority works) are proposed be provided in the system.

There will be a total of 9 Central Effluent Pumping Stations (CEPS) around the BSMSN area. These pumps will be feeding the four CETPs. Out of them only 3 would be serving areas earmarked for Feni. Based on proportionate calculations, the following are the effluent generation estimates from Feni EZ:

*Table 24: Estimated Effluent Generation from Feni*

CETP Flow (MLD)	FENI Zone			
	2025	2030	2035	2040
CEPS 1	8.205	11.424	16.0866	22.6032

<b>CEPS 2</b>	4.6728	6.5145	9.1734	12.8895
<b>CEPS 3</b>	1.2783	1.7823	2.50965	3.52635
<b>Total</b>	14.1561	19.7208	27.76965	39.01905

Source: Analysis of Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

### **Recommended Influent and Treated Effluent Quality Standards for CETP**

To ensure consistency in influent quality all the industries need to send only those effluents, which can be treated at the CETP. For this, pre-treatment facility for individual industries will be required to ensure that the quality of effluent reaching to the CETP fulfils the quality criteria. In case of heterogeneous industrial complexes, pre-treatment is a more reliable relief in operation and maintenance (OandM) of CETP. All industries shall be asked to send effluents to the CETP only after pre-treatment. This will also reduce the risk of corrosion and clogging to the gravity sewers carrying flow to the CETP. Efficiency of the biological treatment process in the CETP will simultaneously increase due to lesser toxic constituents.

Table 25: Proposed Inlet Effluent Quality Standards for CETP

<b>Parameters</b>	<b>Concentration</b>	<b>Parameters</b>	<b>Concentration</b>
<b>pH</b>	5.5-9.0	<b>Zinc (mg/l)</b>	15.0
<b>Temperature (°C)</b>	45.0	<b>Lead (mg/l)</b>	1.0
<b>Oil and grease (mg/l)</b>	20.0	<b>Arsenic (mg/l)</b>	0.2
<b>Cyanide (as CN) (mg/l)</b>	2.0	<b>Mercury (mg/l)</b>	0.01
<b>NH<sub>3</sub>-N (as N) (mg/l)</b>	50.0	<b>Cadmium (mg/l)</b>	1.0
<b>Phenolic compounds (as C<sub>4</sub>H<sub>5</sub>OH) (mg/l)</b>	5.0	<b>Selenium (mg/l)</b>	0.05
		<b>Flouride (mg/l)</b>	15.0
<b>Hexavalent chromium (mg/l)</b>	2.0	<b>Boron (mg/l)</b>	2.0
<b>Total chromium (mg/l)</b>	2.0	<b>Radioactive Material</b>	-
<b>Copper (mg/l)</b>	3.0	<b>-Alpha emitters (He/ml)</b>	10 <sup>-7</sup>
<b>Nickel (mg/l)</b>	3.0	<b>-Beta emitters (He/ml)</b>	10 <sup>-8</sup>
<b>BOD<sub>5</sub> (mg/l)</b>	600	<b>COD (mg/l)</b>	1260
<b>TDS (mg/l)</b>	2100		

Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

Table 26: Recommended Treated Effluent Quality Standard for CETP

Parameter	Into Inland Surface Water	On Land for Irrigation	Into Marine Coastal Areas	For Reuse
<b>pH</b>	5.5-9.0	5.5-9.0	5.5-9.0	6.0-9.0
<b>BOD<sub>5</sub> at 20 °C (mg/l)</b>		30	100	100
<b>Oil and Grease (mg/l)</b>		10	10	20
<b>Temperature (°C)</b>	40	–	45	a) summer - 40 b) winter - 45
<b>Suspended Solids (mg/l)</b>	100	200	a) for process wastewater- 100 b) for cooling water effluents – 10% above total suspended matter of effluent	100
<b>Dissolved Solids (inorganic) (mg/l)</b>	2100	2100	c) –	2100
<b>Total Residual Chlorine</b>	1.0	–	1.0	–
<b>Ammonia (as free ammonia) (mg/l)</b>	–	–	–	5.0
<b>NH<sub>3</sub>-N (as N) (mg/l)</b>	50	–	50	40
<b>Total Kjeldahl Nitrogen (as N) (mg/l)</b>	100	–	100	100
<b>COD (mg/l)</b>	250	–	250	250
<b>Arsenic (mg/l)</b>	0.2	0.2	0.2	0.2
<b>Mercury (mg/l)</b>	0.01	–	0.01	0.01
<b>Lead (mg/l)</b>	0.1	–	0.1	0.1
<b>Cadmium (mg/l)</b>	1.0	–	–	2.0
<b>Total Chromium (mg/l)</b>	2.0	–	2.0	2.0
<b>Chromium (as Cr<sup>+6</sup>) (mg/l)</b>	–	–	–	0.5
<b>Copper (mg/l)</b>	3.0	–	3.0	3.0
<b>Zinc (mg/l)</b>	5.0	–	15.0	15.0
<b>Iron (mg/l)</b>	–	–	–	2.0
<b>Manganese (mg/l)</b>	–	–	–	2.0
<b>Selenium (mg/l)</b>	0.05	–	0.05	0.05
<b>Nickel (mg/l)</b>	3.0	–	5.0	5.0
<b>Boron (mg/l)</b>	2.0	2.0	–	–
<b>% Sodium (mg/l)</b>	–	60	–	–



<b>Cyanide (as CN) (mg/l)</b>	0.2	0.2	-	0.1
<b>Chloride (as Cl) (mg/l)</b>	1000	600	-	600
<b>Fluoride (mg/l)</b>	2.0	-	15.0	15.0
<b>Sulphate (as SO<sub>4</sub>) (mg/l)</b>	1000	1000	-	-
<b>Sulphide (as S) (mg/l)</b>	2.8	-	5.0	5.0
<b>Nitrate (as elementary N) (mg/l)</b>	-	-	10.0	10.0
<b>Pesticides</b>	Absent	Absent	Absent	Absent
<b>Phenolic compounds (as C<sub>6</sub>H<sub>5</sub>OH) (mg/l)</b>	1.0	-	5.0	1.0
<b>Dissolved Oxygen (DO) (mg/l)</b>	-	-	-	4.5-8.0
<b>Dissolved Phosphorus (as P) (mg/l)</b>	-	-	-	4.0
<b>Electro-Conductivity (EC) (mho/cm)</b>	-	-	-	1200

Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

### ***Technology for Central Effluent Treatment Plants (CETP)***

The choice of technology for central effluent treatment plant (CETP) shall be done by a design build process where Contractors will be given the required effluent discharge parameters viz. BOD<sub>5</sub>, TSS etc. and will be invited to come up with the proposed technology and design of a system to meet the required effluent standards at the lowest life cycle cost considering capital and operating cost.

### ***Sludge Treatment***

Utilization of CETP sludge for agricultural use is acceptable, provided it is free from hazardous constituents. The primary sludge, in general, due to its constituents, falls under the purview of regulatory provisions for proper disposal into treatment storage disposal facility (TSDF). The secondary sludge from biological treatment predominantly contains nutrients. This can be utilized as manure, especially for dry land or forest disposal at controlled rates. Both primary and secondary sludge will be dewatered to reduce the amount of sludge. Any sludge that may still contain hazardous material will be disposed in proper TSDF, after required analysis.

### ***Reuse of Treated Water***

Wastewater after treatment will be recycled to meet various industrial water usages (viz. steel plant) as well as other usages to meet non-domestic demand including gardening, cleaning, car washing etc. Effort shall be given to recycle about 70% of the wastewater after treatment to meet various industrial usages. This in turn will substantially reduce the quantum of water to be drawn from various sources to meet the water demand of BSMSN. A separate pipeline is to be planned along with installation of hydrants at various locations to carry the recycled wastewater.

### ***Land Area Requirements for the Construction of CETPs***

Three out of four of the CETPs (1, 2, 3) will be build within Feni EZ, however, they will serve the greater BSMSN. The land required for the construction of CETPs are detailed out below:

Unit	Capacity Requirement at Ultimate Stage (2040)	Land Requirements	Area	Locations
CETP 1	16 MLD	18 acres		Within Precinct F (Feni EZ)
CETP 2	32 MLD			Within Precinct F (Feni EZ)
CETP 3	150 MLD	60 acres		Within Precinct F (Feni EZ)
CETP 4	370 MLD	60 acres		Within Precinct I (outside Feni EZ)
<b>Total land area required</b>		158 acres		

Source: Draft Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan

### 3.6.6.3. Solid Waste Management (Domestic & Hazardous)

In BSMSN, an estimated 1544 tons/day solid waste is expected to be generated in 2040 based on a population estimate of 4.41 million. In Feni EZ, proportional 1.23 million people is expected to use the facilities. Based on which the proportionate solid waste estimate is 432 tons/day.

#### Approach towards solid waste management

A two-tier approach should be thought of for waste management, I.E., (a) prevention and (b) control of environmental pollution. Prevention aims at minimization of industrial wastes at source, while the latter stresses on treatment and disposal of wastes. A schematic diagram of waste management is shown in **Figure 20** and **Figure 21**.

##### a. Prevention- A Waste Minimization Approach

Reduction and recycling of wastes are inevitably site/plant specific. Generally, waste minimization techniques can be grouped into four major categories which are applicable for hazardous as well as non-hazardous wastes. These groups are as follows:

##### Inventory Management and Improved Operations

- Inventorisation and tracing of all raw materials
- Purchasing of fewer toxic and more non-toxic production materials
- Implementation of employees' training and management feedback
- Improving material receiving, storage, and handling practices

##### Modification of Equipment

- Installation of equipment that produce minimal or no wastes
- Modification of equipment to enhance recovery or recycling options
- Reengineering of equipment or production lines to produce less waste
- Improving operating efficiency of equipment
- Maintaining strict preventive maintenance program

##### Production Process Changes

- Substitution of non-hazardous for hazardous raw materials
- Segregation of wastes by type for recovery
- Elimination of sources of leaks and spills
- Separation of hazardous from non-hazardous wastes
- Redesigning or reformulation for products to be less hazardous
- Optimisation of reactions and raw material use

##### Recycling and Reuse

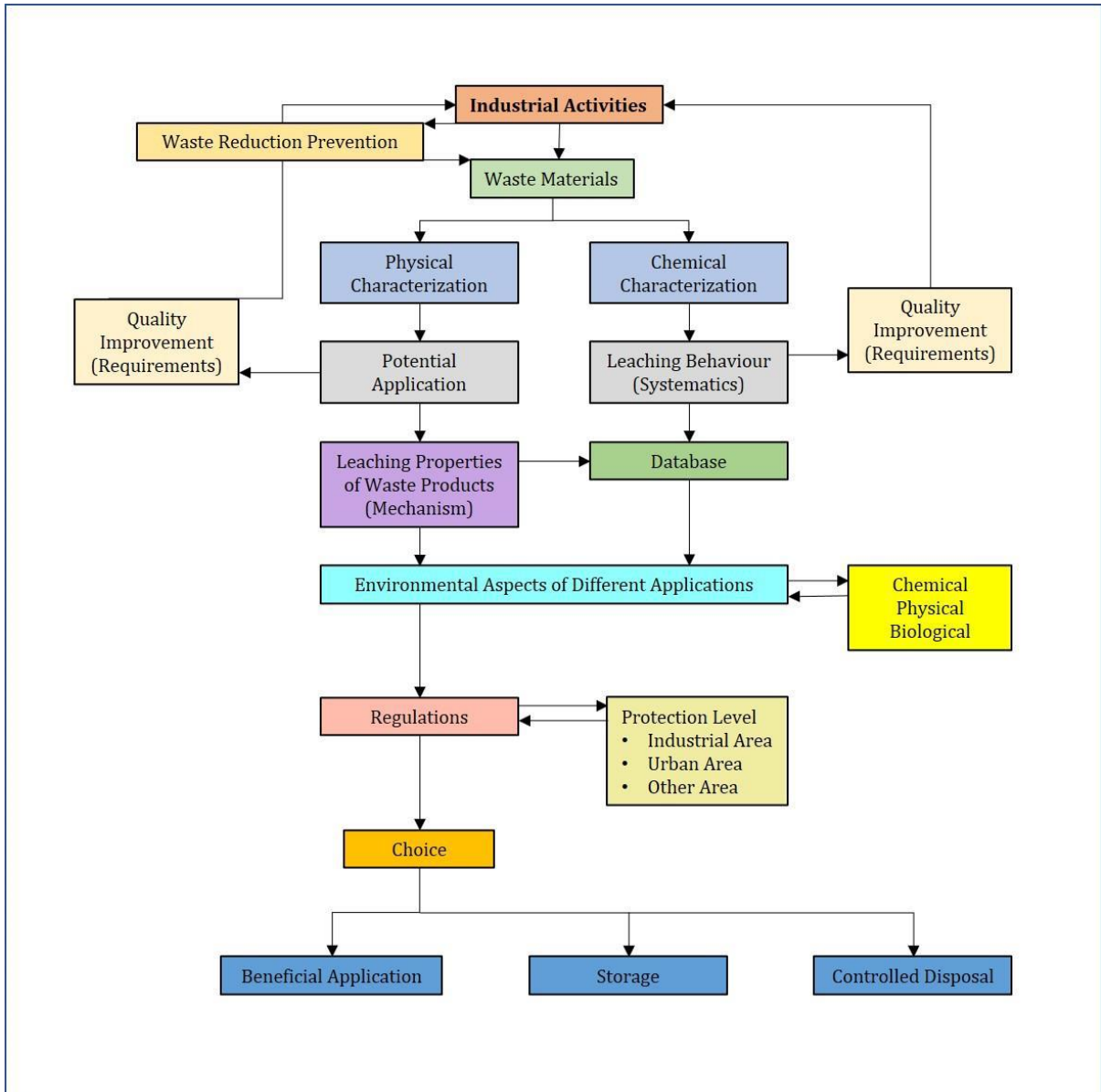
- Installation of closed-loop systems
- Recycling off site for use
- Exchange of waste

Waste minimization at source may be achieved within the industry through application of various approaches described above. The systems for waste minimisation, utilisation and recycling are schematically shown in **Figure 22**.

**b. Waste Management at Source**

- It is possible to cut down waste generation at source by simple, inexpensive measures modifying production processes, through changes in raw materials / product design and by employing recovery / recycling and reuse techniques.
- To avoid treatment through utilization of waste, it is important from the environmental pollution view point as well as for the benefit of entrepreneurs to recycle and reuse the wastes generated by adoption of certain process change or by use of low /no-waste generation technology.
- Waste minimization can be practiced at various places in the industrial processes. More often than not, investment on waste minimization and recovery pays off tangibly within a short time.
- The initial investment for a pollution prevention project may be higher in some cases than the cost of installing conventional pollution control equipment. However, the annual operation and maintenance cost of the removal will almost always make the total cost of treatment higher than the total cost of preventive measures at sources. However, treatment and disposal of residual waste even after taking preventive measures should be given due consideration.
- Wastes from non-hazardous industries can at times produce health problems, not only among the workers and handlers of waste, but also among general population. One example of this category is the cotton dust. Cotton wastes are generally non-hazardous; however, they may, in susceptible individuals provoke respiratory allergic reactions; allergy may be due to inhalation of dust containing cotton wastes or fungus or other contaminants in the waste dust.

*Figure 23: Waste Management Approach*



Source: Master Plan of BSMSN, 2020

Figure 24: Waste Management Scheme

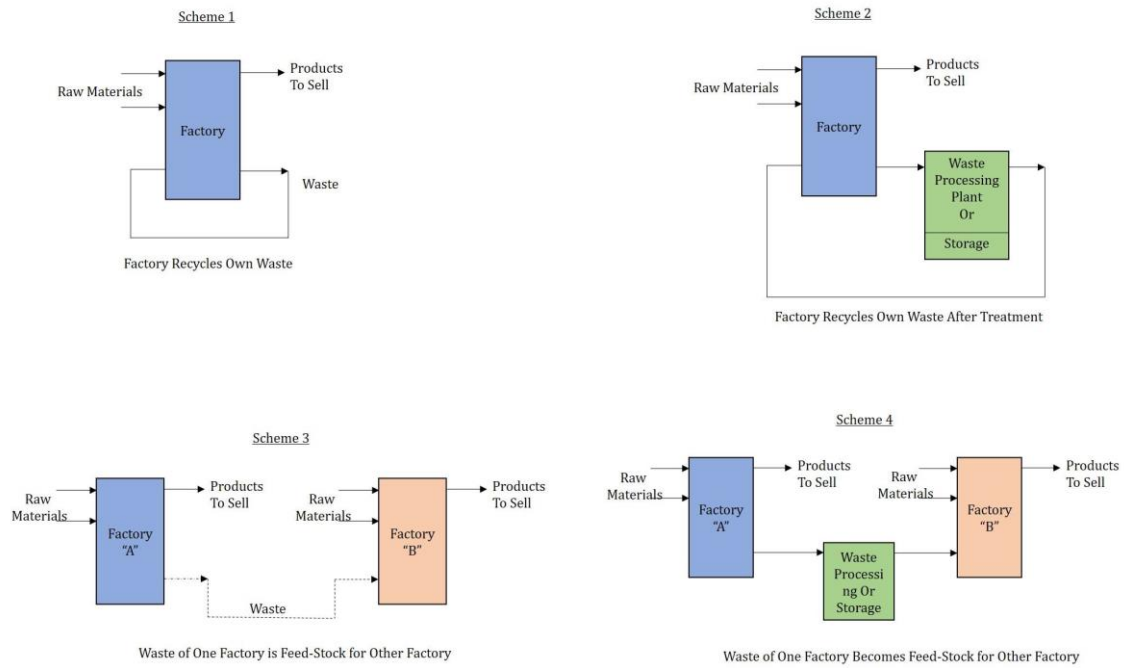
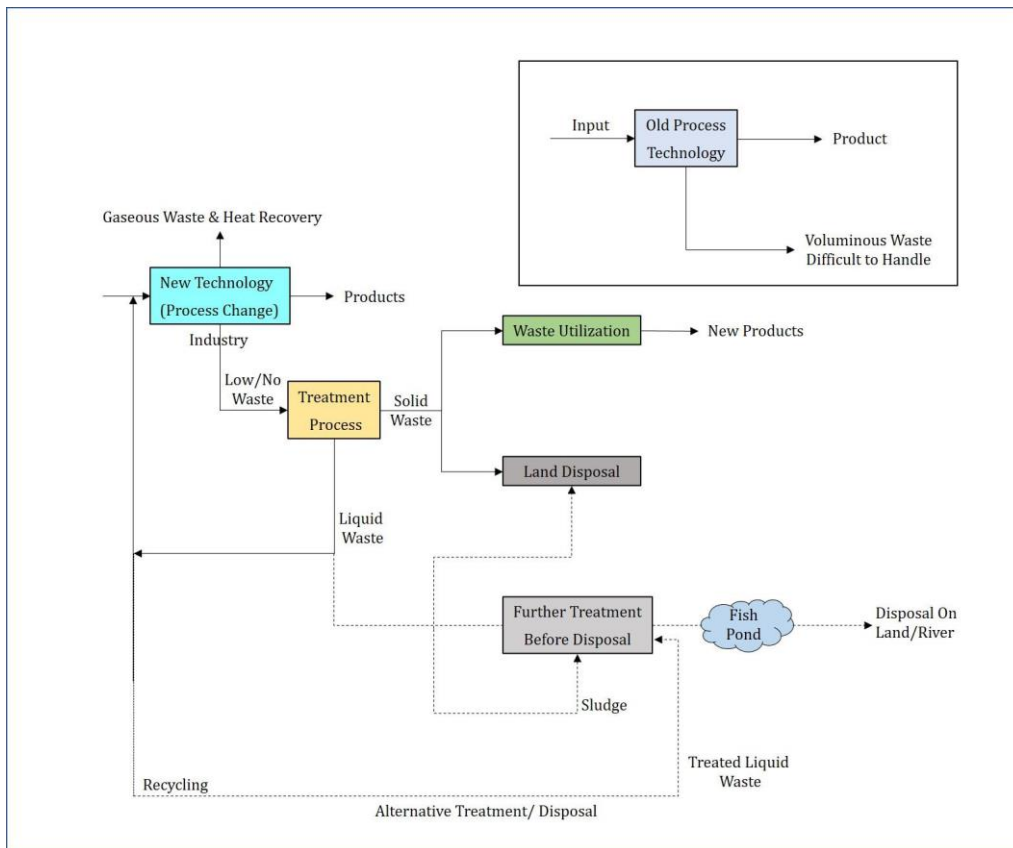


Figure 25: Waste Minimization, Recovery and Utilization



### c. Waste Segregation

Many wastes are mixtures of hazardous and non-hazardous wastes. Much of their contents may even be water. By segregating key toxic constituents, isolating liquid fraction, keeping hazardous streams away from non-hazardous wastes, generator can save substantial amounts of money on disposal or find new opportunities for recycling and reuse of wastes. The Department of Environment, Government of Bangladesh had identified toxicity of different chemicals, through Bangladesh Standards and Guidelines for Sludge Management DOE, GOB, 2015. In Bangladesh quantum of generation of wastes (solid/liquid and hazardous/non-hazardous) for different industry has not been detailed, **which is necessary for wastes exchange system** or for adopting treatment/ disposal alternatives for different wastes segregated.

### d. Collection, Storage and Transport

The unsatisfactory state of storage of hazardous wastes is remedied to a large degree by such low-cost measures as restricting access, fencing off the storage area to minimize any wind-blown nuisance, providing separate covered storage for purifiable of hazardous wastes, and ensuring regular and frequent collection.

There are certain measures a municipal authority can take to control the transportation of industrial wastes, even if it does not want to become actually involved itself. For instance, contractors may be licensed after ensuring that they are technically competent and environmentally aware and should be allowed to handle industrial wastes. **Labeling and coding of hazardous waste load should be made mandatory** so that in the event of an accident, the emergency services know how to handle a spillage. If a municipal authority can also collect industrial waste; industries must pay the charge which will be based on the quantity and nature of the waste. **The principle ‘the polluter pays’ should be adhered to in all such cases.**

### e. Disposal Methods

Depending upon the characteristics of the wastes, different types of disposal methods can be used for hazardous and non-hazardous industrial wastes. The most predominant and widely practiced methods for wastes disposal are: (a) Landfill, (b) Incineration and (c) Composting.

### f. Landfill

The owner or operator of such facility must follow the design and operating criteria stipulated by the regulatory agencies. However, depending upon the characteristics of the waste, the landfill system with leachate collection system has to be designed with the necessary facility for ground water quality monitoring.

Non-hazardous industrial waste may be disposed of along with Municipal solid waste in a scientifically developed landfill site.

The principal objective of a hazardous waste landfill is to isolate the waste materials within a confined area and prevent uncontrolled leakage of liquid contaminants. Design of the facility, therefore, requires provisions for an impermeable liner, a leachate collection and treatment system, and a suitable cover that is resistant to erosion and rainwater infiltration.

In many instances, land can be utilized in the near vicinity or on the premises of industrial companies, thereby reducing transportation costs. The potential also exists to reclaim certain areas for recreational purposes.

### g. Incineration

Depending upon the categories of waste and its potential hazards, following incineration methods may be adopted:

- Destruction of hazardous waste by thermal process using incinerator or any other method; and
- Burning of hazardous waste in boiler or in industrial furnace in order to destroy them and/or for any recycling purpose and/or energy source, which is now a general practice in Cement industry.

In Bangladesh there are very few incinerators installed on a large scale. It is important to have a central incinerator facility in the remote areas of industrial city for incinerating hazardous wastes which may be operated by a corporate body. The hazardous wastes in the industrial city to be treated can be centrally collected and transported to the facilities. In this process of central facility of treatment, the polluter has to pay for treatment facility depending on the quantity and quality of wastes generated.

In the second category of incineration, there are a number of cement industries and thermal power plants where the wastes can be burnt after considering the nature and quantity of wastes. However, in this case it is to be seen that the gaseous emission through stack does not affect the ambient air quality adversely.

#### **h. Waste Manifest System**

In the management of solid and liquid industrial wastes it is very important to incorporate a manifest system by which the chain responsibility of generator, carrier and receiver can be realised. This system will help the regulatory agency as nodal agency, where finally the copy of the manifest will be sent, to know whether the actual wastes generated are transported to the facilities where it is to be disposed off. In this process of waste management, all the three, **viz. pollution generator, carrier and receiver, will have to take authorisation from the nodal agency.**

EPA in 2018 has proposed hazardous waste manifest system which is designed to track hazardous waste from the time it leaves the generator facility where it was produced, until it reaches the off-site waste management facility that will store, treat or dispose of the hazardous waste.

It is recommended that in BSMSN also for the management of industrial wastes, whether they are hazardous and non-hazardous, a manifest system is framed to identify what category of waste has to be transported for disposal and treatment. BSMSN authority may adopt **Electronic Manifest (e-Manifest) System as suggested by EPA.** The schematic sketch of such a system is shown in **Figure 4-21.**

*Figure 26: Waste Manifest (e-Manifest) System*



#### **i. Monitoring**

Monitoring will tell the operating agency about the dividing line between hazardous and non-hazardous waste, about the treatability of the hazardous waste, about incompatibility of different wastes, about the performance efficiency of hazardous waste treatment and disposal facility, about the impact, about the quality of the recovered material, and about the post-closure effects if any. Monitoring gives a final signal if something is going wrong in the facility of operating agency, giving an opportunity of rectification, In consultation with the DOE, GOB the operating agency will have to draw samples of air, water groundwater, leachate waters, soils, ash, solid wastes and aesthetics. The periodicity and station selection be done carefully, and the following locations might prove appropriate: -

- **Air:** upwind, downwind, three stations at 120m around the facility distance depending on stackheight and location of any particular sensitive feature. This is for ambient air. Samples be selected in stack, vents and ducts.

- **Surface Waters:** upstream and downstream in the stream adjoining local nullah, upstream in the rivulet, on both the banks, upper stream and benthic deposits, and add as per sanitary survey.
- **Groundwater:** From wells specially dug one upgradient and at least three on down gradient, and deep enough. This monitoring is more significant when the groundwater is popularly used either for agricultural or personal purposes.
- **Soil:** Surrounding soil at ground level to be sampled in a circular grid.
- **Vegetative Cover:** Whether mal effect is occurred and if yes, in what direction.
- **Biological Indicator:** By planting sensitive plants in all directions and at different distances and to note periodically as to what is the health status of each plant, providing the operating agency with information as to what further precautions are required to be taken.

### ***Municipal Solid Waste (MSW) management***

Municipal solid waste (MSW) is comprised of a number of solid waste streams. The following solid waste streams that compose MSW are:

**Residential Solid Waste** – Solid waste generated from single-family residences, and multifamily residences. Recyclables prevalent in the residential waste stream include paper, plastics, metals, food scraps, yard trimmings, textiles and personal electronics.

**Commercial Solid Waste** - Solid waste generated from businesses, offices, stores, markets, institutions, government, and other commercial establishments. Recyclables common in the commercial waste stream include paper, plastic, metals, food, yard trimmings, lumber, textiles, and electronic devices.

Other solid waste streams that may also be a part of MSW include:

**Bio-Medical Wastes** – treated waste, where allowed, generated from hospitals and other acute care facilities, health research institutions and homes that result from the use and administration of medications, surgery or other medical procedures, or medical or health research and development.

**Bio-Solids** – typically waste generated from the de-watering of municipally generated wastewater.

**Construction and Demolition (C&D) Debris** - materials resulting from the construction and demolition (C&D) of buildings and other structures, including materials such as metals, wood, gypsum, asphalt shingles, roofing, concrete, rocks, rubble, soil, paper, plastics, and glass wastes. (C&D) components can be a significant portion of the MSW stream with a high potential for recycling. Non-recyclable (C&D) wastes may be disposed in municipal solid waste landfills or specially designated landfills, or if cleaned of unacceptable debris, used for land reclamation.

**Others** – There are a host of other separately managed solid wastes that may be a part of MSW such as tires, street sweepings, storm catchment wastes, automotive shredding fluff, carpet, white goods, furniture, and mattresses.

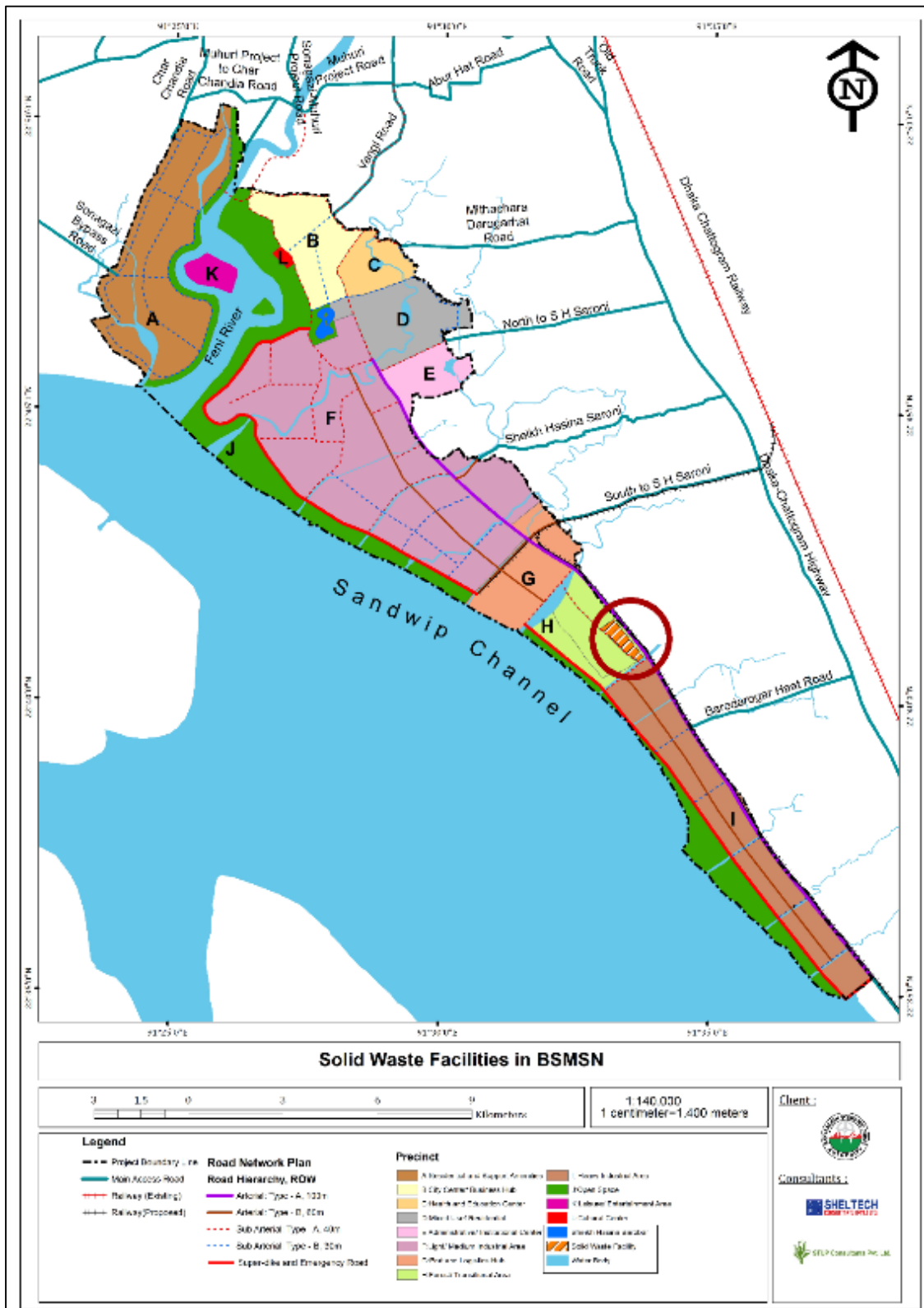
### ***Central Waste Management facility for BSMSN***

It has also been estimated that area required for only Municipal Solid Waste (MSW) management through landfill will be 185 acres and total land requirement considering other facilities like composting plant, different infrastructure, area for biomedical waste treatment and separate area for hazardous waste storage and management will be about 274 acres. If the industrial city authorities (BEZA) adopt 3R / 4R / 5R strategy and global trend in developed countries as reported by US Environmental Protection Agency (EPA) the land demand for landfill will be reduced to 52% i. e. 142.5 acres.

A specific site in Precinct H (Transitional Area) is selected as the land fill site, land for storage and primary processing of industrial solid waste and land for storage and transfer station. Also, there will be thirty secondary transfer station in whole BSMSN area. Location of each utility installation point has been selected as per the prescribed guidelines. Precinct H is an offsite facility for Feni EZ which will be used to manage the solid waste generated from Feni EZ. The details SWM treatment plant, calculation of the size of the landfill facility is added in the Annex G.



Figure 27: Solid Waste Facilities in BSMSN



Source: Draft Masterplan Report of BSMSN

## **3.7. Project Schedule-Phasing Plan**

### **Project Schedule- Phasing Plan of BSMSN**

Because all the land within BSMSN has not yet been acquired and some lands have been allocated to investors, it is more complicated to accurately phase the site according to best practices. Considering the above facts, the Master Plan Area has been divided in three phases. The execution period is divided in three phases as follows:

- Phase I : Years 0 - 5
- Phase II : Years 6 -10
- Phase III : Years 11-20

However, to maximize the land values and minimize capital costs within the urban/industrial city/zone, the following phasing rules should be followed in BSMSN:

- Develop land which has been acquired and where investors want to construct.
- Develop core infrastructure and utility networks incrementally within BSMSN/ Precincts so only the required networks/systems are built to support each phase of development.
- Infrastructure/utility networks should never be constructed without demand as they will erode and will need to be replaced, at a later date. This will substantially increase the infrastructure/utility costs within BSMSN.
- It is imperative that all public infrastructure such as access roads and utility networks be constructed within Precincts before investment projects are implemented by investors.
- All public roads and associated utilities (power, water, drainage, sewerage, telecom etc.) should be constructed in an integrated manner with sufficient rights-of-way (ROWs) in order to support maintenance.
- Try to cluster development so one or a few adjacent Precincts are constructed in parallel. Only construct main public roads between existing Precincts and investment projects. Main roads should be expanded only when new Precincts are to be implemented.
- Larger investment projects within a Precinct should be divided into smaller, phased components, where possible. IE. Similar to Zone 2A/B in the Light and Medium Industrial Precinct F. New phases within investor projects should not begin until 70% of the first or previous phase of a project is sold out/leased.
- Resettlement of the identified Feni and Mirsarai communities should be undertaken early on in the development process, as resettlement is the first step in development. The Feni resettlement area should be at the northern edge of Precinct A, closest to the Feni community. The Mirsarai resettlement should occur on the northern boundary of Precinct D or E.
- All Precincts are to be planned and implemented as per this Master Plan.
- The BSMSN must have secure fencing around the entire site and be monitored with CCTV.

### **Project Schedule- Phasing Plan of Feni EZ**

As per the Draft Master Plan of BSMSN, the construction of Feni EZ will be completed in two phases:

- Phase I : Years 0 – 5
- Phase II : Years 6 -10

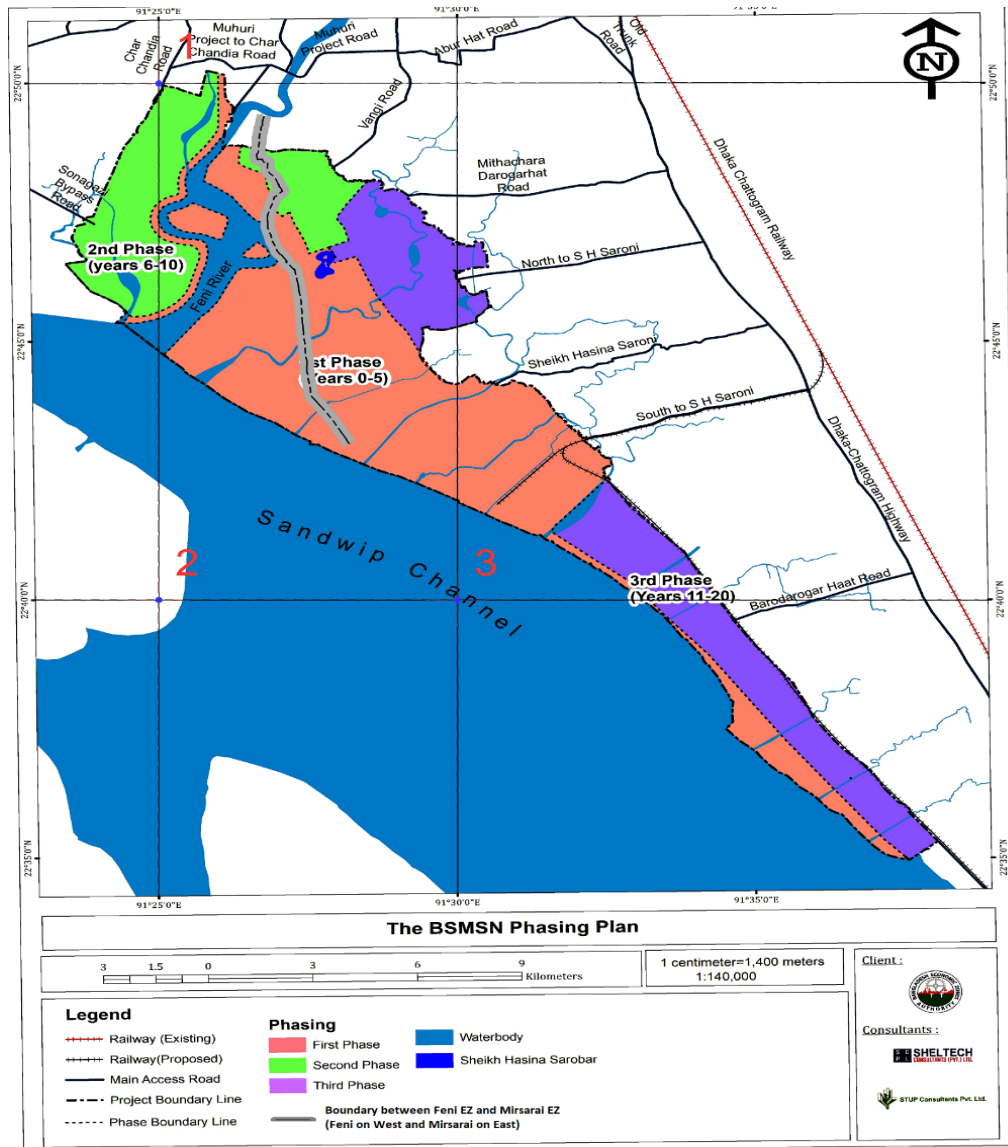


Figure 28: Phasing of the BSMSN and Feni EZ

### 3.8. Resource Requirement

Component wise requirement of resource for proposed EZ development has been furnished in the following section. Construction materials like cement, sand & steel can source from Chittagong. Special materials like DI pipes can be sourced from India or nearby countries.

Table 27: Resource Requirement for Road Construction

Sl. No	Description	Unit	Quantity
1	Earth from excavation work	Cum	1,120,734
2	Supplying and filling earth and compacting in layers	Cum	98,192
3	Construction of granular sub-base	Cum	353,913
4	Providing graded stone aggregate to wet mix macadam	Cum	589,855
5	Providing and applying primer coat with bitumen emulsion	Sqm	2,359,420
6	Providing and applying tack coat with bitumen emulsion	Sqm	2,359,420

Sl. No	Description	Unit	Quantity
7	Providing and applying tack coat with bitumen emulsion	Sqm	2,282,413
8	Providing and laying dense graded bituminous macadam	Cum	114,114
9	Providing and laying Semi dense bituminous concrete	Cum	57,057
10	Providing and fixing Pre-cast solid concrete kerb stones	Rm	770,108

Source: Sheltech

Table 28: Resource Requirement for Development of Foot Path & Road culvert

Sl. No.	Description	Unit	Quantity
1	Earth from excavation work	Cum	49,970
2	Supplying and filling earth and compacting in layers	Cum	49,970
3	Providing and laying in position plain cement concrete of mix 1:4:8	Cum	19,361
4	Providing and laying in position specified grade of reinforced cement concrete	Cum	120,023
5	Providing H.Y.S.D steel (Cold, Twisted) /TMT reinforcement for RCC work	MT	14,117
6	Providing and fixing at site precast cement concrete M15 grade kerb	Sqm	333,184
7	Providing and laying heavy duty cobble stones 60mm thick interlock pavers	Sqm	333,184

Source: Sheltech

Table 29: Resource Requirement for Development of Drains, Culverts

Sl.No	Description	Unit	Quantity
1	Earth from excavation work	Cum	318,579
2	Providing and laying in position plain cement concrete	Cum	53,282
3	Providing and laying in position specified grade of reinforced cement concrete	Cum	9,143
4	Providing H.Y.S.D steel (Cold, Twisted) /TMT reinforcement for RCC work	MT	169
5	Brick work with common burnt clay bricks	Cum	105,389
6	Providing and laying coping and Screed concrete with 1 :2:4 cement concrete	Sqm	176,734
7	Providing 12mm thick cement plaster	Sqm	565,548
8	Providing Weep holes using 75mm dia PVC pipes	Nos	75,639
9	Providing and laying non pressure NP 2 class ( light duty) RCC pipes		
9.1	300mm dia RCC pipe	Rm	1,520
9.2	500mm dia RCC pipe	Rm	3,040
10	Providing, stone pitching	Sqm	108,771

Source: Sheltech

*Table 30: Resource Requirement for Development of Water supply Network*

Sl.No	Description	Unit	Quantity
1	material from Excavating trenches	Cum	359207
2	Supplying sand	Cum	29986.94
3	Providing and fixing 3 layer PPR		
3.1	PN - 10 110mm dia pipe	Rm	240654
3.2	PN - 10 160mm dia pipe	Rm	19247
3.3	PN - 10 200mm dia pipe	Rm	19247
3.4	Providing and laying S& S centrifugally cast (spun) / Ductile iron 250mm dia pipes (classK7)	o	19247
3.5	Providing and laying S& S centrifugally cast (spun)/ Ductile iron 300mm dia pipes (classK7)	Rm	19247
3.6	Providing and laying S& S centrifugally cast (spun)/ Ductile iron 350mm dia pipes (classK7)	Rm	9633
3.7	Providing and laying S& S centrifugally (spun) / Ductile iron 400mm dia pipes (classK7)	Rm	9633
3.8	Providing and laying S& S centrifugally Ductile (spun) iron 450mm dia pipes (Class k7)	Rm	9633
3.9	Providing and laying S& S centrifugally Ductile (spun) iron 500mm dia pipes (Class k7)	Rm	9633
3.10	Providing and laying S& S centrifugally Ductile (spun) iron 600mm dia pipes (Class k7)	Rm	9633
4	PN - 16 110mm Butterfly valve	Each	95
5	PN - 16 160mm Butterfly valve	Each	19
6	PN - 16 200mm Butterfly valve	Each	19
7	250mmdia Butterfly valve - Ductile iron	Each	19
8	300mmdia Butterfly valve - Ductile iron	Each	19
9	350mmdia Butterfly valve - Ductile iron	Each	19
10	400mmdia Butterfly valve - Ductile iron	Each	19
11	450mmdia Butterfly valve - Ductile iron	Each	19
12	500mmdia Butterfly valve - Ductile iron	Each	19
13	PN - 16 110mm Air valve	Each	437
14	PN - 16 160mm Air valve	Each	19
15	PN - 16 200mm Air valve	Each	19
16	250mm dia Air valve - Ductile iron	Each	19
17	300mm dia Air valve - Ductile iron	Each	19
18	350mm dia Air valve - Ductile iron	Each	19
19	400mm dia Air valve - Ductile iron	Each	19
20	450mm dia Air valve - Ductile iron	Each	19
21	500mm dia Air valve - Ductile iron	Each	19
22	PN - 16 110mm Gate valve	Each	266
23	PN - 16 160mm Gate valve	Each	38
24	PN - 16 200mm Gate valve		38
25	250mm dia Gate valve - Ductile iron	Each	38
26	300mm dia Gate valve - Ductile iron	Each	38
27	350mm dia Gate valve - Ductile iron	Each	19
28	400mm dia Gate valve - Ductile iron	Each	19

Sl.No	Description	Unit	Quantity
29	450mm dia Gate valve - Ductile iron	Each	19
30	500mm dia Gate valve - Ductile iron	Each	19
31	Constructing masonry chamber	Each	285

Source: Sheltech

Table 31: Resource Requirement for Development of Sewer Network

Sl.No	Description	Unit	Quantity
1	Material from Excavating trenches	Cum	619,488
2	Constructing brick masonry	Each	2,242
3	Constructing brick masonry circular manhole 1.22m	Each	2,888
4	Constructing brick masonry circular manhole 1.52m	Each	1,292
5	Providing, laying and jointing of pipe		
a)	Sewer pipe - RCC hume pipe 150mm dia	Rm	67,393
b)	Sewer pipe - RCC hume pipe 200mm dia	Rm	48,127
c)	Sewer pipe - RCC hume pipe 250mm dia	Rm	38,513
d)	Sewer pipe - RCC hume pipe 300mm dia	Rm	19,247
e)	Sewer pipe - RCC hume pipe 450mm dia	Rm	9,633
f)	Sewer pipe - RCC hume pipe 500mm dia	Rm	5,776
6	Sewer pipe - RCC hume pipe 500mm dia	Each	4,180

Source: Sheltech

Table 32: Resource Requirement for Development Overhead Transmission Line

Sl.No	Description	Unit	Quantity
1	Supply, Erection Testing, Commissioning of 400KV <b>Double circuit</b> transmission lines	KM	14
2	Supply, Erection Testing, Commissioning of 230KV <b>Double circuit</b> transmission lines	KM	7.84
3	Supply, Erection Testing, Commissioning of 230KV <b>Double circuit</b> transmission lines (underground)	KM	56
4	Supply, Erection Testing, Commissioning of 132KV <b>Double circuit</b> transmission lines (underground)	KM	4.48

Source: Sheltech

### 3.9. Map and Survey Information

#### Project Location

The proposed EZ is located in Sonagazi Upazila, Feni district of Chattogram division. Chattogram division, located in the southeastern part of the country is geographically the largest division of Bangladesh with industrial city of Chattogram being the primary driver of the division's economy. Chattogram division contributes to ~18.9% of overall GDP of the country and it houses various industrial units. Owing to the presence of Bangladesh's most important seaport, Chattogram Sea Port, this division has seen rapid industrialization with steel re-rolling mills, cement plants and other trade dependent industries being established in this area. Chattogram division has 11 districts (zilas) and 99 sub-districts (Upazilas).

Feni district is located in the middle of Chattogram division and shares border with India to its north and Bay of Bengal to its South. The following surround it –

- Comilla district – North-West
- India – North & East
- Chattogram district – South-East
- Sandwip Channel (Bay of Bengal) – South
- Noakhali - West

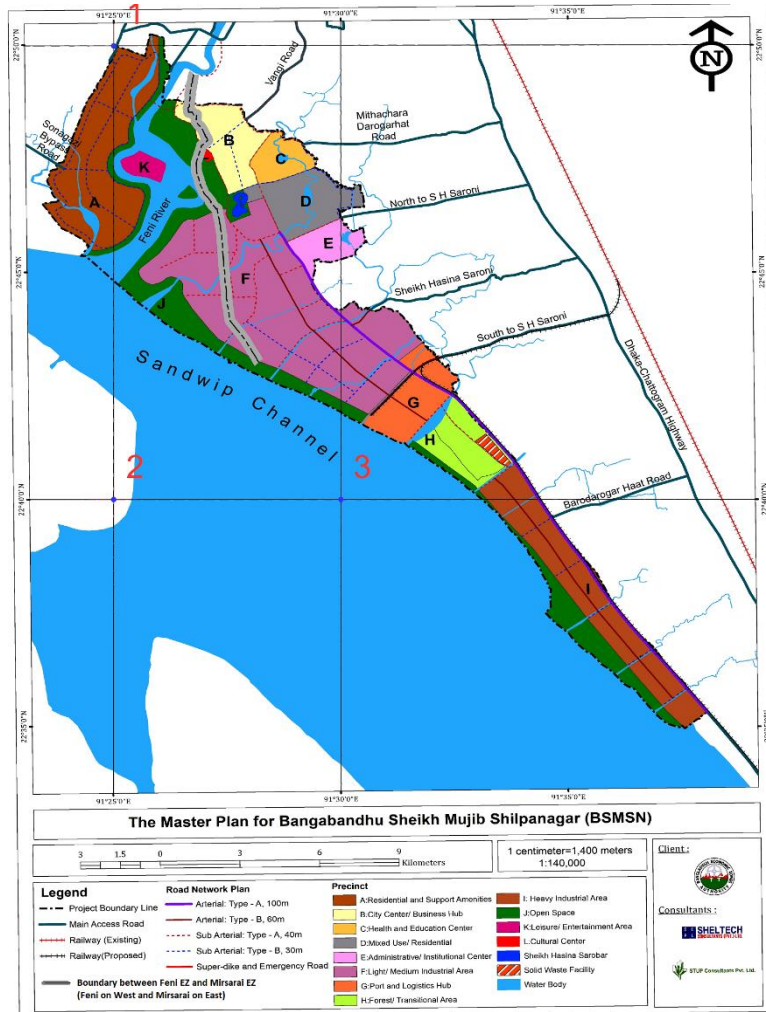
Feni district comprises 6 upazilas; proposed EZ is located in Sonagazi upazila. Proposed Feni EZ is a part proposed Bangabandhu Sheikh Mujib Shilpa Nagar Area proposed across Mirsarai, Feni and Chattogram District. Proposed Feni EZ is spread across Dakhin Char Khondaker, Char Khowajer Namchi, Char Nasrin, Bahir Char, Thak khowajer Namchi, Char Khondaker, Char Ram Narayan Mouzas of Sonagazi Upazila in Feni District.

*Figure 29: Feni Site Location (Chattogram Division - Feni District - Sonagazi Upazila)*



*Source: Information obtained from site visit, Google Map, and PwC Analysis*

*Figure 30: Master Plan of the Bangabandhu Sheikh Mujib Shilpa Nagar & Location of EZ*



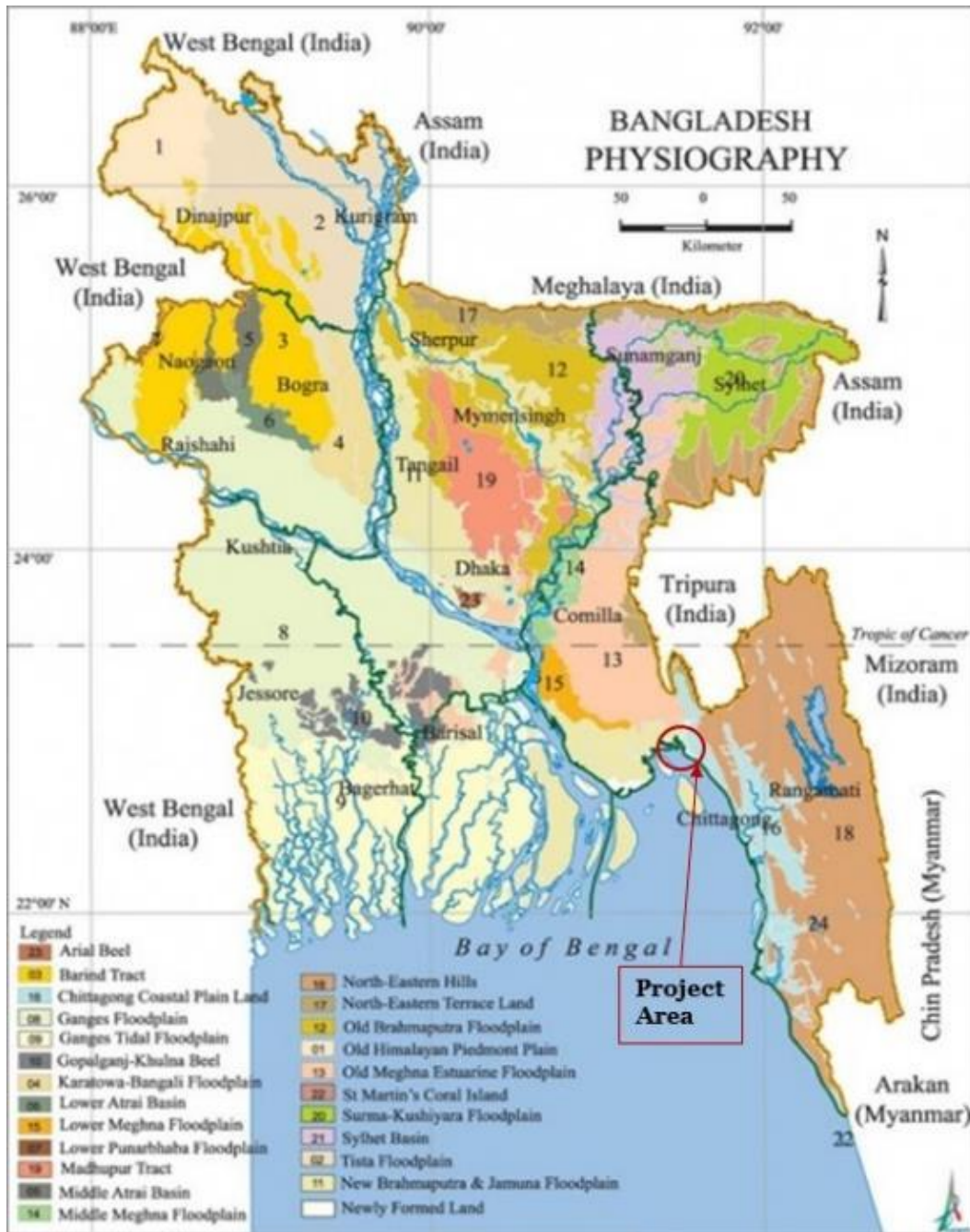
Source: BEZA

### Topography of the Project Site

Bangladesh is the largest deltaic region in the world with most of its parts, at low elevations. It is a riverine country criss-crossed by innumerable rivers, rivulets and their tributaries. In the context of physiography, Bangladesh may be classified into three distinct regions (a) floodplains, (b) terraces, and (c) hills each having distinguishing characteristics of its own. The physiography of the country has been divided into 24 sub-regions. Physiographic map of Bangladesh is furnished in following figure. As per the physiographic map of Bangladesh the study area falls under coastal plains of Chittagong and Ganges Flood Plain.



Figure 31: Physiographic Map of Bangladesh showing the EZ area



Source: Banglapedia

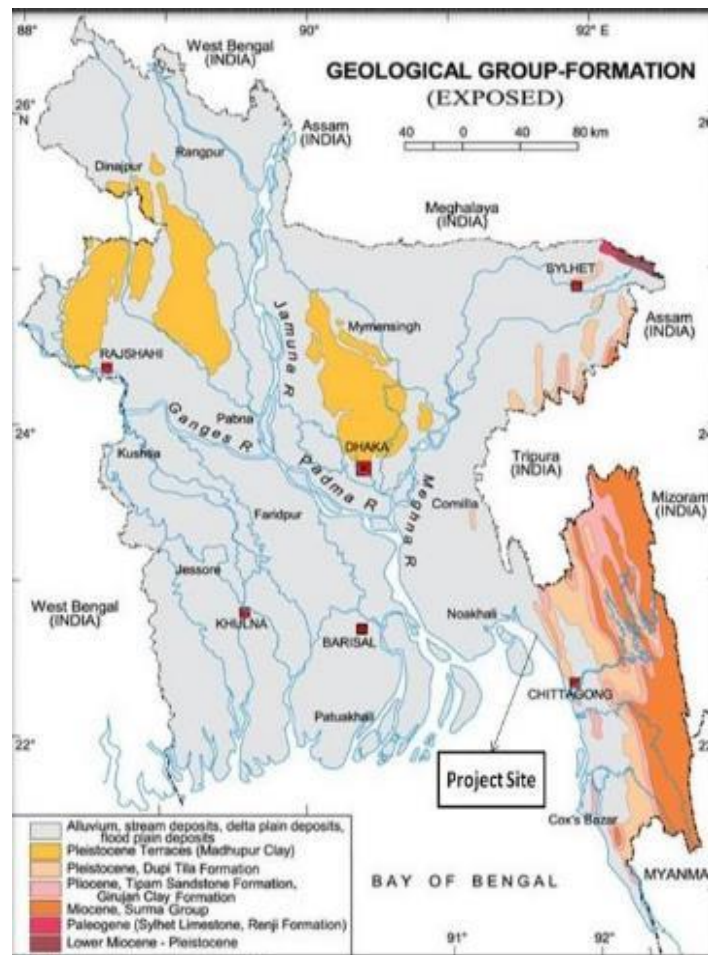
EZ site is a located on relatively newly formed delta and low lying in nature. The proposed area is crisscrossed by many channels/distributaries/streams of Boro Feni River. Significant part of the site remains submerged during high tide due to the proximity of Bay of Bengal.

The average natural ground level for the proposed EZ is +6 m level. To avoid inundation during monsoon season, the land filling of 5 m above the existing natural ground level is considered.

## Geology

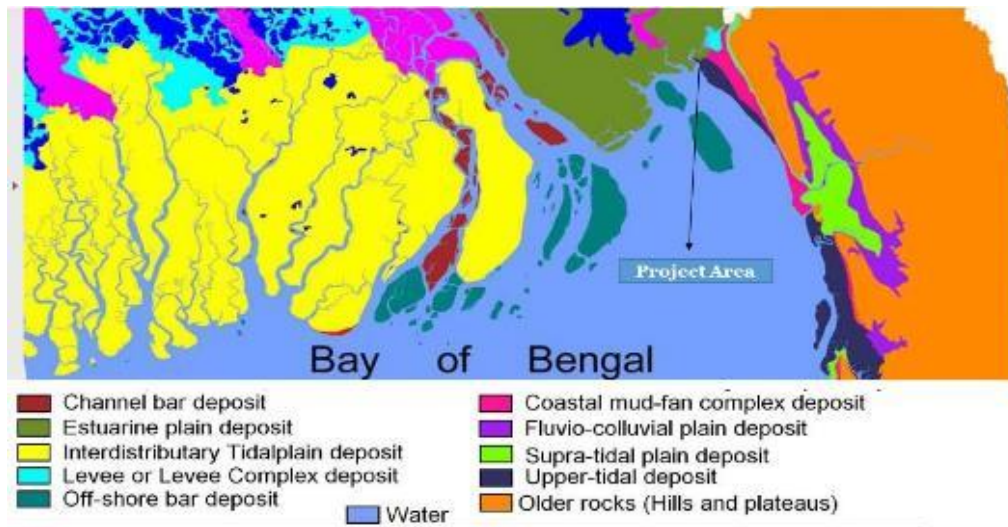
The geology of the project area can be generally classified as sedimentary with metamorphic rocks such as limestone including travertine. These occur as either of the following: quartzite, graphitic schist, chlorite, amphibole, mica and kyalite schist, hornblende, bitite and garnet, gneiss, acid gneiss, granulate or charkonite. The site is close to the sea and Feni River and is covered with clay and sand deposits. As per the geological map of Bangladesh the site is covered with stream and flood plain deposits and is classified as upper tidal deposit and Estuarine Plain Deposit zone as per geological map of Coastal Bangladesh.

Figure 32: Geological map of Bangladesh showing proposed site area



Source: <http://www.gsb.gov.bd/>

Figure 33: Geological Map of Coastal Areas of Bangladesh



Source: <http://gsb.portal.gov.bd/>

### 3.10. Project Plan (Master Plan)

A best practice master plan based on zoning exercise has been created. This master plan comprises major road network which has been planned based on planned entry/exit. This was followed by sub-zoning, land parcellation, planning of internal access road based on land parcellation, planning of utilities & amenities and Phasing.

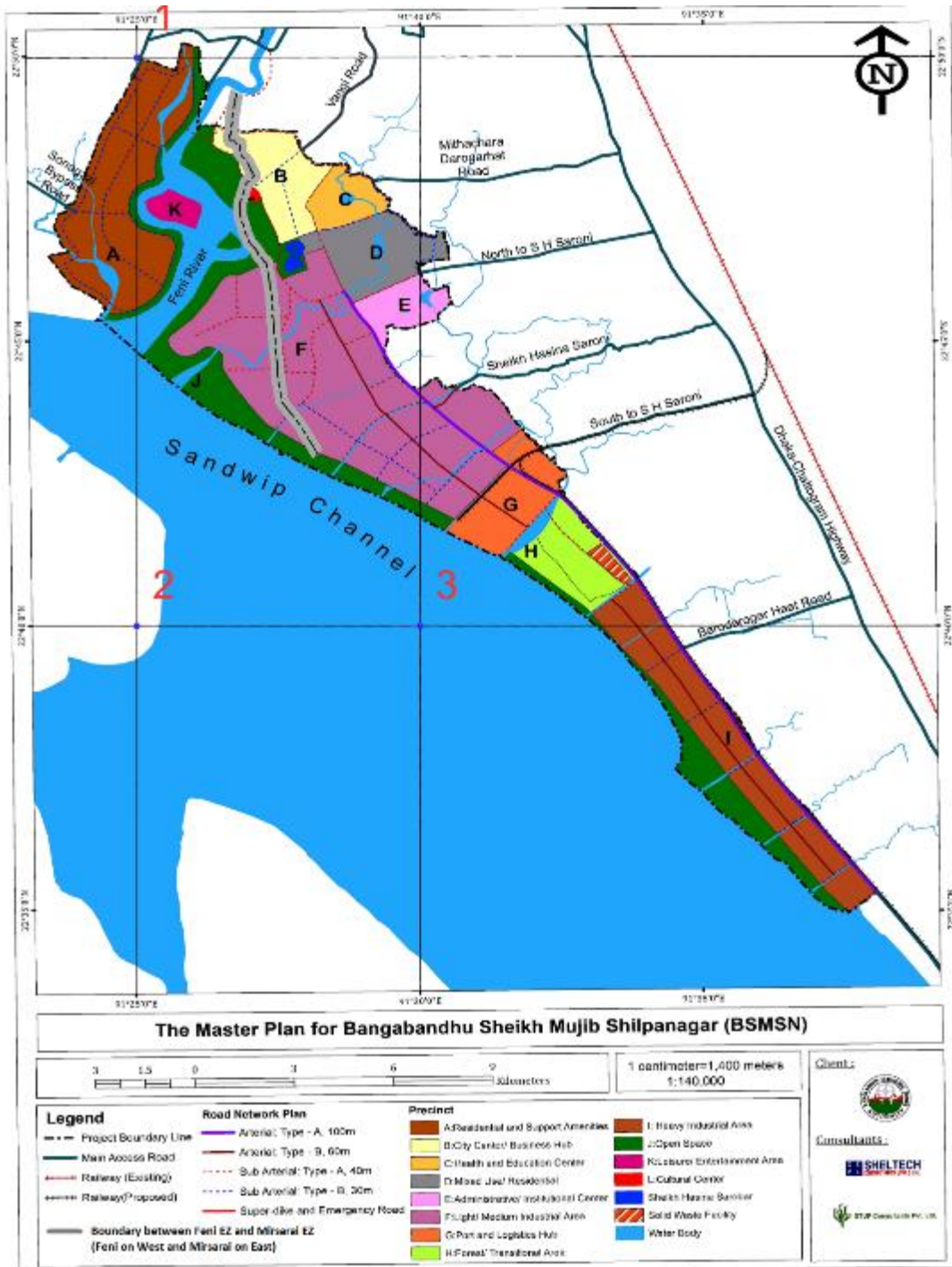
Detailed master planning is done cluster wise covering the following components:

- Micro level zoning
- Land use plan
  - Detailing the locations and sizes of various land uses
- Land parcel plan
  - Showing the sub-division of industrial land
- Phasing
- Utilities mapping
- Greenery and open space plan
- Road category

According to the BEZA, proposed EZ is spread over an area of 9549.61 acres out of which 2,013 acres is left for open spaces and green zones.

The master plan of EZ is given in the figure on the next page.

Figure 34: Master plan of BSMSN (Feni EZ Demarcated)



Source: Draft Masterplan Report of BSMSN

Feni EZ area will be used mostly for residential and non-commercial activities. However, a small portion of light industrial area will fall in Feni. Various type of industries to be accommodated within Industrial Zone arrived from market demand analysis are as follows-

- Textile and textile accessories
- Pharmaceuticals
- Food and Agro Processing Industry
- Electronics Industry

- Automobile Industry
- Power and Energy
- Leather Product Industries
- Light Industry (motorcycle assembly, machinery parts and general assembly)

Moreover, the power hub of the BSMSN area is located in Precinct F, of which majority falls in Feni. The power hub will contain a power plant which would be of Gas Turbine Plants and Combine Cycle Power Plant (LNG) in nature.

Within industrial Zone, there should be a chance for establishing various type of industries according to the trend, wish and requirements of developer. In order to provide that flexibility during implementation stage, area for the Industrial Zone has been earmarked as whole and further earmarking of area for different type of industries listed above has been avoided. This will attract the developers towards EZ due to its high flexibility.

Apart, area for Utilities and supporting amenities have also been earmarked in the proposed master plan.

### **3.10.1. Land use Plan**

The land use pattern of the EZ is determined after considering the land requirement for various processing units, logistics requirements, utilities, and public amenities etc.

The different land use proposed in the master plan for Feni EZ is described in the table below.

*Table 33: Land Use Plan of Feni EZ within BSMSN*

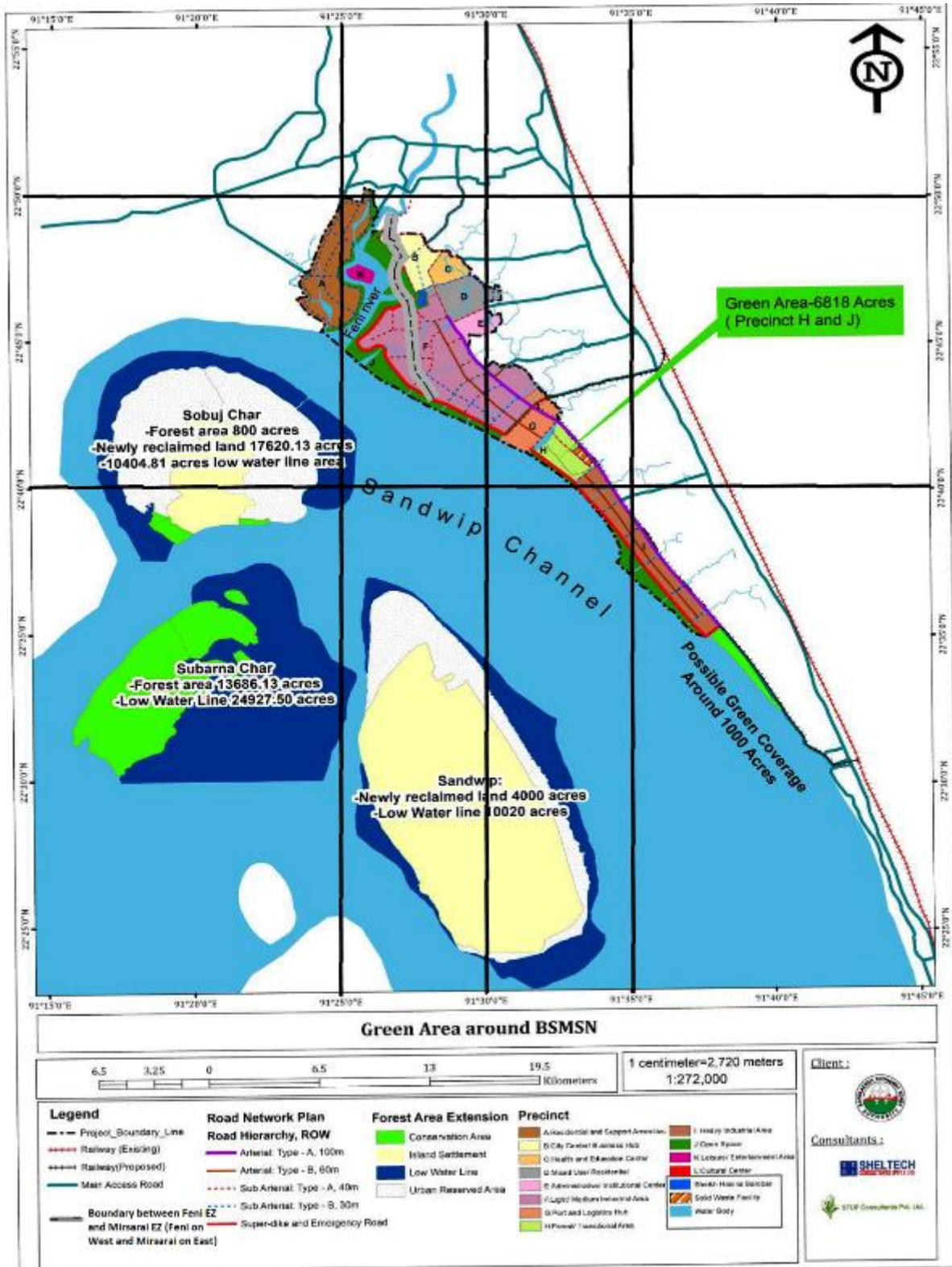
Precinct	Land Use Designation	Size in Acres	Percentage
EZ	FENI EZ		
A	Residential and Support Amenities	4606.57	48.24%
B	City Center/Business Hub	178	1.86%
F	Light/Medium Industrial Area	2,393.00	25.06%
J	Open Space	2013.69	21.09%
K	Leisure/Entertainment Area	350.89	3.67%
L	Cultural Center	7.46	0.08%
Total		9549.61	100.00%

*Source: Analysis of Draft Masterplan of BSMSN*

Green space required as per international planning norms in practice is being earmarked at strategic locations in the master plan. Private Green within the industrial plots is not included in the computation of overall green area of EZ. The greenery will be concentrated at the boundary of zones and at pocket parks.

The layout showing earmarked area for Green/Open space within the proposed EZ is as follows:

Figure 35: Green and open space



Source: Draft Masterplan of BSMSN

### 3.10.2. Existing land use pattern

Land use and land cover change patterns investigate are essential components in land resource evaluation and environmental studies due to the changing nature of land use patterns. The land use study for the proposed project and its 10 km buffer has been undertaken with the following objectives:

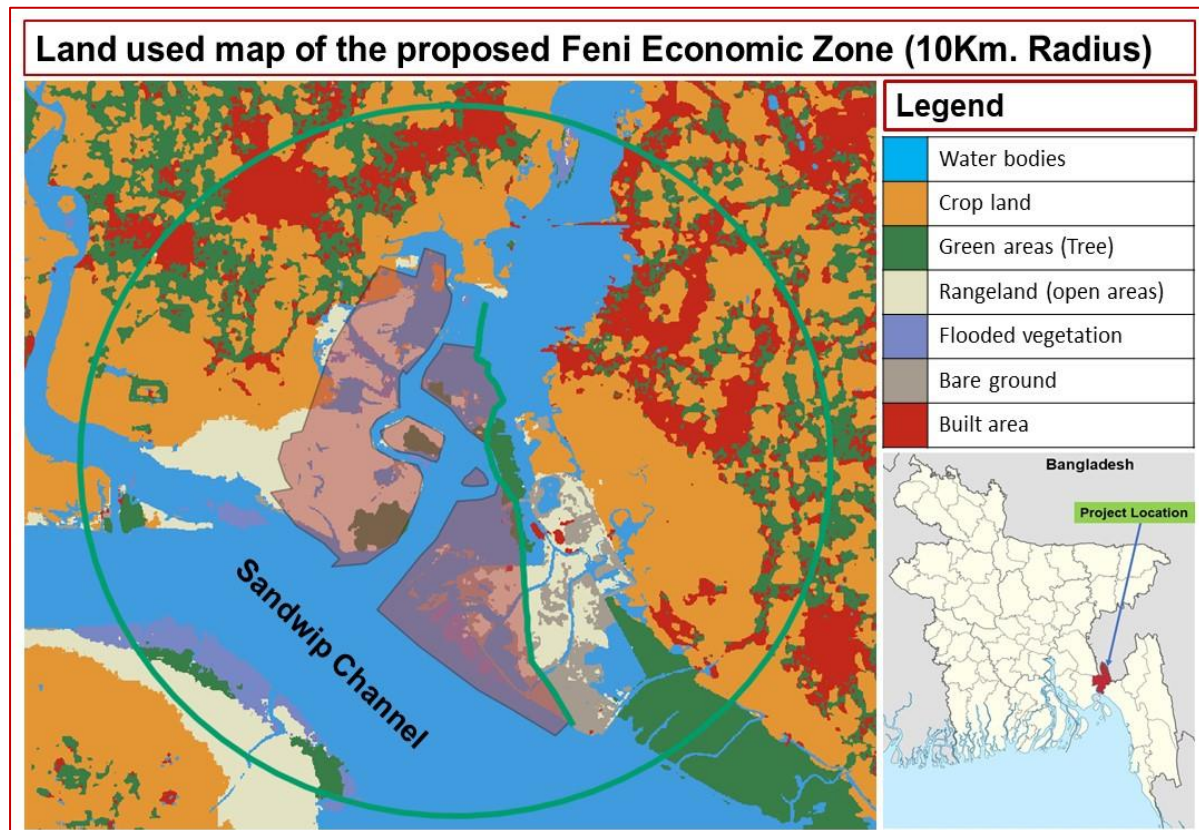
- To study the land use and land cover change patterns in the 10 km radius areas of the proposed Feni EZ project site and provide inputs for environmental planning of the proposed plant by analyzing the existing land use/land cover scenario:
- To establish the existing baseline scenario using a GIS database for incorporation of thematic information on the different physical features including water bodies, cropland, green areas, rangeland (open areas), flooded vegetation, bare ground, built areas etc.

The evaluation of the existing environmental status of the study area has considered 0-10 km. This revealed that the land use and land cover consist mainly of water bodies, cropland, green areas, rangeland (open areas), flooded vegetation, bare ground, and built areas. Table 33 shows the existing land use composition around 10 km of the project study area. Figure 30 is showing the land use pattern within 10 km of the study area.

Table 34: Existing Land use pattern around 10 km of the Project Area

Land use category	Area in acres	Percentage (%)
Water bodies	140	45.3
Crop land	88	28.5
Green areas (trees)	25	8.1
Rangeland (open areas)	32	10.4
Flooded vegetation	5	1.6
Bare ground	5	1.6
Built area	14	4.5

Figure 36: Land use/Land Cover Map for 10 km Study Area



### 3.11. Project Cost

#### Project Cost of BSMSN

The cost of the project as estimated is furnished in below table

Table 35: Project Cost

Description of Items	Total Costs	
	(In Million Taka)	(In Million USD)
<b>Off -Site Costing</b>		
Highway Improvements	39606	466
Rail Station Expansion/Improvements	2760	33
Rail Extension/Light Rail Expansion	121992	1435
Road Network Improvements from Highway to BSMSN Boundaries	85146	1002
Electricity Network Transmission	6016.11	70.77776
Water Network	20433.8	240.4
<b>Off-Site Total</b>	<b>275953.91</b>	<b>3247.178</b>
<b>On-Site Costing</b>		
Resettlement Costs	598.07	7.036151
Cut and Fill	1951340	22956.94
Embankment	6292.8	74.03294
Road Network	203067	2389
Electricity Network	288106	3389.48
Water Network	71201.2	837.8
Storm water Drainage System	101652.3	1195.9
Wastewater Handling System	51084.2	601
Gas Network	21716.73	255.4909
Solid Waste Facility	2599.92	30.5946
Plantation	107.767	1.267846
<b>On-Site Total</b>	<b>2488223.19</b>	<b>29273.57</b>
<b>Grand Total Project Costs</b>	<b>2973719.615</b>	<b>34985.72</b>

Source: Draft Masterplan BSMSN

#### Project Cost of Feni EZ

Considering Feni EZ is 28% of total BSMSN area the cost of the project can be estimated at 832,6141 Million BDT or 9,796 million USD.



# ***4. Environmental and Social Baseline***

This section establishes the baseline environmental status of the proposed economic zone and surrounding area to determine the project influence area within which the impacts of the Project are to be assessed.

Establishing baseline helps in understanding the prevailing environmental and socio economic status of the study area. It provides the background environmental and social conditions for anticipating of the future environmental characteristics of the area based on the operation of the new/ expansion activity of the project during its life cycle. It also helps in environmental management planning and strategy to minimize any potential impact due to the Project activities on surrounding environment. Field surveys were conducted at the project site to collect the requisite baseline information through discussions with project proponents, and local people. The baseline information are being gathered pertaining to:

- The physical environment (meteorological condition, air, water, land, soil, noise etc.)
- The Biological environment (Ecological condition, Biodiversity etc.)
- The socio-economic and cultural environment

## ***4.1. Methodology***

To assess environmental baseline of the project area a survey was conducted to identify environmental and social sensitive receptors located within and around the project area. The study area considered as 10 KM radius around the EZ site. The project activity areas are considered as core area and remaining study area as buffer zone. Environmental baseline data was collected through primary surveys as well from secondary sources by literature study and discussions with various stakeholders.

## ***4.2. Proposed Site and Study Area***

The proposed site is located adjacent to the confluence point of Bay of Bengal and Boro Feni River. The two blocks of the proposed EZ are located at either bank of the Boro Feni River. Muhuri Dam is located on Boro Feni River at just about 1.2 Km upstream from the proposed site. From Muhuri Dam location, the river splits into a number of streams before finally meeting Bay of Bengal. 2 streams of the river flow through proposed EZ blocks as well. The Bay of Bengal forms the entire southern boundary of the site. The mixing of saline water from sea and freshwater of the River in the confluence area generates a brackish water ecosystem. The region is quite rich in biological diversity. The Bay of Bengal and Boro Feni River are identified as key environmental features of the site surrounding and has a significant role on the topography, livelihood, and ecology of the area. Another river, named Choto Feni located about 5 km west of the proposed site also converges to sea at the southwest side of the proposed site. Considering the ecological importance of the site, a 10 km radius from the proposed site boundary has been considered as the zone of influence due to the proposed development. Hence, 10 Km radius is considered as a study area for carrying out an Environmental Review. Zila/Upazila level secondary information was also collected for various environmental and social components irrespective of any demarcated boundary.

The study area is considered as 10 KM radius around the proposed EZ site. The project activity areas are considered as core area and the remaining study area as buffer zone. The environment setting of project area and its surrounding has been presented in the following table and figure.

*Table 36: Environmental Setting of Project Surrounding Area*

<b>Particulars</b>	<b>Details</b>
Location	Nearest Village Char Chandia, Sonagazi upazila, District Feni, Bangladesh Latitude: 22°47'24.13"N Longitude: 91°24'4.19"E
Affected Mouza	Dakhin Char Khondaker Char Khowajer Namchi Char Nasrin Bahir Char Thak khowajer Namchi Char Khondaker Char Ram Narayan
Nearest Airport	Shah Amanat International Airport (75 km) located at SE direction
Nearest Railway Station	Nearest Railhead: Boraiyarhat station (15 Km) located at NE direction Nearest railway junction: Chattogram Station (75 Km) located at SSE direction
Nearest Port	Chattogram Port (75 km) is located at SSE direction
Seismic Zone	Zone II
National Park/Sanctuary/Ecologically Critical Area etc	None within 10 kms
Important Bird Area	Muhuri Dam (Located adjacent to the Proposed Site)
Forests / Vegetation Cover	About 160 Ha of Mangrove Plantation is present to the southern part of the proposed EZ site
Archaeologically important places/monuments	None within 300 m of the EZ site

*Source: Google Earth & Site Visits*

Figure 37: Map Showing Environmental Settings surrounding to Project Site



Source: BSMSN Masterplan and Google Earth

### 4.3. Baseline Data Collection and Monitoring Stations

The present EIA Report has been prepared based on the Primary field investigations / assessment and secondary data collected from Forest Department, Bangladesh Meteorological Department, Bangladesh Bureau of Statistics, DoE, published journals, books, public consultation etc. As a part of primary study, a reconnaissance survey and baseline monitoring for various environmental parameters were conducted. Towards assessing baseline condition Water sample (Surface & Ground) were collected. Ambient Air Quality & Noise Level were also monitored at project area. Secondary data available on air quality, water quality and soil quality is also studied for defining the baseline environment of the area.

#### 4.3.1. Meteorology

The project area lies in the South-Eastern climate zone of the country and shows three main seasons, i.e.

**The Southwest Monsoon:** May to October- 90% of the annual rainfall occurs during this period and relative humidity is high.

**The Northeast Monsoon:** It lasts from November to March.

**The Hot Season:** This hottest season extend from about late March to May. The highest daily temperatures generally occur at this time, and Flash floods often occur from the rivers entering the eastern part of the region from the Tripura Hills.

The climate is tropical in project area. Project area has significant rainfall most months, with a short dry season. According to Köppen and Geiger, this climate is classified as Tropical Monsoon Climate (Am). Meteorological condition has been established using data on different metrological parameters accumulated from Bangladesh Meteorological Department. Summary of the analysis of metrological parameters are given in the following sections.

Figure 38: Project Area Shown on Climate Region Map of Bangladesh



Source: BMD

### 4.3.1.1. Temperature

Nearest meteorological monitoring station from proposed site is located at Sitakunda which is located about 25 Km away. The data of Sitakunda station has been considered for establishing temperature profile of the project area. The average minimum temperature varies between 5.7 to 24.8 °C whereas maximum temperature ranges from 28.4 to 40.2 °C. Monthly minimum and maximum temperatures and average minimum and maximum temperatures for the period 2008-2018 for Sitakunda Station are given in below tables.

*Table 37: Monthly minimum (average) temperature (°C) (2008 to 2018)*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul.	Aug	Spt	Oct	Nov	Dec
<b>2008</b>	9.0	6.7	14.4	17.0	20.6	23.0	23.9	24.2	23.2	18.8	13.0	12.1
<b>2009</b>	9.0	10.7	****	****	****	****	****	23.8	24.0	18.3	12.3	8.3
<b>2010</b>	7.5	9.3	17.1	22.1	20.7	21.8	24.7	24.8	24.1	20.8	14.6	9.7
<b>2011</b>	6.3	10.0	13.5	17.8	21.2	23.9	23.8	23.6	23.6	18.8	14.7	9.3
<b>2012</b>	7.7	8.4	14.2	18.9	19.5	21.0	24.5	23.5	24.3	17.8	11.7	5.7
<b>2013</b>	5.7	11.0	13.7	18.3	20.2	23.7	24.8	24.4	24.1	19.8	13.4	8.3
<b>2014</b>	7.7	9.8	14.0	20.1	22.0	23.2	24.1	24.4	24.3	19.0	13.5	11.0
<b>2015</b>	9.0	8.5	12.8	19.6	22.2	23.0	23.5	24.1	23.1	20.8	14.6	9.2
<b>2016</b>	7.5	10.8	18.0	18.2	20.1	23.3	23.6	23.1	24.5	20.4	15.0	13.3
<b>2017</b>	8.6	10.5	13.4	18.9	21.6	21.8	24.3	24.5	24.2	19.0	13.9	11.1
<b>2018</b>	6.8	13.0	15.0	18.2	20.5	22.0	24.3	24.0	24.2	19.2	14.0	8.8
<b>Ave of 10 years</b>	7.7	9.9	14.6	18.9	20.9	22.7	24.2	24.0	24.0	19.3	13.7	9.7

Source: BMD; Station: Sitakunda (Note : \*\*\* means data missing)

*Table 38: Monthly maximum (average) temperature (°C) (2008 to 2018)*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul.	Aug	Spt	Oct	Nov	Dec
<b>2008</b>	30.4	31.9	34.4	39.2	36.3	34.6	33.7	34.4	36.0	35.7	33.6	31.7
<b>2009</b>	30.2	32.9	36.7	37.9	35.9	36.5	34.4	34.5	36.0	35.1	35.1	30.8
<b>2010</b>	31.4	33.2	38.9	36.9	36.8	34.9	34.5	34.9	34.2	36.7	35.1	32.1
<b>2011</b>	31.2	33.7	35.4	35.9	35.4	35.5	35.2	34.9	35.8	34.8	32.7	31.9
<b>2012</b>	31.0	34.7	35.5	36.8	36.2	36.4	34.6	35.0	35.9	35.7	34.9	30.2
<b>2013</b>	31.4	34.7	35.7	35.8	33.9	35.9	34.7	33.7	36.1	35.5	33.0	31.0
<b>2014</b>	31.4	32.1	34.8	40.2	35.9	35.2	35.1	34.5	35.0	35.8	34.6	31.2
<b>2015</b>	32.1	32.1	36.3	35.8	35.1	35.7	34.4	34.7	36.6	34.9	33.4	29.6
<b>2016</b>	28.9	34.0	35.7	35.5	37.5	34.9	34.6	34.7	35.5	35.2	35.2	31.6
<b>2017</b>	31.4	33.1	33.5	35.2	36.8	35.9	35.5	34.3	35.4	35.4	34.5	31.8
<b>2018</b>	28.4	33.3	35.2	36.3	35.6	35.3	36.4	34.5	36.5	35.2	33.3	30.5
<b>Ave of 10 years</b>	30.7	33.2	35.6	36.9	35.9	35.5	34.8	34.6	35.7	35.5	34.1	31.1

Source: BMD; Station: Sitakunda

### 4.3.1.2. Humidity

Nearest meteorological monitoring station from proposed site is located at Sitakunda which is located about 25 Km away. The data of Sitakunda station has been considered for establishing humidity condition of the project area. The average relative humidity at project area varies between 65 % in the month of March and 90 % in the month of July. The average relative humidity for the last 10 years for project area is provided in below table. The data shows that average humidity does not vary much with the change in seasons and is relatively high.

*Table 39: Monthly average relative humidity (in %) during Jan 2008 to Dec 2018*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Spt	Oct	Nov	Dec
<b>2008</b>	80	74	82	75	79	87	90	88	85	86	81	86
<b>2009</b>	79	73	74	81	80	83	88	88	86	84	80	79
<b>2010</b>	77	70	75	79	82	88	86	87	87	86	85	80
<b>2011</b>	72	67	71	79	83	87	87	88	87	84	81	81
<b>2012</b>	79	66	78	82	84	87	89	85	85	85	82	81
<b>2013</b>	75	70	76	78	86	85	85	88	87	85	78	81
<b>2014</b>	76	72	69	71	78	86	84	87	84	82	80	79
<b>2015</b>	77	73	65	78	80	84	89	86	86	85	80	80
<b>2016</b>	79	78	78	81	81	83	87	85	84	84	83	82
<b>2017</b>	75	70	77	82	81	85	88	86	88	85	82	84
<b>2018</b>	81	77	78	76	83	84	86	85	86	85	79	80
<b>Ave of 10 years</b>	77	72	75	78	82	85	87	87	86	85	81	81

Source: BMD; Station: Sitakunda

### 4.3.1.3. Rainfall

Nearest Meteorological station of BMD to the site is Sitakunda which is app. 25.0 km to EZ site in SW direction. Average yearly rainfall of the area is 3327 mm. The average monthly rainfall data for Sitakunda Station (obtained from BMD) is provided in table below. The data shows that rainy season in project area mainly prevails from May to September. Rainy season is very prominent in this region like other coastal areas of the country.

*Table 40: Rainfall (in mm) pattern in Project Area (Jan 2008 to Dec 2018)*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul.	Aug	Spt	Oct	Nov	Dec	Annual
<b>2008</b>	32	5	13	7	439	386	994	687	226	154	2	0	2945
<b>2009</b>	0	0	1	78	320	394	916	803	315	271	21	0	3119
<b>2010</b>	0	1	37	71	314	876	377	473	421	289	4	5	2868
<b>2011</b>	1	0	126	163	361	502	818	1136	524	127	0	0	3758
<b>2012</b>	1	0	24	352	251	954	1274	567	234	256	19	1	3933
<b>2013</b>	0	0	13	57	470	569	333	390	496	269	1	0	2598
<b>2014</b>	0	25	21	27	194	995	508	757	350	87	0	0	2964
<b>2015</b>	3	0	5	168	209	761	1304	592	548	213	3	5	3811
<b>2016</b>	3	285	55	65	328	323	631	359	378	217	109	0	2753
<b>2017</b>	0	0	119	419	239	949	1313	772	835	179	1	42	4868
<b>2018</b>	18	0	0	246	279	1025	1114	454	170	218	0	2	3526
<b>Ave of 10 years</b>	5	29	38	150	309	703	871	635	409	207	15	5	3377

Source: BMD; Station: Sitakunda

#### 4.3.1.4. Evaporation

Evaporation in the project area reaches its maximum level in between April-May when temperature, sunshine and wind are all at or close to their maximum levels for the year. Potential evaporation data of Comilla station is presented in table below.

*Table 41: Monthly Average Evaporation Data (Period: 2008-2018)*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	9	15	19	26	27	21	20	23	24	17	12	8
2009	8	16	19	25	24	22	21	18	19	17	16	9
2010	9	15	22	23	20	18	21	19	21	20	16	14
2011	12	15	19	22	22	20	18	17	19	18	12	11
2012	13	14	21	19	23	19	21	16	17	17	12	8
2013	10	15	15	15	12	15	15	11	13	15	14	10
2014	10	13	16	22	18	13	15	14	-	-	-	-
2015	12	15	17	15	16	15	13	19	20	19	16	12
2016	12	16	22	27	27	27	25	27	22	20	15	14
2017	13	16	19	21	28	25	20	23	18	21	16	11
2018	10	16	19	23	19	21	-	-	-	-	-	-

Source: BMD; Station: Comilla

#### 4.3.1.5. Wind Speed and Direction

Like the country's wind characteristics, the region is characterized by Southerly wind from the Bay of Bengal during monsoon and Northwesterly wind from Himalaya during winter. Data on Monthly Prevailing Wind Speed (in Knots) and Direction recorded in Sitakunda station from 2008 to 2018 is given in table below and wind rose diagram (based on data from 1977 to 2005) is furnished in **Appendix B**. It was observed from windrose diagram that predominant wind direction is south.

*Table 42: Wind Speed (in Knots) and Direction recorded in Sitakunda station from 2008 to 2018*

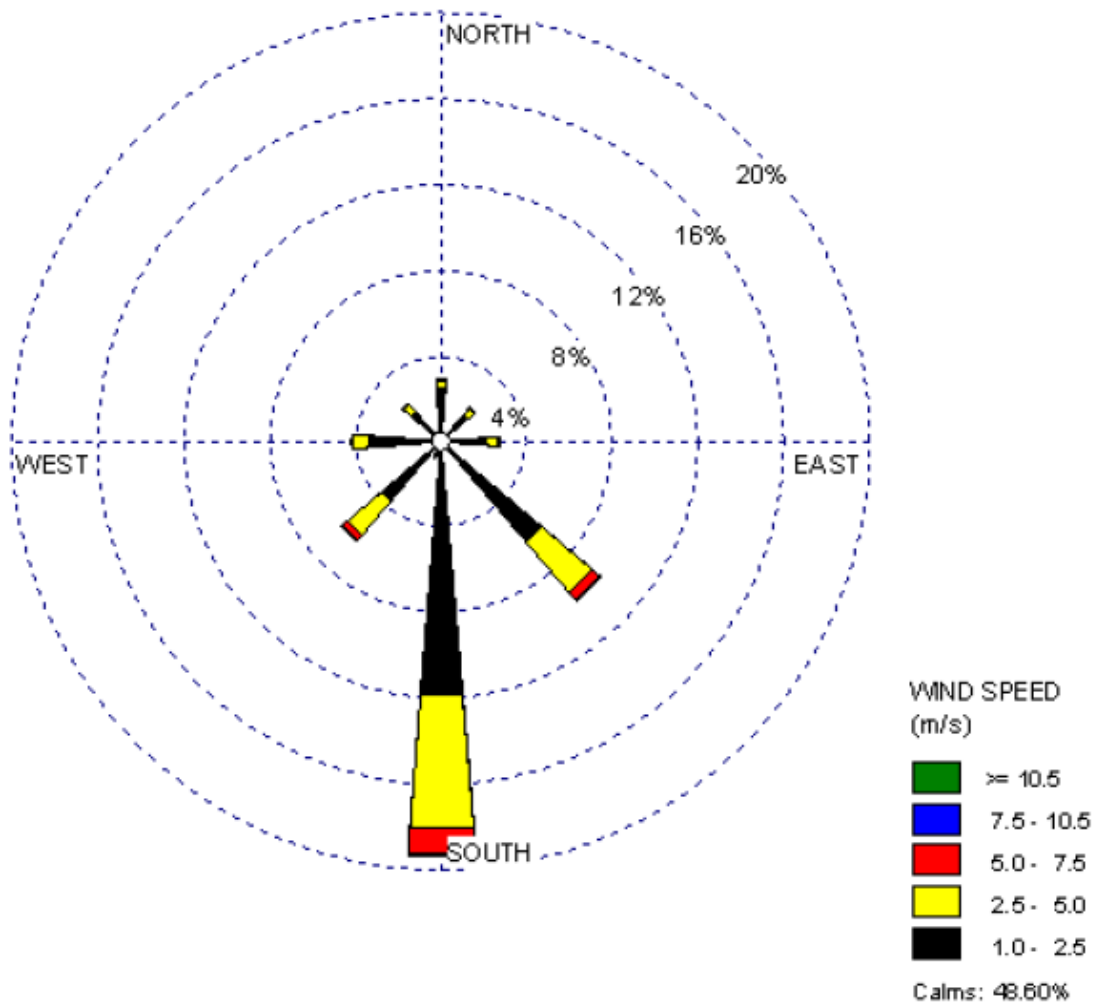
Year	Speed (knot)/ Direction	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Jan.	Speed	2.5	1.9	1.9	2.2	2	1.1	1.4	1.4	2.2	1	1.7
	Direction	W	W	W	N	W	W	W	W	NW	NNE	W
Feb.	Speed	2.7	3.4	2	2.6	2.7	1.5	2.1	1.6	3.3	3.8	2
	Direction	W	W	W	W	W	W	W	W	S	SW	SW
Mar.	Speed	3.7	3.2	4.8	3.9	3.2	1.7	1.8	2.2	2.3	4.1	2.8
	Direction	SW	S	S	S	S	W	W	W	S	S	SW
Apr.	Speed	3	4.9	4.9	2.3	2.6	1.8	2.8	3.2	5.1	3.6	2.6
	Direction	S	S	S	W	S	S	S	S	S	SE	S
May	Speed	3	3.7	3.8	2.6	2	2.6	2.2	3.2	3.1	3	2.4
	Direction	S	S	S	S	S	S	S	S	S	SE	SW
Jun.	Speed	4.4	3.2	3.3	2.6	3.2	1.8	1.9	3.2	2.5	4.1	3.3
	Direction	S	S	S	S	S	S	S	S	S	S	SW
Jul.	Speed	3.7	3.6	2.8	2.5	3	2.3	2.7	3.1	3.1	4	2.7
	Direction	S	S	S	S	S	S	S	S	S	S	S
Aug.	Speed	3.4	2.4	2.1	2.5	2.6	2.8	2.2	2.3	3.2	3	2.6
	Direction	S	S	S	S	S	S	S	S	S	S	S
Sep.	Speed	3.6	3.3	2.7	2.4	2.2	2.5	2.1	2.9	2.3	3.1	2.4
	Direction	SE	SE	S	S	S	S	S	S	S	S	S
Oct.	Speed	3.1	2.9	1.8	1.6	1.5	2.1	1.4	2.6	2.5	2.9	2.6
	Direction	SW	S	S	S	S	S	W	E	SSE	S	SE

Year	Speed (knot)/ Direction	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Nov.	Speed	1.3	1.3	1	1.4	1.1	1	1.3	1.2	1.2	1.4	1.7
	Direction	W	W	W	W	S	W	S	N	N	NW	SE
Dec.	Speed	1.4	2	1.9	1.8	1.1	1.2	1	2	1	2.2	2.8
	Direction	W	NW	N	NW	W	W	W	W	W	S	SW

**Note: E-East; W-West; N-North; S- South**

Source: BMD; Station: Sitakunda

Figure 39: Windrose Pattern (January to December; Period : 1977 – 2005)



Source: BMD; Station: Sitakunda

#### 4.3.1.6. Sunshine Hours

The monthly average sunshine hour in Sitakunda varies from 2.4 to 9.3 hours/day. Highest sunshine hours are recorded in month of April. Monthly average Sunshine hours of the project area is furnished in below table.



Table 43: Monthly average Sunshine Hours/Day (Jan 2007 to Dec 2017)

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annual (Avg)
2007	6.5	7.3	9.1	8.2	7.8	5.0	3.2	5.8	4.8	6.0	7.5	6.9	6.6
2008	6.9	8.0	7.0	9.3	7.6	4.4	4.5	5.2	6.2	7.3	8.6	5.9	6.8
2009	8.1	8.6	7.3	8.4	7.5	6.8	4.7	4.4	5.0	7.5	7.8	7.4	7.0
2010	7.4	8.3	7.8	7.9	6.4	4.1	5.2	5.1	5.5	6.9	7.9	7.6	6.7
2011	7.7	8.4	8.2	7.6	6.3	3.9	5.3	4.3	5.5	7.5	8.6	6.4	6.7
2012	6.4	9.0	7.5	6.9	7.9	4.6	3.8	6.3	5.5	7.3	6.4	7.0	6.6
2013	7.4	8.3	8.2	8.3	3.5	6.2	5.4	4.2	5.4	5.7	9.0	7.4	6.6
2014	7.8	8.1	8.6	8.9	7.5	4.6	5.4	4.5	6.6	7.7	8.3	7.5	7.2
2015	7.2	8.2	8.8	6.9	7.1	4.0	2.4	4.2	5.5	6.1	8.0	5.6	6.2
2016	6.4	6.0	6.8	7.2	6.7	5.7	3.3	4.9	6.4	6.0	7.6	7.5	6.3
2017	8.3	7.9	7.1	6.2	7.5	4.0	2.6	4.7	4.2	5.9	8.0	6.8	6.1

Source: BMD; Station: Sitakunda

### 4.3.2. Air Quality and Noise

#### 4.3.2.1. Air Quality

To establish the baseline of the study area, ambient air quality monitoring was conducted by Bangladesh Environmental Engineering Training & Lab Services Ltd., Bangladesh on 26th-27th August'2020. Ambient air sample is collected from the site using Respirable Dust Sampler Lata Envirotech APM-460BL for PM10 and Fine Particulate Sampler Envirotech APM-550 for PM2.5. With an attachment APM 411TE to measure ambient gaseous compounds (SO<sub>2</sub>, NO<sub>2</sub>). The APM 550 system is a manual method for sampling fine particles (PM<sub>2.5</sub> fraction) and is based on impactor designs standardized by USEPA for ambient air quality monitoring. Ambient air enters the APM 550 series samplers' system through an omni-directional inlet designed to provide a clean aerodynamic cut-point for particles greater than 10 microns. Particles in the air stream finer than 10 microns proceed to a second impactor that has an aerodynamic cut-point at 2.5 microns. The air sample and fine particulates exiting from the PM 2.5 impactor are passed through a 47 mm diameter Teflon filter membrane that retains the fine particulate matter. The sampling rate of the system is held constant at 1m<sup>3</sup>/hr by a suitable critical orifice. The standard system is supplied with a Dry Gas Meter to provide a direct measure of the total air volume sampled. The APM 460 sampler uses an improved cyclone with sharper cutoff (D<sub>50</sub> at 10 microns) to separate the coarser particulates from the air stream before filtering it on the glass microfibre filter. By using the APM 460, measurement of Respirable Particulate Matter can be done accurately and TSPM can also be assessed by collection of dust retained in the cyclone cup. The APM 411TE is designed as an attachment to operate with Envirotech's Respirable Dust or High-Volume Samplers and PM 2.5 samplers. When paired with an appropriate dust sampler, the APM 411 TE allows the user to collect gaseous pollutant samples (for monitoring SO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub>, Ozone, etc.) as well as dust samples simultaneously. All samples are collected from the site according to the standard sample collection method. The sampling machines consist of blowers which blow air through standard filters e.g., glass fiber filters. There are different kinds of filters for different parameters. Dusts are trapped in filters. The collected samples are analyzed as per standard procedure to determine all parameters in the laboratory of Bangladesh Environmental Engineering Training & Lab Services Ltd. The concentration of PM<sub>10</sub> was computed from the average airflow rate, sampling period, and the mass of particulate matter collected over the filter surface. The concentration of PM<sub>2.5</sub> is computed as the weight of dust deposited on the filter divided by the volume of air sampled.

$$[PM_{10} (\mu g/m^3)] = (\text{Final weight of filter paper} - \text{initial weight of filter paper}) / \text{volume of air}$$

$$[PM_{2.5} (\mu g/m^3)] = (\text{Final weight of filter paper} - \text{the initial weight of filter paper}) / \text{volume of air}$$

The ambient SO<sub>2</sub> concentrations were computed from the amount of SO<sub>2</sub> collected and the volume of air sampled.

$$[SO_2 (\mu g/m^3)] = (A - A_0) \times 1000 \times B \times D/V$$

Where, A= Sample Absorbance, A<sub>0</sub>= Reagent blank Absorbance, B = Calibration factor (µg/absorbance), D = Volume of absorbance solution in impinger during monitoring/volume of absorbing solution taken for analysis, and V = Volume of Air Sample in liters.  
[NO<sub>X</sub> (µg/m<sup>3</sup>) = (A – A<sub>0</sub>) x 1000 x B x D/ 0.82V]

Where, A= Sample, Absorbance, A<sub>0</sub>= Reagent blank Absorbance, B= Calibration factor (µg/absorbance), D=Volume of absorbance solution in impinger during monitoring/ volume of an absorbing solution was taken for analysis and V= Volume of Air Sample in liters. Carbon Monoxide: Rubber Bladder and Aspirators have been used to collect the 8 hourlies samples for carbon monoxide. The CO levels were analyzed through the NDIR Spectroscopy method.

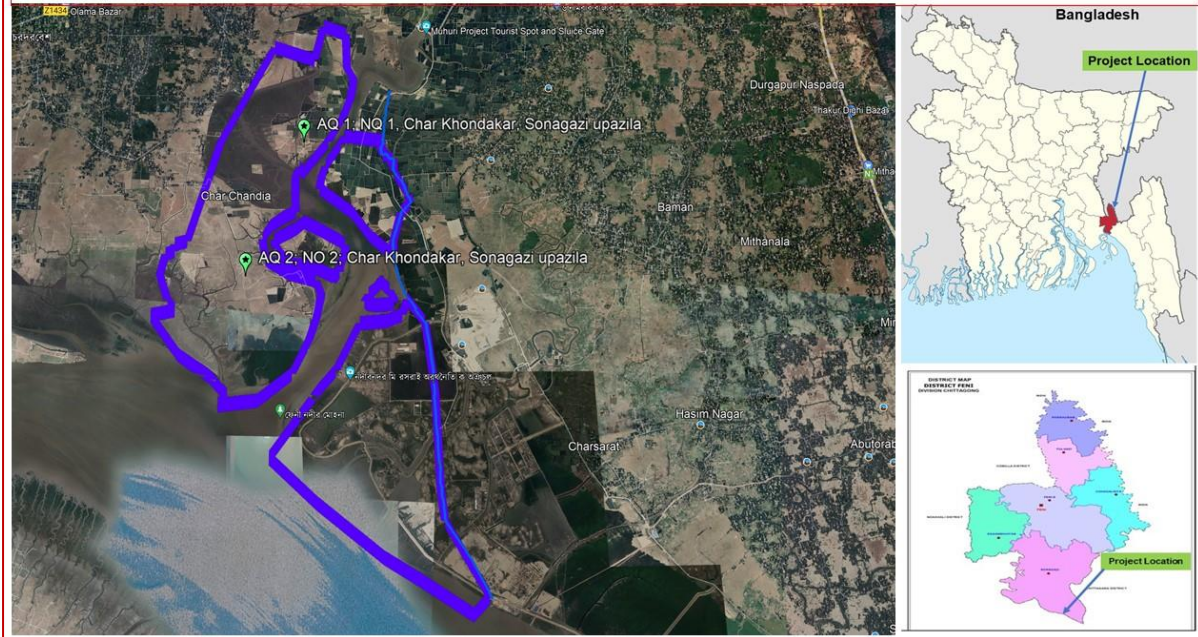
The existing ambient air quality of the study area was mentioned at two (2) locations during the monitoring period 26th-27th August'2020. The monitored parameters are shown in table (52). The baseline ambient air quality has been established through a scientifically designed ambient air quality-monitoring network. The ambient air quality monitoring locations are based on the following aspects covered in the field survey plan developed before the fieldwork: meteorological conditions of the area are based on information provided by the BMD observatory at Dhaka, the topography of the study area, and location of sensitive receptors such as major settlements, two samples were taken because the proposed EZ, are mostly bare land and no settlements.

#### Air Quality Monitoring Pictures



*Figure 40: Air quality monitoring locations*

### Geographical details of Ambient air and Noise sampling location



Ambient air quality of the project area is furnished in below table.

*Table 44: Ambient Air Quality of Project Area*

Sampling Location: Proposed EZ Site (Char Khondakar, Sonagazi upazila, Feni, Chittagong.)						
Project Location Coordinate: 22.783037°N 91.412643°E; 22°48'41.72"N, 91°25'32.89"E						
Sample Site Description				Time & Duration: Sampling has been done between 8.00 AM 26/08/2020 to 8.00 AM 27/08/2020		
<p>•Weather Condition: Sunny; Temperature 29°C, Wind:S 6km/h; Humidity: 83%; Dew Point: 27°C</p> <p>•Site Condition The sampling site was bare land; The site was fully empty; no construction and traffic was observed in there; Very low people movement was observed in there.</p>						
Parameter	Unit	Concentration Present	IFC Standard mg/m <sup>3</sup>	Bangladesh Standard**	Duration (hours)	Method of Analysis
PM <sub>10</sub>	µg/m <sup>3</sup>	39.29	150	150	24 Hr	Gravimetric
SPM	µg/m <sup>3</sup>	62.76	-	200	24 Hr	Gravimetric
PM <sub>2.5</sub>	µg/m <sup>3</sup>	12.19	75	65	24 Hr	Gravimetric
SO <sub>2</sub>	µg/m <sup>3</sup>	5.16	125	365	24 Hr	West- Geake
NO <sub>2</sub>	µg/m <sup>3</sup>	11.73	200 (1 Hr)	NYS	24 Hr	Jacob and Hochheiser
NO	µg/m <sup>3</sup>	08.73	NYS	NYS	24 Hr	Jacob and Hochheiser
O <sub>3</sub>	PPM	6	160 (8 Hr)	NYS	8 Hr	Portable Meter-Bosean (BH-4S Portable 4 in 1) Gas detector
CO*	PPM	1	NYS	9	8 Hr	Indicator Tube Method
CO <sub>2</sub>	PPM	357	NYS	NYS	1 Min	Portable Meter (CEM DT 802)
TVOC	µg/m <sup>3</sup>	3	NYS	NYS	1 Min	Portable Meter-CEM DT 900A
NH <sub>4</sub>	PPM	0.02				Portable Meter-Bosean (BH-4S Portable 4 in 1) Gas detector
Cl	PPM	0.002				Portable Meter-Bosean (BH-4S Portable 4 in 1) Gas detector
<b>Note:</b>						
• CO concentrations and standards are 8-hourly basis.						

- **The Bangladesh National Ambient Air Quality Standards have been taken from the Environmental Conservation Rules, 1997 which was amended on 19th July 2005 vide S.R.O. No. 220-Law/2005.**
- **WHO Ambient Air Quality Guideline Values (2005 and 2000), which are also being referred in the World Bank and IFC's General EHS Guidelines (2007)**
- **NYS: Not Yet Standardized**

*Source: Primary Baseline Study, Aug'20*

#### Interpretation of Monitored Parameters

##### Particulate Matter (SPM, PM<sub>2.5</sub> & PM<sub>10</sub>):

Particulate matter is the general term used to describe a mixture of solid and liquid particles in air including dust, soot, smoke, and dirt. Normally SPM is a partial matter less than 100 micron, PM<sub>10</sub> is particulate matter less than 10 microns in aerodynamic diameter and is often called the coarse fraction. PM<sub>2.5</sub> is particulate matter less than 2.5 microns (about 0.0001 inch) in aerodynamic diameter and is often called the fine fraction.

Particulate matter is the sum of all solid and liquid particles suspended in air many of which are hazardous. Especially, PM<sub>10</sub> and PM<sub>2.5</sub> particles are small enough to penetrate and accumulate in the respiratory system. Exposure can cause respiratory morbidity, impaired lung function and irritation. It is also carcinogenic. This pollution is sometimes referred to as "black carbon pollution". Ambient air quality report reflects that SPM, PM<sub>2.5</sub> and PM<sub>10</sub> are within the standard according to the Bangladesh Ambient Air Quality Standard ECR 1997, Schedule 2. Hence, it can be interpreted that the air quality is good for human health and another living thing.

##### Gaseous Pollutant NO<sub>x</sub> (NO<sub>2</sub> & NO):

Oxides of Nitrogen (NO<sub>x</sub>) are noxious gas that an accumulation of NO<sub>2</sub> and NO. It's highly reactive and formed when fuel is burned at high temperatures. The main sources are motor vehicles, engine water vessels, generators, and industrial fuel-burning instruments. Nitrogen dioxide can cause respiratory problems. It can also take part in the chemical reactions in the atmosphere to form corrosive nitric acid and can also react with sunlight to form ground-level ozone long term exposure can decrease lung function, increase the risk of respiratory conditions, and increases the response to allergens. NO<sub>x</sub> also contributes to the formation of fine particles (PM) and ground-level ozone, both of which are associated with adverse health effects. To know the concentration of NO<sub>x</sub> (NO<sub>2</sub> and NO) ambient air quality was tested. Results revealed that the concentration of NO<sub>x</sub> i.e. (Jointly NO<sub>2</sub> and NO) is within the standard according to the Bangladesh Ambient Air Quality Standard ECR 1997, Schedule 2. Hence, it can be interpreted that the air is good for human health, agriculture, and another living thing.

##### Gaseous Pollutant SO<sub>2</sub>:

Sulfur dioxide (SO<sub>x</sub>) is a gas that is often produced in the burning of fossil fuels containing Sulphur. It can cause respiratory problems and damage vegetation. Sulfur dioxide dissolves easily in water and therefore can contribute to acid rain once it is released into the atmosphere. To know the concentration of SO<sub>2</sub> ambient air quality was tested. Results revealed that the concentration of SO<sub>2</sub> is within the standard of according to the Bangladesh Ambient Air Quality Standard ECR 1997, Schedule 2. Hence, it can be interpreted that the air is good for human health, agriculture, and another living thing.

##### Gaseous Pollutant CO & CO<sub>2</sub>:

Carbon monoxide (CO) is a gas that is slightly lighter than air and is formed when carbon in fuel is not burned completely. In urban areas, almost all CO is produced by motor vehicles. Exposure to CO can disrupt the supply of oxygen to the body tissue, and cause neurobehavioral effects and cardiovascular problems. As well as Most of the air pollution we cause results from the burning of fossil fuels, such as coal, oil, natural gas, and gasoline to produce electricity and power our vehicles. Carbon dioxide (CO<sub>2</sub>) is a good indicator of how much fossil fuel is burned and how much of other pollutants are emitted as a result Fresh air contains about 400 ppm CO<sub>2</sub>. The exhaust gas of combustion engine contains about 140,000 ppm CO<sub>2</sub>. Human breath contains about 50,000 ppm CO<sub>2</sub>. Indoor ventilation is well-balanced at a level of 1,000 ppm CO<sub>2</sub>. To know the concentration of CPO & CO<sub>2</sub> ambient air quality was tested. Results revealed that concentration of CO is within the standard of according the Bangladesh Ambient Air Quality Standard ECR 1997, Schedule 2. Hence, it can be interpreted that the air is good for human health and other living thing.

##### Gaseous Pollutant Total Volatile Organic Compound (TVOC):

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Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide array of products numbering in the thousands.

Organic chemicals are widely used as ingredients in household products. Paints, varnishes, and wax all contain organic solvents, as do many cleanings, disinfecting, cosmetic, degreasing and hobby products. Fuels are made up of organic chemicals. All these products can release organic compounds while you are using them, and, to some degree, when they are stored. However, it may create Eye, nose and throat irritation, headaches, loss of coordination and nausea, damage to liver, kidney and central nervous system, some organics can cause cancer in animals, some are suspected or known to cause cancer in humans. To know the concentration of VOC, air quality was tested. Results revealed that concentration of VOC is negligible. The local people were asked to find out the syndromes of VOC on human health; however, such type of issues not recorded.

#### Gaseous Pollutant Ozone (O<sub>3</sub>):

Ground-level or "bad" ozone is not emitted directly into the air but is created by chemical reactions between oxides of nitrogen (NO<sub>x</sub>) and volatile organic compounds (VOC) in the presence of sunlight. Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of NO<sub>x</sub> and VOC. Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, and congestion. It can worsen bronchitis, emphysema, and asthma. Ground-level ozone also can reduce lung function and inflame the linings of the lungs. Repeated exposure may permanently scar lung tissue. Ground-level ozone also damages vegetation and ecosystems. To know the concentration of O<sub>3</sub>, air quality was tested. Results revealed that concentration of O<sub>3</sub> is negligible. The local people were asked to find out the syndromes of O<sub>3</sub> on human health; however, such type of issues not recorded.

#### Gaseous Pollutant Ammonia (NH<sub>3</sub>):

Emissions of ammonia have been demonstrated to play a role in the formation of airborne fine particulate matter, by reacting with gaseous emissions of sulphur dioxide and oxides of nitrogen. Agriculture emits ammonia to the atmosphere, and atmospheric processes can transport the particulate form of ammonium long distances. Hence NH<sub>3</sub> emissions contribute to international transboundary air pollutant issues addressed by the UNECE Convention on Long Range Transboundary Pollution. Ammonia (NH<sub>3</sub>) is found naturally in ambient air, as well as emitted from anthropogenic sources, and plays a role in atmospheric chemistry. It has many sources, including agriculture, fossil fuel combustion, industrial emissions, and biochemical processes in natural soils.<sup>1-4</sup> Food production is a significant source of ammonia, with emissions occurring due to application of fertilizer or manure to soils and volatilization from animal waste. However, concentration of ammonia was found negligible. The local people were asked to find out the syndromes of NH<sub>3</sub> on human health; however, such type of issues not recorded.

#### Gaseous Pollutant Chlorine (Cl):

Most of the chlorine in the stratosphere is there because of human activities. When released, this chlorine is rapidly converted to forms that dissolve in water and therefore are removed from the lower atmosphere. Chlorine gas can be released to the air when bleach is mixed with other cleaning solutions that contain an acid, for example, some toilet cleaners. Mixing bleach with ammonia also produces very hazardous gases, such as chloramines. CFC components have a life cycle in the atmosphere of up to 100 years. So, one free chlorine atom coming from a CFC molecule can cause a huge amount of damage and destroy ozone molecules for many years. However, Cl concentration in air was identified as negligible in amount. The local people were asked to find out the syndromes of Cl on human health; however, such type of issues not recorded.

### **4.3.2.2. Noise Quality**

To establish the baseline condition of the noise environment monitoring of noise level was carried out by Bangladesh Environmental Engineering Training & Lab Services Ltd., Bangladesh on 26th-27th August 2020. The noise levels were measured with the help of a portable precision digital sound level meter (Model-SI-4033DS, made in Taiwan). The instrument calibration was achieved using manufacturer-supplied pistaphone calibrator capable of producing known sound pressure level.

Sampling was done to measure the Sound Level for daytime and nighttime of the proposed Feni Economic Zone site.

Noise Quality Monitoring Pictures



Noise inspection at Day time



Noise inspection at Night time

Table 45: Instrument Specification for Noise Level

Instrument Name	Resolution	Measuring Range	Accuracy
Digital Sound Level Meter (Model-SI-4033DS, made in Taiwan)	0.1 dB.	35 to 130 dB.	± 5 dB.

Source: Primary Baseline Study, Aug'20

Noise levels for both day and night-time have collected from the sample locations of the Feni Economic Zone. LAeq data of 8 hours represent that the noise levels were found below the standard limit of Department of Environment, Govt. of Bangladesh for the respective land use. The noise monitoring results are provided in the following table.

Table 46: Ambient Noise Quality of Project Area

Sample Location	GPS Location	Land Use Category	Sampling Duration (Time)				Noise Level (dBA) (LAeq)	
			Day		Night		Day	Night
			Start	End	Start	End		
Proposed Feni Economic Zone site	Longitude: 91.412643° Latitude: 22.783037° Longitude: 22°48'41.72"N, Latitude: 91°25'32.89"E	Industrial Zone	9.00 AM	4.59 PM	6.00 PM	1.59 AM	58.5	48.9
			9.00 AM	4.59 PM	6.00 PM	1.59 AM	57.9	49.2
<b>Bangladesh ECR -1997 Standard for Noise (Industrial Land use)</b>							75	70

Source: Primary Baseline Study, Aug'20

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### ***4.3.2.3. Source of Air Pollution and Noise Generation***

No significant noise or air polluting source was identified from proposed site and study area. Due to construction and site preparation activity in Bangabandhu Sheikh Mujib Industrial City in the nearby areas and movement of plying traffic, dust, gaseous emission and noise is being caused in the study area to some extent. However, it is envisaged that once the industries in the industrial city are operational, adequate mitigation measures must be taken to negate the cumulative impact on ambient environment of project surrounding area.

### ***4.3.3. Water Resources***

#### ***4.3.3.1. Surface Water System & Drainage***

Major water bodies within 10 km study area are Bay of Bengal, River Feni, Feni reservoir, Choto Feni River, Muhuri River. Project site lies in the flood plain of Feni River.

Feni River originates in the eastern hills of Tripura and enters Bangladesh at Belchhari of Matiranga Upazila of Khagrachhari District. It flows through Ramgarh (Khagrachhari), Fatikchhari (Chittagong) and then flows along the border of Chittagong (Mirsarai Upazila) and Feni (Chhagalnaiya, Feni, Sonagazi Upazila) districts, before discharging into the Bay of Bengal near Sonagazi. The length of the river is 108 Km. The principal tributary of the Feni River is the Muhuri River, which drains the Feni plain. Choto Feni is another river passing through the southwestern border of the proposed area. It flows through the northern part of the study area and flows into the Sandwip Channel of the Bay of Bengal. Site is located adjacent to Bay of Bengal towards Northern side.

Feni EZ is located on both side of the Feni River. In the eastern side of Feni River, Precinct A of the EZ is located. Whereas, on the western side of the Feni River – portions of Precinct F, Precinct J, Precinct K, Precinct L and Precinct B are located. Majority of the site is bounded by River Feni and some stretch/branch of River passes through the EZ. In general, the flow of surrounding area will be towards river. Hence there are chances of site for flooding due to surrounding storm water runoff and overflow of river and its branches.

Figure 41: Waterbodies around the EZ site



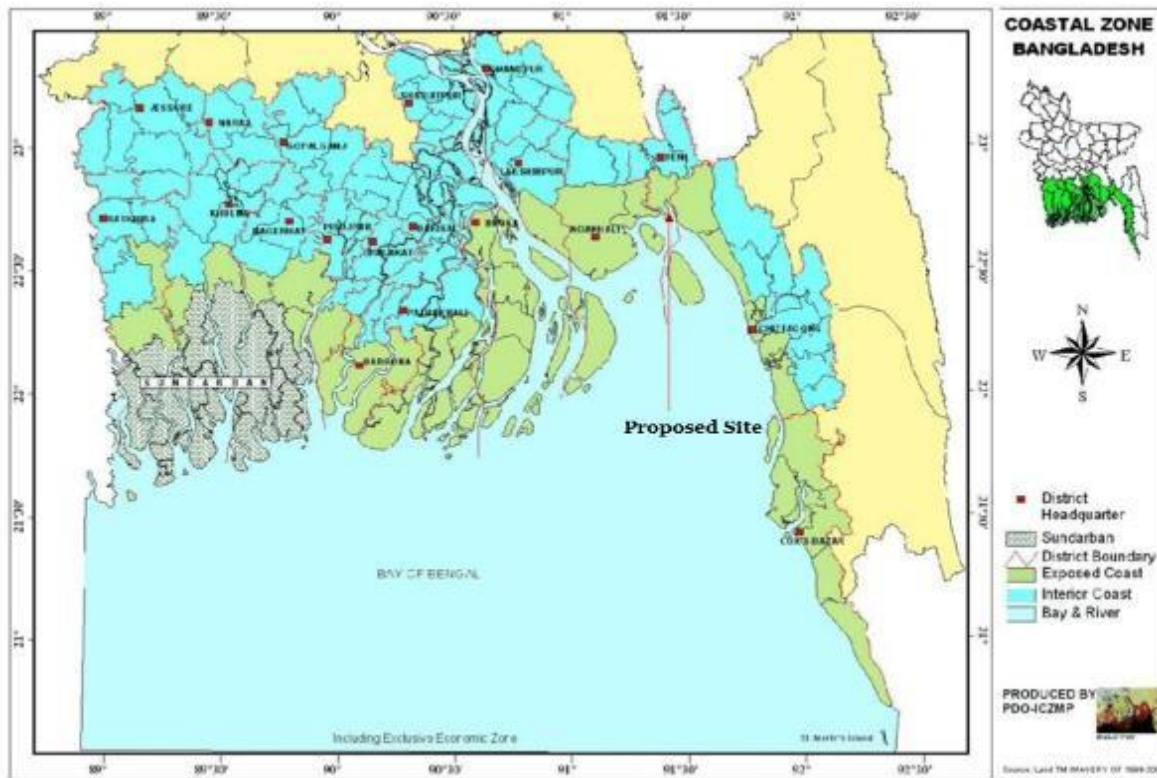
Source: Google Earth

#### 4.3.3.2. Tropical Cyclones & Tidal flooding

Bangladesh very often becomes the landing ground of cyclones formed in the Bay of Bengal. This is because of the funnel shaped coast of the Bay of Bengal, most of the damage occurs in the coastal regions of Khulna, Patuakhali, Barisal, Noakhali and Chittagong and the offshore islands of Bhola, Hatiya, Sandwip, Manpura, Kutubdia, Maheshkhali, Nijhum Dwip, Urir Char and other newly formed islands. The coastal zone of Bangladesh is disaster prone. Project site is located in Southern part of the coastal areas of Bangladesh. Map showing the coastal area of Bangladesh is given below.



Figure 42: Coastal Map of Bangladesh



Source: ICZMP

Number of cyclones have struck the nearby area of the proposed site in past and have caused severe damage at few times. As per the cyclone risk zone map of the coastal area of Bangladesh, the project site is located in a high-risk area of Bangladesh. The Cyclone risk zone and track map of Bangladesh is given in Figures in a subsequent section. The maximum height experienced by the coastal belt in the Chittagong area in the last 30 years was during the 1991 cyclone. It was among the deadliest tropical cyclones on record. Wind velocity was around 225 Km/h which caused the highest storm surge in the area with 6 meters (20 ft.) height. A list of the major cyclones that hit the Bangladesh coast is given in the table below.

Table 47: List of major cyclones in Bangladesh

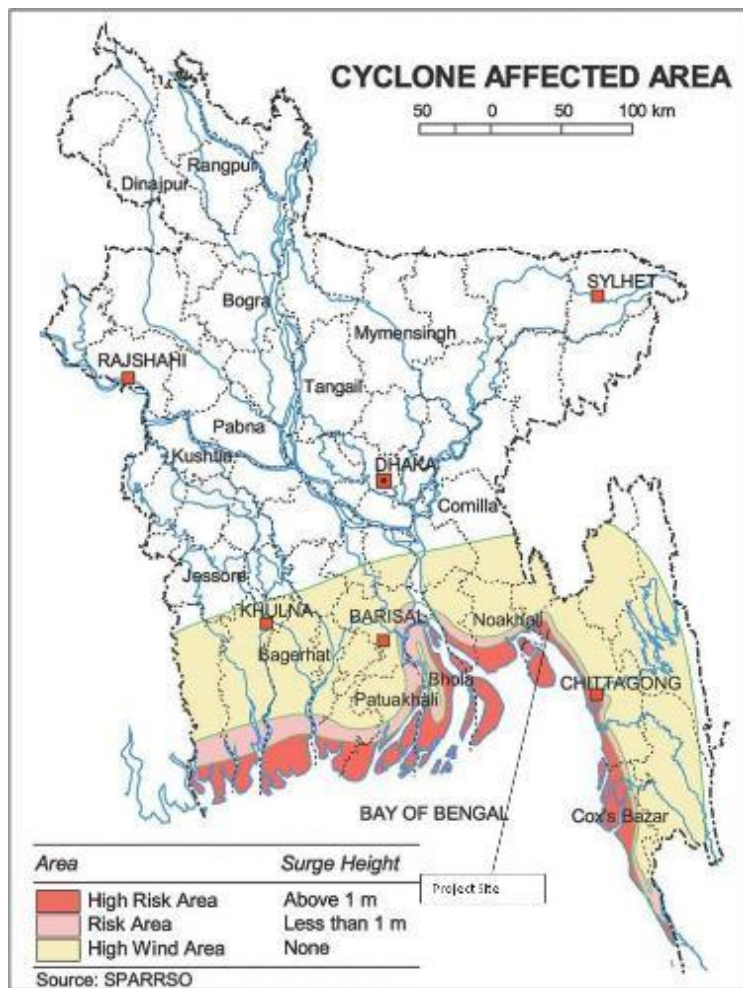
Date of Occurrence	Nature of Phenomenon	Landfall Area	Maximum Wind Speed in km/hr.	Direction of Predominant Wind	Tidal Surge Height in ft.
11/10/60	Severe Cyclonic Storm	Chittagong	160	South-East	15
31/10/60	Severe Cyclonic Storm	Chittagong	193	South-East	20
9/5/61	Severe Cyclonic Storm	Chittagong	160	South-East	8-10
30/5/61	Severe Cyclonic Storm	Chittagong (Near Feni)	160	South-South-East	6-15
28/5/63	Severe Cyclonic Storm	Chittagong- Cox's Bazar	209	South-East	8-12
11/5/65	Severe Cyclonic Storm	Chittagong-Barisal Coast	160	South-South-East	12
5/11/65	Severe Cyclonic Storm	Chittagong	160	South-East	8-12

Date of Occurrence	Nature of Phenomenon	Landfall Area	Maximum Wind Speed in km/hr.	Direction of Predominant Wind	Tidal Surge Height in ft.
15/12/65	Severe Cyclonic Storm	Cox's Bazar	210	South-East	8-10
1/11/66	Severe Cyclonic Storm	Chittagong	120	South-East	20-22
23/10/70	Severe Cyclonic Storm of Hurricane intensity	Khulna-Barisal	163	South-West	-
12/11/70	Severe Cyclonic Storm with a core of hurricane wind	Chittagong	224	South-East	10-33
28/11/74	Severe Cyclonic Storm	Cox's Bazar	163	South-East	9-17
10/12/81	Cyclonic Storm	Khulna	120	South-West	7-15
15/10/83	Cyclonic Storm	Chittagong	93	South-East	-
9/11/83	Severe Cyclonic Storm	Cox's Bazar	136	South-East	5
24/5/85	Severe Cyclonic Storm	Chittagong	154	South-East	15
29/11/88	Severe Cyclonic Storm with a core of hurricane wind	Khulna	160	South-West	2-14.5
18/12/90	Cyclonic Storm (crossed as a depression)	Cox's Bazar Coast	115	South-East	5-7
29/4/91	Severe Cyclonic Storm with a core of hurricane wind	Chittagong	225	South-East	12-22
2/5/94	Severe Cyclonic Storm with a core of hurricane wind	Cox's Bazar-Teknaf Coast	220	South-East	5-6
25/11/95	Severe Cyclonic Storm	Cox's Bazar	140	South-East	10
19/5/97	Severe Cyclonic Storm with a core of hurricane wind	Sitakundu	232	South-East	15
27/9/97	Severe Cyclonic Storm with a core of hurricane wind	Sitakundu	150	South-South-East	10-15
20/5/98	Severe Cyclonic Storm with core of hurricane winds	Chittagong Coast near Sitakunda	173	South-South-East	3
28/10/00	Cyclonic Storm	Sundarban Coast near Mongla	83	South-South-West	-
12/11/02	Cyclonic Storm	Sundarban Coast near Raimangal River	65-85	South-South-West	5-7
19/5/04	Cyclonic Storm	Teknaf-Akyab Coast	65-90	South-East	2-4
15/11/07	Severe Cyclonic Storm with core of hurricane winds <b>(SIDR)</b>	Khulna-Barisal Coast near Baleshwar River	223	South-West	15-20

Date of Occurrence	Nature of Phenomenon	Landfall Area	Maximum Wind Speed in km/hr.	Direction of Predominant Wind	Tidal Surge Height in ft.
25/5/09	Cyclonic Storm (AILA)	West Bengal-Khulna Coast near Sagar Island	70-90	South-South-West	4-6
16/5/13	Cyclonic Storm (MAHASEN)	Noakhali-Chittagong Coast	100	South-South-East	-
30/7/15	Cyclonic Storm (KOMEN)	Chittagong-Cox's Bazar Coast	65	South-East	5-7
21/5/16	Cyclonic Storm (ROANU)	Barisal-Chittagong Coast near Patenga	128	West-South-West	4-5
30/5/17	Severe Cyclonic Storm (MORA)	Chittagong-Cox's Bazar Coast near Kutubdia	146	South-East	-

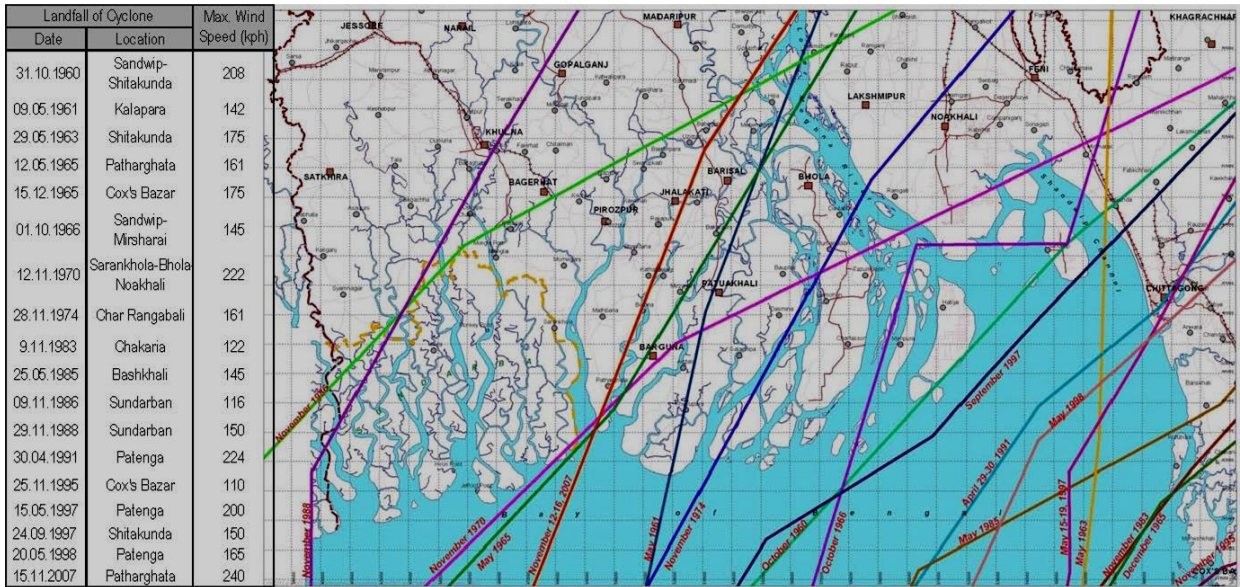
Source: BMD

Figure 43: Cyclone Risk Zone Map



Source: DMB

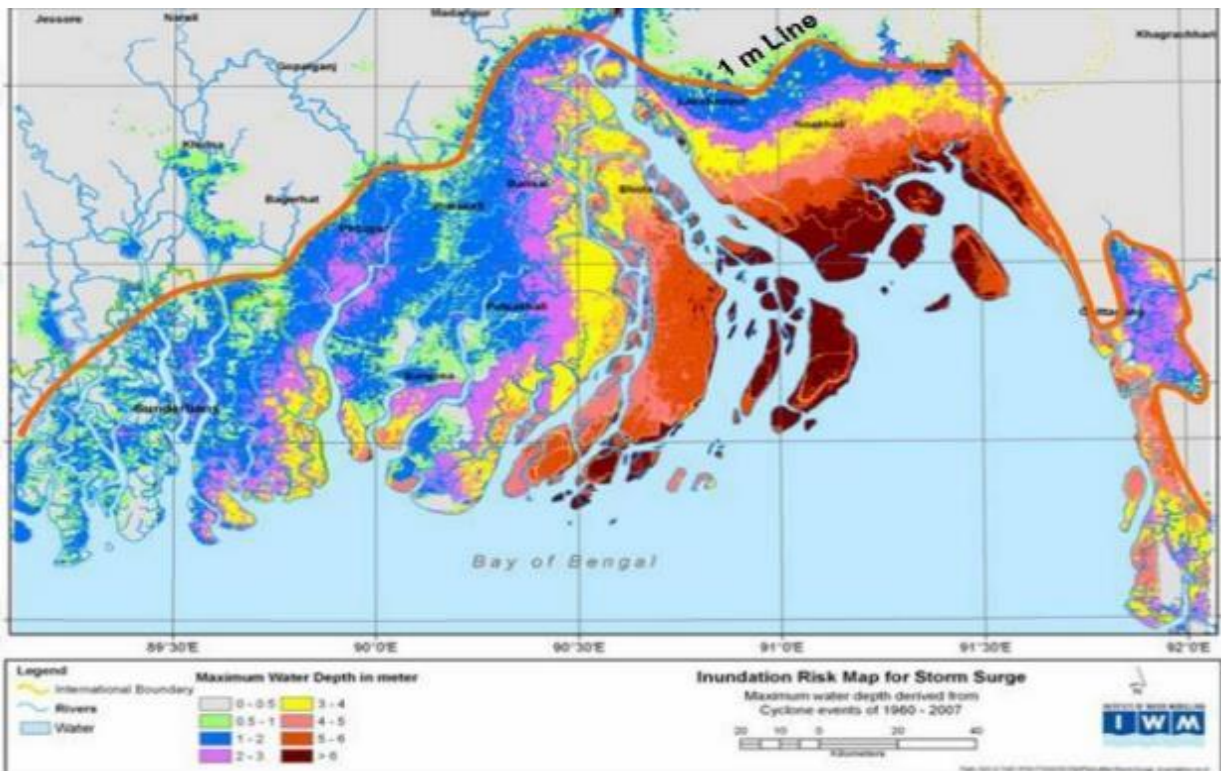
Figure 44: Cyclone Storm Track Map



Source: Department of Disaster Management

The inundation risk map for storm surge shows that the highest inundation depth having range between 5 m and 6 m lies in the proposed project area. Cyclone tracking map of the Bangladesh shows the Tropical cyclones from the Bay of Bengal accompanied by storm surges are one of the major disasters in Bangladesh. The country is one of the worst sufferers of all cyclonic casualties in the world. The high number of casualties is due to the fact that cyclones are always associated with storm surges.

Figure 45: Inundation Risk Map for Storm Surge



Source: IWM

Several cyclones protection measures have been taken by Govt. of Bangladesh for protection of inland area from cyclones. The coastline in study area is protected by two bunds constructed by Bangladesh water Development Board (BWDB) and under Char Development and Settlement Project (CDSP).

These two bunds protect inland area from tidal flooding. Also, mangrove plantation has been carried out along the coastline towards eastern side of study area to further protect inland areas.

#### Tornado

It is the pre-monsoon period when most of the abnormal rainfall or drought conditions frequently occur in different parts of Bangladesh. Also, there are severe local seasonal storms, popularly known as nor'westers (kalbaishakhi). Severe nor'westers is generally associated with tornadoes. Tornadoes are embedded within a mother thundercloud and moves along the direction of the squall of the mother storm. The frequency of devastating nor'westers usually reaches the maximum in April, while a few occur in May, and the minimum in March. Nor'westers and tornadoes are more frequent in the afternoon. Nor'westers may occur in late February due to early withdrawal of winter from Bangladesh. The occasional occurrence of nor'westers in early June is due to the delay in the onset of the southwest monsoon over the region. List of the nor'westers and tornadoes occurred in Bangladesh is given in table below.

*Table 48: List of Major Tornadoes had hit the Bangladesh (in last 25 Years)*

Date	Location	Fatalities (No.)	Injured (No.)	Affected (No.)
<b>8<sup>th</sup> April, 1995</b>	Munshiganj	40	Data Available Not	Data Available Not
<b>13<sup>th</sup> May, 1996</b>	Jamalpur & Tangail	700	32000	100000
<b>12<sup>th</sup> October, 1997</b>	Dhaka-Gazipur	35	2500	51110
<b>8<sup>th</sup> April, 1998</b>	Nilphamari	21	Data Available Not	Data Available Not
<b>19<sup>th</sup> May, 1998</b>	Dhaka-Sirajgonj	25	175	5000
<b>19<sup>th</sup> September, 2000</b>	Savar-Gazipur	10	50	8000
<b>4<sup>th</sup> May, 2003</b>	Brahmanbaria	20	200	Data Available Not
<b>14<sup>th</sup> April, 2004</b>	Netrokona & Mymensingha	111	3500	16000
<b>20<sup>th</sup> March, 2005</b>	Gaibandha & Rangpur	133	1408	26000
<b>4<sup>th</sup> April, 2011</b>	Northern Bangladesh	12	150	1000
<b>22<sup>nd</sup> March, 2013</b>	Bijoy Nagar and Akhaura, Brahmanbaria Sadar Upazilas	31	500	1000
<b>27<sup>nd</sup> April, 2014</b>	Northern Bangladesh	20	1000	7250

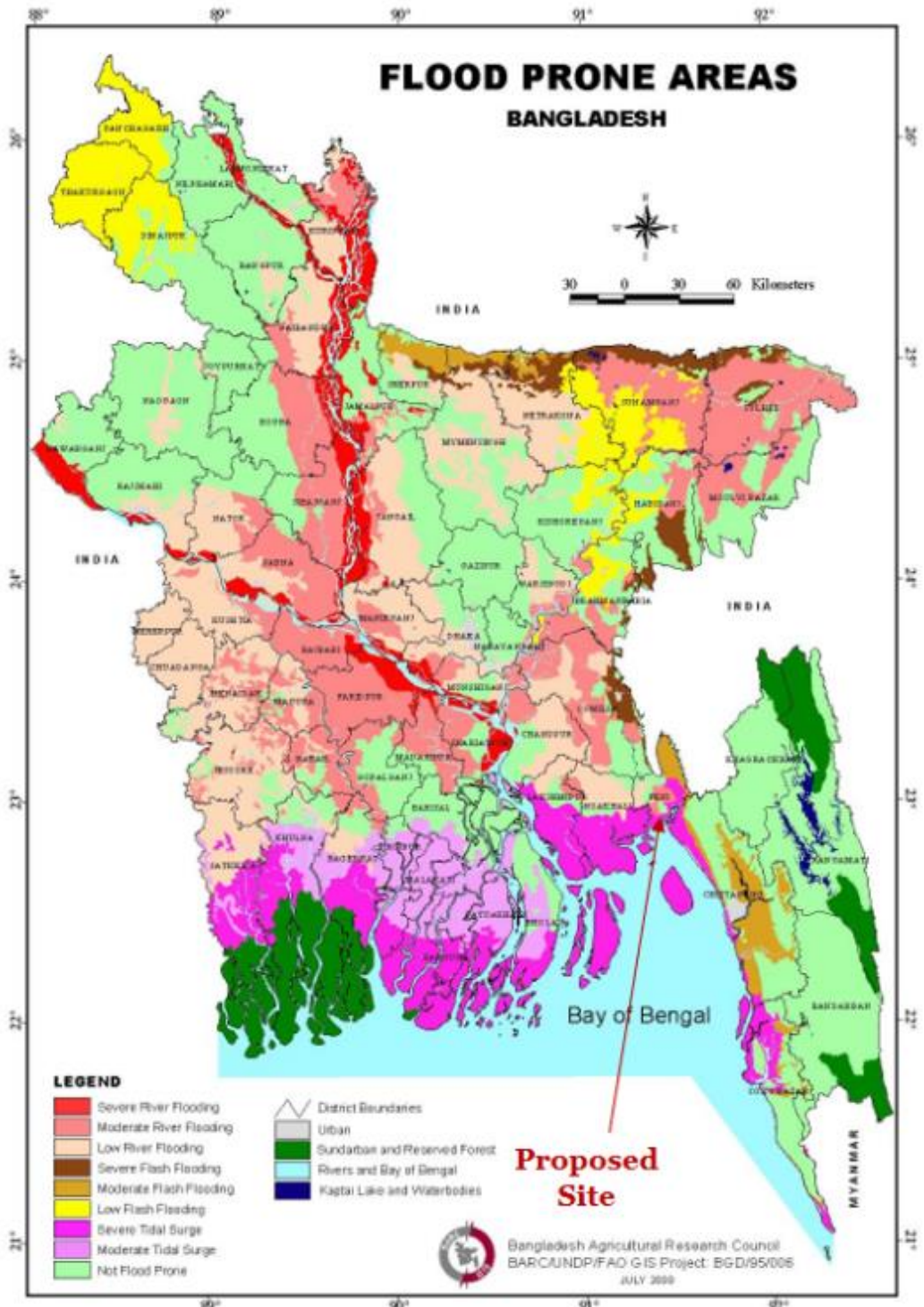
*Source: DMB & BMD*

#### Floods

Floods are the most significant natural hazard in the country causing extensive damage to human life and property. The country lies on the downstream part of three major river basins: Brahmaputra, Ganges and Meghna and thus is frequently flooded. There have been many destructive floods in Bangladesh, including very severe floods of 1987, 1988 and 1998. The 1988 flood set a new record for flooded area, while 1998 flood was unprecedented with its long duration. The flood damage potential in Bangladesh is increasing due to the possible causes of climate change, urban concentration in the three river basins, encroaching of settlements into flood prone areas, and overreliance on the safety provided by flood control works such as levees, reservoirs. There are two types of floods which occur in Bangladesh: annual floods (barsha) that inundate up to 20% of the land

area; and low frequency floods of high magnitude that inundate more than 35% of the area (bonna). The major floods that occurred in 1954, 1955, 1974, 1984, 1987, 1988, 1993, 1998, 1999, 2000 and 2007 have been very destructive and caused serious threat to live and economy. Major River in the study area is Feni River. Feni River receives flow from Muhuri river, Lemua canal and various other khals. As stated by BWDB, Recorded Highest Water Level of Feni River at Sonapur Station is 7.85 m in the year of 1978 (please refer **Appendix C**). Map of the Bangladesh showing Flood Prone Areas is furnished in figure below. It is observed that severe tidal surge occurs in the area where proposed site is located

*Figure 46: Flood Prone Area Map*



Source: BARC

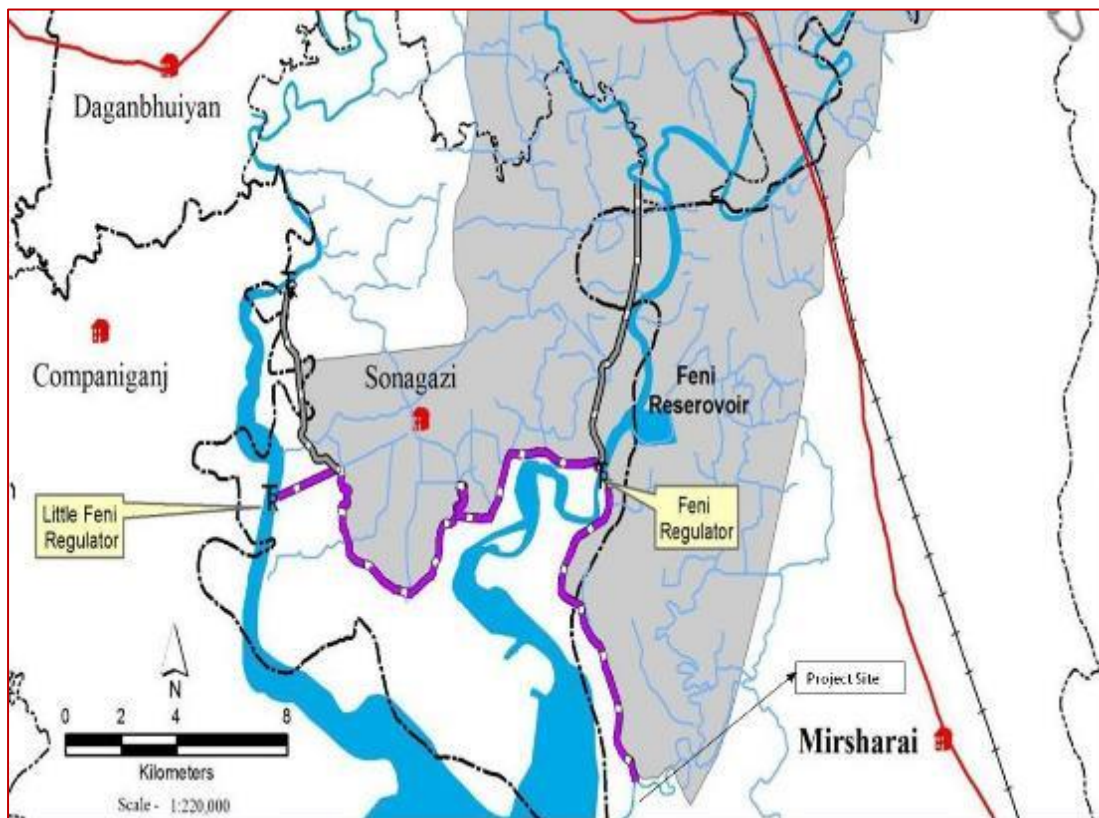
### 4.3.3.3. Salinity

The proposed site is located in the Meghna Estuarine Flood Plain. Here new deposition and erosion are constantly taking place on the margins, continuously altering the shape of the land areas. The sediments are deep silts, which are finally stratified and slightly calcareous in nature. In many parts, the soil surface becomes saline to varying degrees in the dry season. Seasonal flooding is mainly shallow but fluctuates tidally mainly by rainwater or non-saline river water. Flooding by saltwater occurs mainly on the land margins and during high tides in the monsoon also in storm surges when tropical cyclones occur.

River Feni is Major River in the study area. Feni River carries fresh water from upstreams, i.e above coastal embankment (Muhuri Project Road). In down streams water of Feni River is saline due to tidal influence. Salinity is more during lean season. Influx of saline water within the river is controlled with the help of regulators/gates. In many parts along the coast of this region brackish/saline water of marine origin renders the groundwater unsuitable for irrigation and potable water supply.

Map showing location of regulators in Feni River is presented below.

*Figure 47: Map showing location of Regulators in Feni River*



*Source: IEE, BAN: Irrigation Management Improvement Project, Muhuri Irrigation Project, Chittagong & Site Visit*

### 4.3.3.4. Drainage Congestion and Water Logging

The average natural ground level for the proposed EZ is +6 m above the mean sea level. To avoid inundation during monsoon season, average landfilling of +5 m above the existing natural ground level has been recommended.

The study area is covered with the clay and sand deposits brought by the Feni River. The average natural ground level for the proposed EZ is +6 m AMSL level. To avoid inundation during monsoon season, the landfilling of +5 m above the existing natural ground level is considered. Water logging is observed at the study area during monsoon season. According to the information collected through stakeholder

consultation, the area is affected in normal floods/tidal floods. But during heavy rainfall and sometimes during high tide cause water stagnation in the area for some longer time.

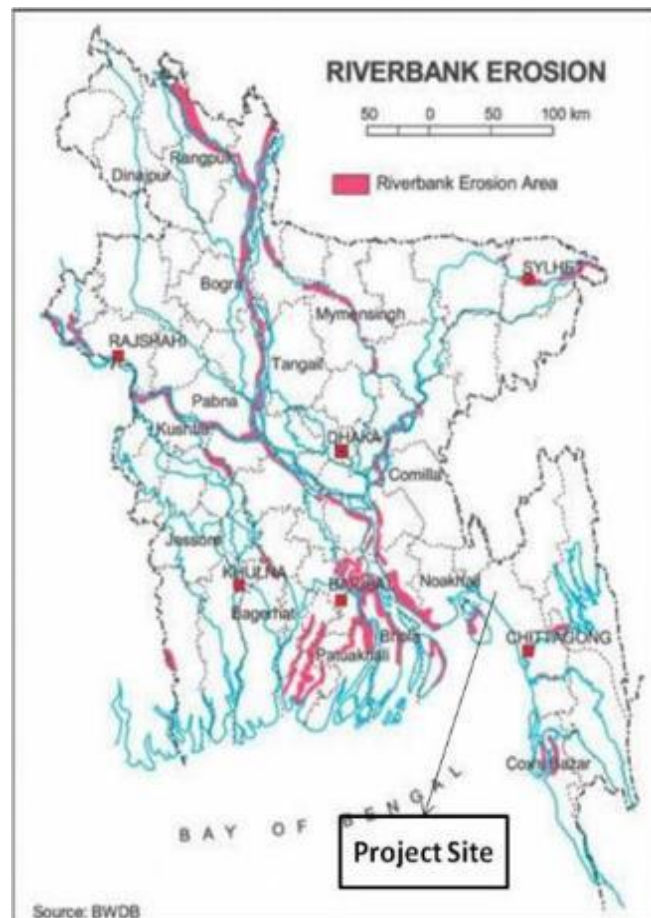
*Figure 48: Water Logged in the Project Area due to Tidal Flood*



#### **4.3.3.5. Erosion and Sedimentation**

No erosion site at EZ site and at riverbank is observed. Map showing areas prone to riverbank erosion is given in following figure.

*Figure 49: Map showing river bank erosion of Bangladesh*



*Source: BWDB*



### 4.3.3.6. River Morphology<sup>6</sup>

Proposed Feni EZ is located adjacent to River Feni on its eastern side. The project area is located around the confluence of the Muhuri and Feni rivers. The Feni River forms a portion of the boundary between Bangladesh and India. Significant part of the project area's drainage basin is in India. The principal rivers and khals within the project boundaries not only fluctuate with the tides in the Sandwip Channel, but also allow the intrusion of seawater.

During monsoon period, the mean and maximum ranges of tide in the Feni estuary have been found as 3.50 m and 5.50 m respectively. The tides have also been studied based on annual maximum High-Water Level data collected over the periods 1985 to 2004 at the gauge downstream of Feni regulator in the Feni River. The maximum high-water level and mean of annual maximum high-water level of Feni River near Feni regulator are about 6.0 m and 5.276 m (SOB) respectively over the 20 years period.

*Table 49: Mean High Water Level of Feni river*

Mean Water Level in Meter (PWD)				
Year	Pre – Monsoon (Mar – May)	Monsoon (Jun – Sep)	Post – Monsoon (Oct – Nov)	Dry Period (Dec – Feb)
2000	3.46	4.30	3.62	2.79
2001	3.36	4.05	3.49	2.67
2002	3.38	4.04	3.55	2.56
2003	3.42	4.11	3.76	2.73
Mean	3.47	4.14	3.61	2.69

Source: BWDB

### River Course Shifting

The following Historical satellite images shows changes and evolutions of riverbanks, mainstream and sand bar (char) during recent years since 1984.

*Figure 50: Changes in river bank lines*



<sup>6</sup> Prefeasibility Report, Feni EZ



Since 1984 -1990, the Feni River near to the proposed site has maintained a single channel section with no char land. It is noted that the river width is within the range from 0.5 km to 2.0 km.



Since 1990 -1994, the river has maintained the same channel section with Char land developing in the mid of the river.



Since 1994 -2000, it is observed that there is extension in the developed Char land in all the directions.



Since 2000 -2013, the Char land is further getting extended in all the directions. Also, the channel flow became uniform due to creation of manmade channels near the check dam.



Since 2013 -2020, the channel flow is streamlined and uniform. Three parcels of Char lands were formed.

Hence, to stabilize and protect the site, as recommended in Master Plan, necessary embankment needs to be created for utilization of the char land. The height of the embankment to be provided is +10.00 m and the length of the embankment to be provided is 30 km.

#### *4.3.3.7. Navigation*

Navigability of rivers in Bangladesh has been deteriorating steadily over the years. The withdrawal of water beyond the border and within Bangladesh for irrigation and other purposes has resulted in decreased navigability of rivers during dry season resulting in gradual channel decline.

The river network connects almost all the country's major cities, towns and commercial centers. Moreover, being cheap, safe and environmentally friendly, inland water transportation is often the only mode that serves the poor, proving especially useful during periods of widespread flooding.

Currently, container feeder service is available from Chittagong Port to Port Klang; Port of Singapore and Colombo Port for connecting the mother vessels serving international destinations. More than 5 feeder vessel operators with vessels capacity of 1,000 -1,500 boxes (containers) have deputed their feeder vessels in this circuit. The transit time is about 3-4 days from /to Chittagong Port to the hub ports. All international Shipping Lines have their presence in Bangladesh, and some even operate their own feeder vessels.

Due to the steady growth in traffic volume, Chittagong Port performs well on the financial front. It is financing its 3rd Port development project at Paira Bandar with its own resources.

The third port, Paira Seaport, was inaugurated by the Prime Minister on 19th November 2013. It is on Rabnabad channel - which is 31 Km from the sea boundary, 316 Km from Chittagong, 130 Km from Mongla port and 340 Km from the capital. This port shall have draft of 8 -10 m when in operation.

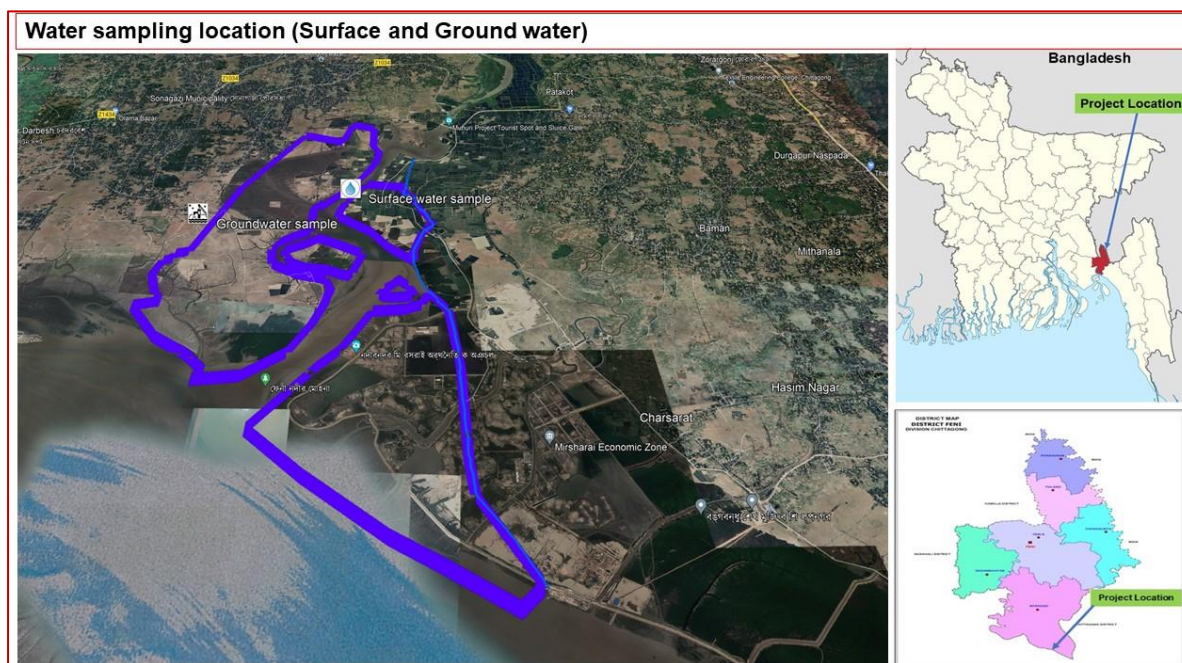
In addition to the Pangaon ICT, the Government of Bangladesh granted approval to establish a container port on the bank of the Meghna River in Narayanganj District to the Ananda Group in November 2013. It will be the fifth inland container terminal (ICT) in the private sector. Approvals for establishing ICTs have already been granted to the Rupayan Group, Kumudini Welfare Trust, AK Khan and Company and Cemcor. Meanwhile, the Ministry of Shipping, GoB, is finalizing a draft of guidelines for establishing ICTs under private sector investment. A deep seaport is also proposed to be constructed at Sonadia, Cox Bazar.

Bangladesh inland waterway transport is divided into four levels. The Dhaka-Chittagong route (Pangaon ICT, 160 nautical miles: about 290 km), including a part of a coastal shipping route, is classified as a first-level waterway with 3.6~3.9 m water depth. Bangladesh Inland Water Transport Authority (BIWTA) manages the navigability of these inland water routes by conducting waterway depth surveys, maintenance dredging etc.

### 4.3.3.8. Surface Water Quality

Surface water sample from Feni River, passing through the proposed site was drawn by Bangladesh Environmental Engineering Training & Lab Services Ltd., Bangladesh on 27th August'2020 for testing to have an understanding about the surface water quality of the project area. Sampling of surface water has been conducted by following grab sampling method towards analyzing various physico-chemical parameters. Surface water quality parameters such as, PH, Temperature, EC, Total Dissolved Solid (TDS), BOD<sub>5</sub>, COD, DO, Total Hardness, Turbidity, Total Alkalinity, Total Coliform, Nickel, Copper, Cadmium, Cobalt, Lead, Total Iron, Arsenic, Chloride, Acidity, Oil & Grease were measured among which major physicochemical properties such as pH, DO, EC, TDS were measured in-situ during the field visit while the rests were measured in the laboratory. Values of different parameters of the surface water quality regarding the DoE standard are given in the following table. It shows that all values are within the standard limit except Turbidity, Nickel, Copper, Lead, and oil and grease. It might be because the water might be polluted by different organic substances by commercial and other anthropogenic activities (such as pollution from the household, sewage pipelines, etc.). For the Surface water quality test APHA 22<sup>nd</sup> EDN.2012 guideline was followed.

**Figure 51: Water sample collection site**



*Table 50: Surface Water Quality Data of Feni River (Coordinates: 22.810027° N & 91.431483° E)*

SL No.	Parameters	Concentration Present	Unit	ECR 1997 Standard for Surface Water	Methods of Analysis
1.	PH	8.21	mg/L	6-9	APHA22ndEDN.2012 (4500H+B)
2.	Temperature	26	°C	(20-30) °C	APHA22ndEDN.2012 (2550 B)

SL No.	Parameters	Concentration Present	Unit	ECR 1997 Standard for Surface Water	Methods of Analysis
3.	Electrical Conductivity (EC)	89.5	µS/cm	1200	APHA22ndEDN.2012 (2510 B)
4.	Total Dissolved Solids (TDS)	135.2	mg/L	2100	APHA22ndEDN.2012 (2540C)
5.	BOD <sub>5</sub>	33.8	mg/L	50	APHA22ndEDN.2012 (5210 B)
6.	COD	125	mg/L	200	APHA22ndEDN.2012 (5220 B)
7.	Dissolved Oxygen (DO)	7.66	mg/L	5 or more	APHA22ndEDN.2012 (4500 O)
8.	Total Hardness as CaCO <sub>3</sub>	325	mg/L	200-500	APHA 22ndEDN.2012 (2340-)
9.	Turbidity	<b>3290.5</b>	NTU	10	APHA22ndEDN.2012 (2130 B)
10.	Alkalinity	250	mg/L	20-250	APHA22ndEDN.2012 (2320 B)
11.	Total Coliform (TC)	47	CFU/100ml	200	APHA22ndEDN.2012 (9222H)
12.	Fecal Coliform (FC)	00	CFU/100ml	0.00	APHA22ndEDN.2012 (9222B)
13.	Nickel (Ni)	<b>2.89</b>	mg/L	2	APHA22ndEDN.2012
14.	Copper (Cu)	<b>4.76</b>	mg/L	0.5	APHA22ndEDN.2012
15.	Cadmium (Cd)	0.116	mg/L	0.5	APHA22ndEDN.2012
16.	Cobalt (Co)	0.00	mg/L	0.00	APHA22ndEDN.2012
17.	Total Iron (Fe)	0.00	mg/L	2	APHA22ndEDN.2012 (3500- Fe)
18.	Lead (Pb)	<b>3.99</b>	mg/L	0.1	APHA22ndEDN.2012 (3500-Pb)
19.	Arsenic (As)	0.02	mg/L	0.2	APHA22ndEDN.2012 (3500-As)
20.	Chloride (Cl <sup>-</sup> )	52	mg/L	600	APHA22ndEDN.2012 (4500 Cl <sup>-</sup> )
21.	Acidity	167	mg/L		APHA22ndEDN.2012

SL No.	Parameters	Concentration Present	Unit	ECR 1997 Standard for Surface Water	Methods of Analysis
22.	Oil & Grease	<b>16</b>	mg/L	10	APHA22ndEDN.2012 (5520 B)

Source: Primary Baseline Study, Aug'20

#### 4.3.3.9. Previous Studies on Surface and Groundwater

Feni River is the main river in the study area. Water upstream of Muhuri Project Road in Feni River is fresh whereas downstream it is saline due to tidal influence. Water samples were collected from the proposed intake site in Feni River at Azampur, at each sampling site, the sampling location was about 100–150 ft from the Riverbank water line and water samples were collected manually from a depth of about 0.30 m below the water surface to avoid the presence of floating impurities using a pre-washed container. The sampling campaign was carried out jointly by BUET and IWM. Tables 50, 51, and 52 about the time and location of the six samples, characteristics are below respectively.

Table 51: Time and location of the six sampling campaigns

Sampling Location	Azampur (Feni River)
GPS Co-ordinates	22°51'27.50" N; 91°28'11.10"E
Batch No.	Time of Sampling Collection
Batch 1	17/07/2018-18/07/2018 (wet season)
Batch 2	01/09/2018-02/09/2018 (Wet season)
Batch 3	10/10/2018-11/10/2018 (wet season)
Batch 4	28/01/2019-29/01/2019 (dry season)
Batch 5	25/02/2019-26/02/2019 (dry season)
Batch 6	13/03/2019-14/03/2019 (dry season)

The results of testing and laboratory analysis (at BUET) of raw water samples collected in the wet season (Batch-1,2,3) and dry season (Batch-4,5,6) from the Azampur site are presented below along with Bangladesh Drinking Water Standard (GoB, 1997). In these tables, the parameter values not satisfying the corresponding drinking water standards have been marked in "bold" font style.

Table 52: Characteristics of raw water collected in the wet season from Feni

Sl.	Water quality parameters	Unit	Concentration present			Bangladesh Drinking Water Standard
			Batch 1	Batch 2	Batch 3	
1	pH	-	7.35	7.62	7.18	6.5-8.5
2	Color (Apparent)	Pt-Co	<b>628</b>	<b>314</b>	<b>376</b>	15
3	Color (True)	Pt-Co	<b>176</b>	<b>147</b>	<b>147</b>	15
4	Turbidity	NTU	<b>218</b>	<b>69</b>	<b>72.4</b>	10
5	Total Dissolved Solids (TDS)	mg/L	78	88	188	1000
6	Iron (Fe)	mg/L	<b>3</b>	<b>3</b>	<b>1.52</b>	0.3-1.0
7	Total Coliform (TC)	CFU/100mL	8600	TNTC	TNTC	0
8	Fecal Coliform (FC)	CFU/100 mL	7000	TNTC	160	0
9	Electric Conductivity (EC) at 25C	µS/cm	1.25	143	163	0
10	Dissolved Oxygen (DO)	mg/L	<b>6.32</b>	<b>6.32</b>	5.44	6
11	Ammonia (NH <sub>3</sub> -N)	mg/L	0.4	0.45	0.26	-
12	Total Suspended Solids (TSS)	mg/L	<b>186</b>	<b>42</b>	<b>26</b>	10

13	Temperature	C	30.1	29.6	28.9	20-30
14	Chemical Oxygen Demand (COD)	mg/L	7	7	12	4
15	Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	0.8	3	3.2	0.2
16	Chlorophyll-a	µg/L	1.2	3.2	2	-

**Source:** Detail Study on Total Water Demand & Water Availability Assessment for BSMSN, February 2020

*Table 53: Characteristics of raw water collected in the dry season from Feni River*

Sl.	Water quality parameters	Unit	Concentration present			Bangladesh Drinking Water Standard
			Batch 4	Batch 5	Batch 6	
1	pH	-	7.19	7.42	7.59	6.5-8.5
2	Color (Apparent)	Pt-Co	244	636	404	15
3	Color (True)	Pt-Co	176	280	224	15
4	Turbidity	NTU	46.2	80.2	55.8	10
5	Total Dissolved Solids (TDS)	mg/L	119	160	132	1000
6	Iron (Fe)	mg/L	1.04	1.6	2.0	0.3-1.0
7	Total Coliform (TC)	CFU/100mL	38	380	1050	0
8	Fecal Coliform (FC)	CFU/100 mL	10	240	350	0
9	Electric Conductivity (EC) at 25C	µS/cm	178	210	190	0
10	Dissolved Oxygen (DO)	mg/L	6.51	6.19	5.48	6
11	Ammonia (NH <sub>3</sub> -N)	mg/L	0.41	0.53	0.38	-
12	Total Suspended Solids (TSS)	mg/L	23	32	36	10
13	Temperature	C	21.2	22.8	26.1	20-30
14	Chemical Oxygen Demand (COD)	mg/L	2	5	6	4
15	Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	0.4	1	2.6	0.2
16	Chlorophyll-a	µg/L	8.2	1.2	37.8	-

**Source:** Detail Study on Total Water Demand & Water Availability Assessment for BSMSN, February 2020

Furthermore, Infrastructure Investment Facilitation Company (IIFC) in association with Shahidul Consultant Limited (hereinafter referred to as SCL) conducted a comprehensive Environmental Impact Assessment (EIA) of the Water Treatment Plant (Phase-1) at Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN). Under this study Groundwater and surface water four samples were collected from two different sites (Osmanpur Intake point (Feni River), and the WTP site, of BSMSN) on 03 March 2021. The sampling campaign was carried out by Development Solutions Consultant Limited (DSCL).

*Table 54: The time and location of four sample, characteristics are below respectively.*

Sampling location	Project area
GPS Co-ordinates	22.856292N,91.474350E 22.789581N, 91.454385E
Sample collection time	03, March 2021.



Groundwater	Intake Point (Osmanpur) WTP Site (BSMSN)
Surface water	Intake Point (Osmanpur) WTP Site (BSMSN)

### Surface Water Quality

The surface water samples were collected from two (02) subproject locations along the subproject area on 03 March 2021. The laboratory test result of the surface water samples and the GoB standards for inland surface water (ECR, 1997) is shown in the following table.

*Table 55: Results for Surface water Quality*

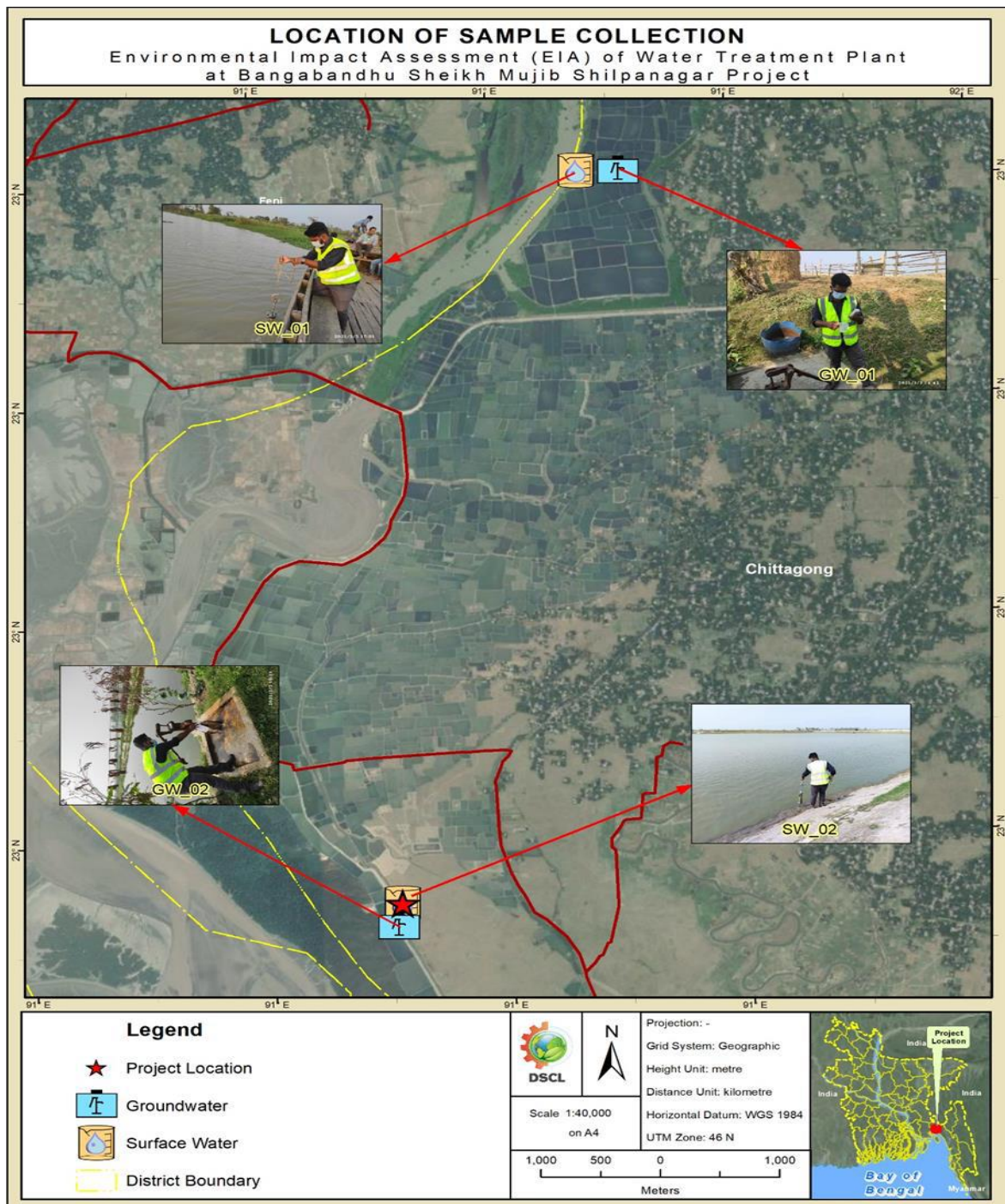
Parameters	Unit	SW-01 Osmanpur Intake Point (Feni River)	SW-02 WTP Site BSMNSN	The standard for Inland Surface Water** (Best fishing practice)	Analysis Method
		22.856446N, 91.470924E	22.7916667N, 91.4547222E		
Temperature*	°C	28.4	29.2	NYS	Multimeter
pH*	-	7.32	6.8	6.5-8.5	Multimeter
Electrical Conductivity (EC)*	µs/cm	1122	845	NYS	Multimeter
Dissolved Oxygen (DO)*	mg/L	7.1	4.8	5 or more	DO meter
Total Dissolved Solids (TDS)*	mg/L	1056	698	NYS	Multimeter
Biological Oxygen Demand (BOD)	mg/L	7.0	12	6 or less	5 Days Incubation
Chemical Oxygen Demand (COD)	mg/L	24	48	NYS	CRM
Color	Hazen	1.1	2.1	NYS	UVS
Turbidity	NTU	5	45	NYS	Turbidity meter
Total Suspended Solids (TSS)	mg/L	8	13	NYS	Periodate
Sulphate	NTU	2	3	NYS	Gravimetric Method
Phosphate	mg/L	4.3	6.2	NYS	UV-VIS
Nitrogen (Ammonia)	mg/L	0.26	0.25	NYS	UV-VIS
Chloride	mg/L	30	160	NYS	Titrimetric

\*Tested in the field, NYS – Not Yet Standardized

\*\*Standards for Inland Surface Water is followed Environmental Conservation Rule (ECR)'97

DPHE April2021

**Source:** EIA of Water Treatment Plant (Phase-I) at BSMSN



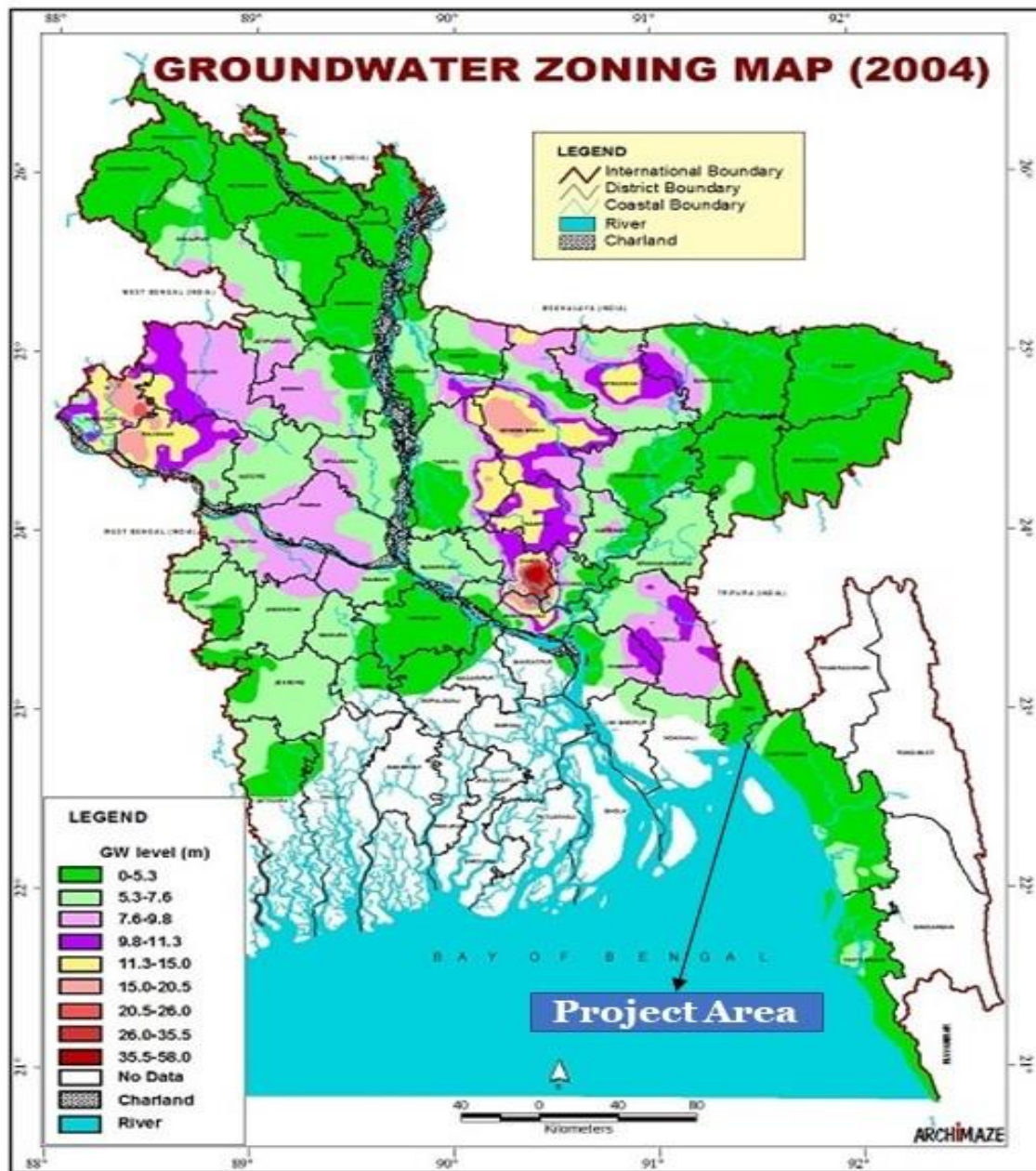
**Source:** EIA of Water Treatment Plant (Phase-I) at BSMSN

The surface water quality standard is yet not developed in the ECR 1997 except for a few parameters. Among the tested parameters the DO and BOD values did not maintain the standard value set by ECR 1997 for the sampling location SW\_02. It might be because the water might be polluted by different organic substances by commercial and other anthropogenic activities (such as pollution from the household, sewage pipeline, etc.).

### 4.3.3.10. Ground Water system

For the preliminary interpretation of the tentative ground water depth in the proposed site, data for 1 of the nearest boreholes have been observed. It was observed on basis of the lithology profile that the recommended depth of tapping the water is from 155 m Below Ground Level to 215 m Below Ground Level. Appropriate hydrological observations and tests need to be carried out within the proposed EZ site to determine the exact depth of groundwater. Bore well data collected from Department of Public Health and Engineering (DPHE) department in support of groundwater level is furnished in **Appendix D**. Ground water zone map of Bangladesh is given below figure. According to the map, the water level in the project area ranges between 0-5 mbgl.

Figure 52: Ground water Zoning Map of Bangladesh



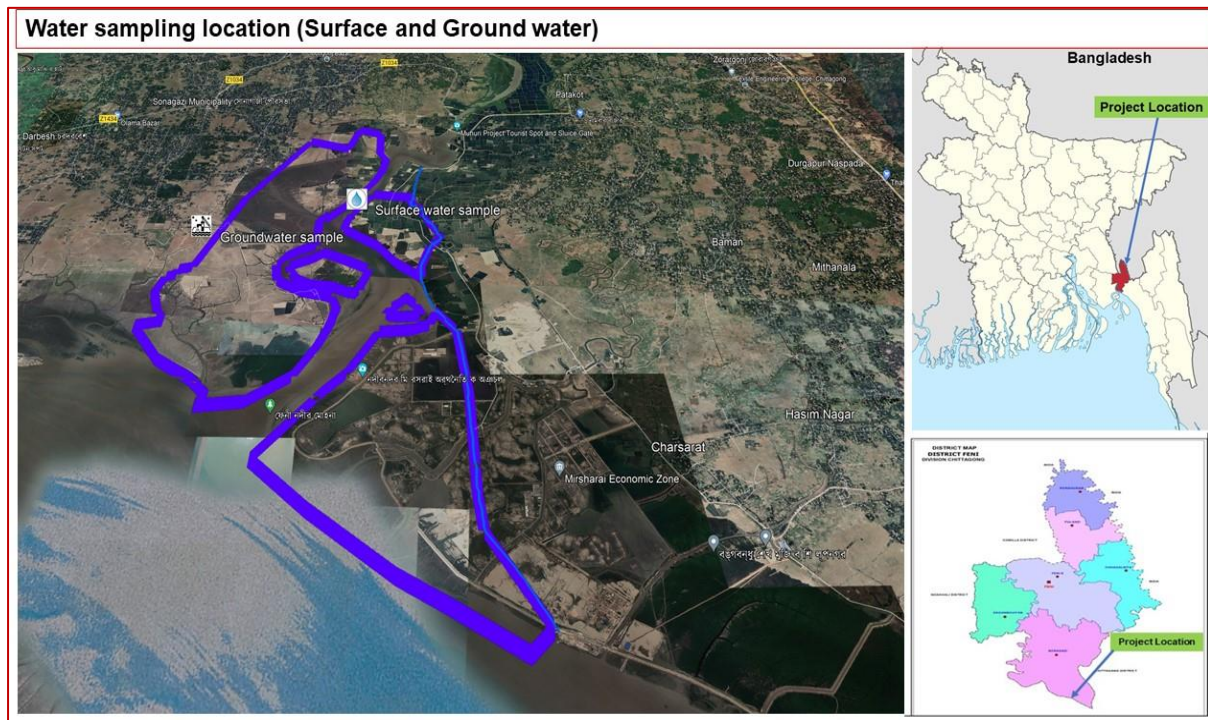
Source: <http://www.badc.gov.bd/site/page/821c0395-1a32-42bb-8666-fbc4819e83cb/Zoning-map>

### 4.3.3.11. Ground Water Quality

Ground water sample from Tube well located in the vicinity of proposed project area was drawn by Bangladesh Environmental Engineering Training & Lab Services Ltd., Bangladesh on 27th August'2020 for testing to have an understanding about the ground water quality of the project area. The results as analysed are given in following table. The test result shows that most of the tested parameters are within the national standard set by government of Bangladesh except Turbidity, Total Coliform, COD, BOD, Cadmium and Lead. It was observed that concentration of Manganese is marginally high. No such polluting source was observed near the monitoring location.

However, during sample collection it was also revealed that local people were facing tidal flood few days ago. The flood water may have contributed to increasing turbidity. In addition, the BOD and COD are above standard levels which might be because the water might be polluted by different organic substances by commercial and other anthropogenic activities (such as pollution from the household, sewage pipeline, etc.). It may be stated that the water is not completely safe for drinking without treatment.

**Figure 53: Water sample collection site**



Water sample collection at project site



Surface water sample collection



Surface water sample collection



Groundwater sample collection

Groundwater sample collection

*Table 56: Ground Water Quality of Project Area*

SL No.	Parameters	Concentration Present	Unit	ECR 1997 Standard for Drinking Water	Methods of Analysis
1.	PH	7.62	mg/L	6-9	APHA22ndEDN.2012 (4500H+B)
2.	Electrical Conductivity (EC)	179	µS/cm	1200	APHA22ndEDN.2012 (2510 B)
3.	Total Dissolved Solids (TDS)	271	mg/L	1000	APHA22ndEDN.2012 (2540C)
4.	BOD	<b>10.7</b>	mg/L	0.2	APHA22ndEDN.2012 (5210 B)
5.	COD	<b>54</b>	mg/L	4	APHA22ndEDN.2012 (5220 B)
6.	Dissolved Oxygen (DO)	8.02	mg/L	6 or more	APHA22ndEDN.2012 (4500 O)
7.	Total Hardness as CaCO <sub>3</sub>	132.5	mg/L	200-500	APHA 22ndEDN.2012 (2340-)
8.	Turbidity	<b>33.4</b>	NTU	10	APHA22ndEDN.2012 (2130 B)
9.	Alkalinity	147	mg/L	20-200	APHA22ndEDN.2012 (2320 B)
10.	Calcium (Ca)	33	mg/L	75	APHA22ndEDN.2012 (3500- Ca)

SL No.	Parameters	Concentration Present	Unit	ECR 1997 Standard for Drinking Water	Methods of Analysis
11.	Magnesium (Mg)	8.7	mg/L	30-35	APHA22ndEDN.2012 (3500- Mg)
12.	Sulfate (SO <sub>4</sub> )	38.5	mg/L	400	APHA22ndEDN.2012 (4500- SO <sub>4</sub> <sup>2-</sup> )
13.	Total Coliform(TC)	<b>20</b>	CFU/100ml	0.00	APHA22ndEDN.2012 (9222H)
14.	Fecal Coliform(FC)	00	CFU/100ml	0.00	APHA22ndEDN.2012 (9222B)
15.	Nickel (Ni)	.0011	mg/L	0.1	APHA22ndEDN.2012 (3500- Ni)
16.	Cadmium (Cd)	<b>0.010</b>	mg/L	0.005	APHA22ndEDN.2012 (3500- Cd)
17.	Chromium (Cr)	0.00	mg/L	0.05	APHA22ndEDN.2012 (3500- Cr)
18.	Total Ironv (Fe)	0.00	mg/L	0.3-1.0	APHA22ndEDN.2012 (3500- Fe)
19.	Arsenic (As)	0.00	mg/L	0.05	APHA22ndEDN.2012 (3500-As)
20.	Chloride (Cl <sup>-</sup> )	52	mg/L	150 – 600	APHA22ndEDN.2012 (4500 Cl <sup>-</sup> )
21.	Manganese (Mn)	<b>0.11</b>	mg/L	0.1	APHA22ndEDN.2012
22.	Fluoride (F <sup>-</sup> )	<0.10	mg/L	1	APHA22ndEDN.2012 (5520 F <sup>-</sup> )
23.	Ammonia	0.45	mg/L	0.5	APHA22ndEDN.2012
24.	Aluminium	0.01	mg/L	0.2	APHA22ndEDN.2012
25.	Lead (Pb)	<b>3.99</b>	mg/L	0.1	APHA22ndEDN.2012 (5520 Pb)
26.	Mercury (Hg)	.001	mg/L	.001	APHA22ndEDN.2012

Source: Primary Baseline Study, Aug'20

Several studies revealed that Arsenic contamination of groundwater is the prime concern in the Chittagong division<sup>7</sup>. The problem was first discovered at the end of 1993. The shallow aquifer has high arsenic concentrations including in the project surrounding area. However, the measured arsenic level from the project area was within the DoE limit.

#### 4.3.3.12. Previous Studies on Groundwater Groundwater Quality

<sup>7</sup> <https://academic.oup.com/heapol/article/22/5/335/557357>; Determinants of drinking arsenic-contaminated tubewell water in Bangladesh: M M H Khan, Khandoker Aklimunnessa, M Kabir, Mitsuru Mori Health Policy and Planning, Volume 22, Issue 5, September 2007,

The groundwater samples were collected from two (02) subproject locations on 03 March 2021 (figure below). The laboratory test result of the groundwater sample with the GoB standards for potable water (ECR, 1997) is shown in the table below.

*Table 57: Groundwater Sample Collection and Onsite Testing*

Parameters	Unit	GW-01 Intake Point Osmanpur	GW-02 WTP Site BSMSN	Standard for potable Water**	Analysis Method
		22.856292N, 91.474350E	22.789581N, 91.454385E		
Temperature*	°C	30.1	<b>33.5</b>	20-30	Multimeter
pH*	-	7.21	7.08	6.5-8.5	Multimeter
Electrical Conductivity (EC)*	µs/cm	698	701	NYS	Multimeter
Dissolved Oxygen (DO)*	mg/L	6.2	6.6	6 or more	DO meter
Salinity*	ppm	765	865	<600	Multimeter
Total Dissolved Solids (TDS)*	mg/L	468	512	NYS	Multimeter
Arsenic (As)	mg/L	0.001	0.001	0.05	AAS
Chloride (Cl)	mg/L	<b>760</b>	15	150-160	Titrimetric
Total Hardness (as CaCO <sub>3</sub> )	mg/L	310	180	200-500	Calmagite Method
Iron (Fe)	mg/L	<b>2.60</b>	0.67	0.3-1	AAS
Alkalinity	mg/L	185	135	NYS	Titrimetric
Turbidity	NTU	4	5	10	Turbidity meter
Total Coliform (TC)	N/100ml	0	0	0	MFM
Fecal Coliform (FC)	N/100ml	0	0	0	MFM

\*\*Standards for Potable Water is followed by Environmental Conservation Rule (ECR)'97

DPHE April 2021

\*On-site Test Result. NYS-Not Yet Standardized

**Source:** EIA of Water Treatment Plant (Phase-I) at BSMSN

The groundwater quality parameters, measured in the subproject location were found to comply with the national water quality standards set by DoE for maximum parameters except for Salinity, Chloride, and Iron. The study reveals that in the project corridor, for GW\_01 and GW\_02 the value of Salinity did not comply with the national standard. The scarcity of water intensifies during the summer season when the salinity of water increases and during cyclones when the water sources get damaged and, contaminated with saline water.

For GW\_01 the value of chloride did not comply with the national standard as well as the value of Iron (Fe) did not maintain the national standard set for potable water. The reason for the selection was to compare the existing water quality with national standards and to ensure good potable water for the workers during the construction period.

### **4.3.4. Land Resources**

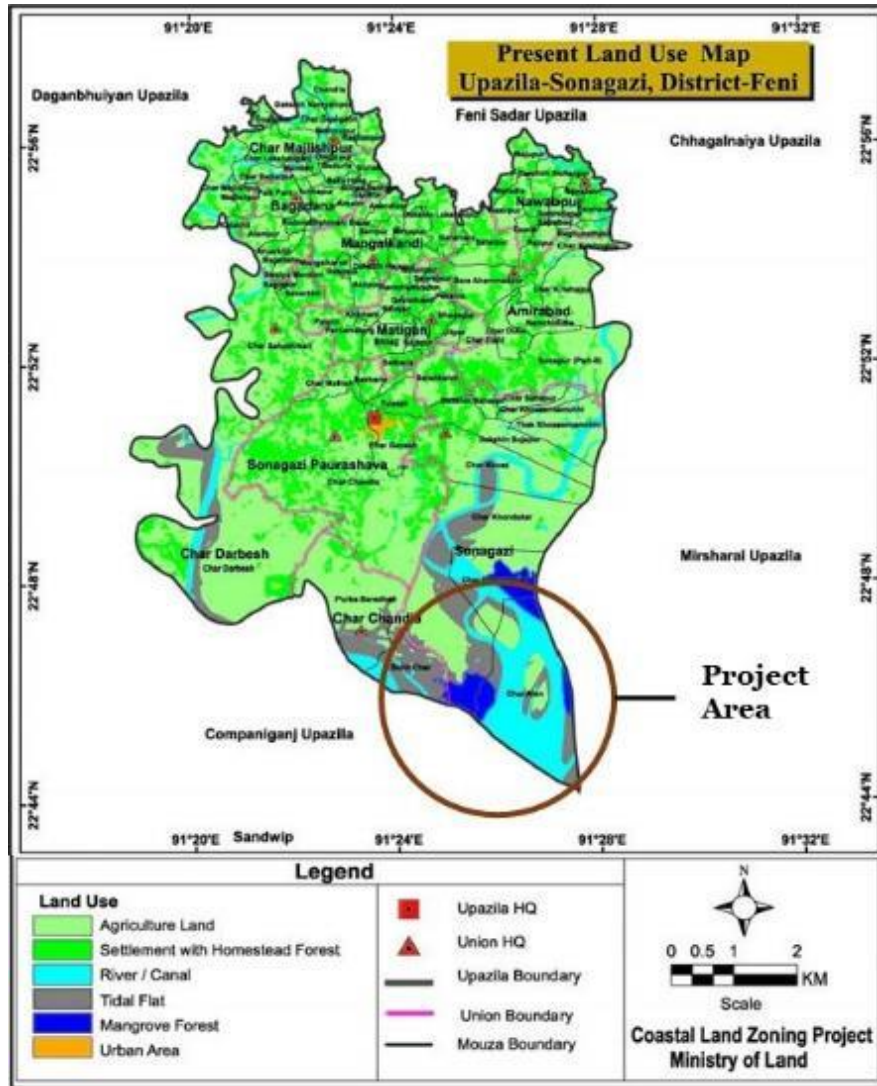
#### **4.3.4.1. Land Use**

According to the land use map of Sonagaji Upazila, Feni District the proposed site falls under the following zones-

- Agricultural Land
- River Canal

- Tidal Flat
- Mangrove Forest
- Mixed Crop Zone

Figure 54: Land use of Sonagazi Upazilla



Source: Coastal Land Zoning Project, Ministry of Land

#### 4.3.4.2. Agro-Ecological Regions

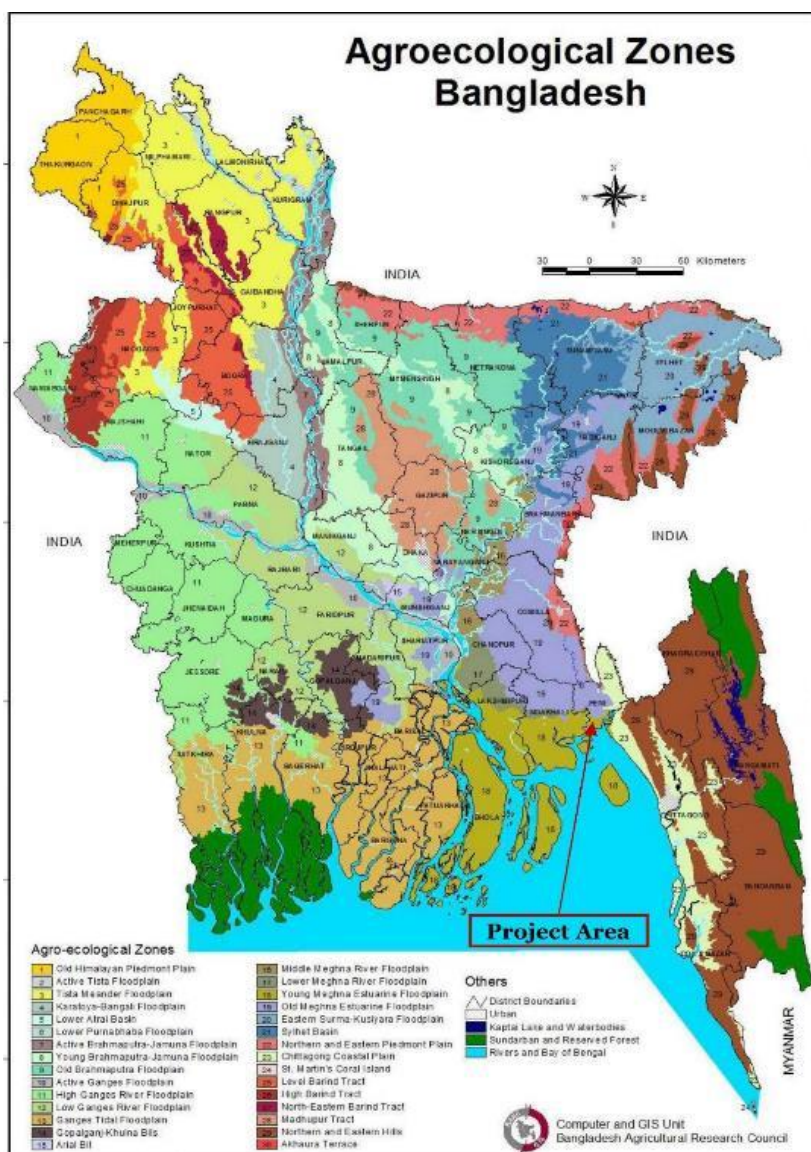
An Agroecological Region is a zone that has a unique combination of physiographic, soil, hydrological and agroclimatic characteristics. Thirty agroecological regions and 88 subregions and 535 units have been identified by adding successive layers of information on the physical environment which are relevant for land use and accessing agricultural potential.

The proposed site is located in AEZ 18 i.e. Young Meghna Estuarine Floodplain. The AEZ covers an area of 9269 km<sup>2</sup> in the southwest part of the country spreading across Chittagong, Feni, Noakhali, Lakshmipur, Bhola, Barisal, Patuakhali and Barguna districts having young alluvial land in and adjoining the Meghna estuary. It is almost level with low ridges and broad depressions. The area includes an island and a mainland area both. The major soils are grey to olive, deep, silt loam and silty clay loams which are stratified either throughout or at a shallow depth. Young soils are calcareous throughout and mainly saline in dry season, while older soils are noncalcareous and are only very



slightly or non saline. Calcareous Alluvium is the dominant general soil types with few Calcareous Grey Floodplain Soils and Non calcareous Grey Floodplain Soils. Map showing Agro-ecological zones of Bangladesh is given in figure below.

Figure 55: Agro-ecological Zone of Bangladesh



Source: Bangladesh Agricultural Research Council

#### 4.3.4.3. Land Types

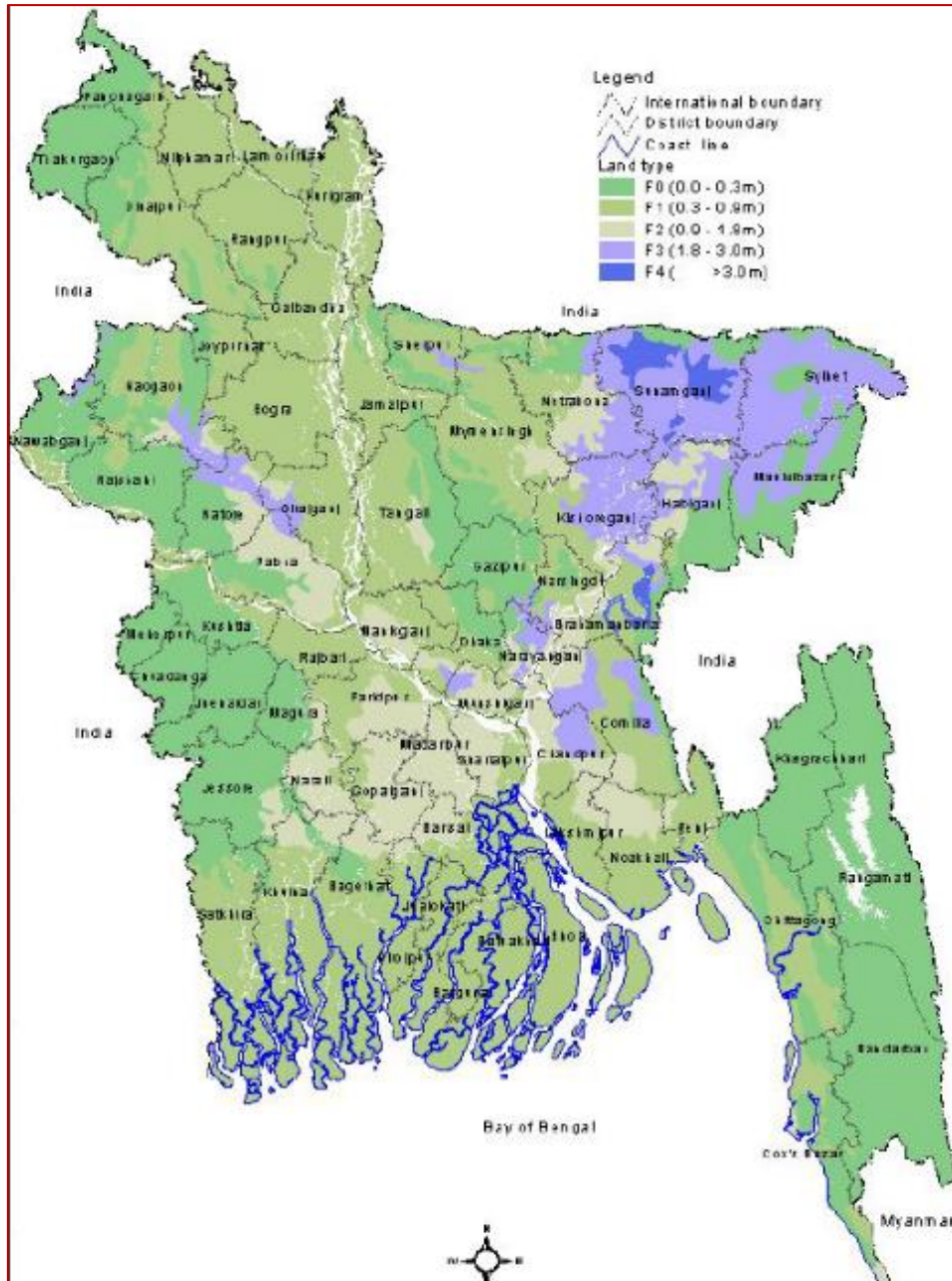
Land types are classified depending upon the depth of inundation during monsoon season due to normal flooding in an average year. Soil Research Development Institute (SRDI) has made the land type classification into five types, i.e. High land (Above flood level), Medium highland (Flooding depth 0-90 cm), Medium lowland (Flooding depth 90-180 cm), Lowland (Flooding depth 90-270 cm) and very lowland (Flooding depth >270 cm). Land type classification based on flooding during Monsoon Season by SRDI is given in below table and figure.

Table 58: Land Type Classification

<b>Land Type</b>	<b>Description</b>	<b>Flooding Depth</b>	<b>Flooding Characteristics</b>
<b>F0</b>	Highland	0-30 cm above flood level	Non-flooded to intermittent
<b>F1</b>	Medium Highland	flooding depth 30-90 cm	Seasonal
<b>F2</b>	Medium Lowland	flooding depth 90-180 cm	Seasonal
<b>F3</b>	Lowland	flooding depth 180-270 cm	Seasonal, but remains wet in the early dry season
<b>F4</b>	Very Lowland	flooding depth > 270 cm	Seasonal but remains wet in most of the dry season

Source: SRDI

Figure 56: Land Type Classification



Source: NAPA; MoEF, Bangladesh

As per the classification, the proposed area will fall under the Medium Highland category. However, in some part of the proposed site tidal inundation is observed.

#### 4.3.4.4. Seismicity

Bangladesh is located in the tectonically active Himalayan orogenic belt, which has developed through the collision among the Indian, Arabian, and Eurasian plates over the last 30-40 million years (Ma), (Aitchinson et al.2007)<sup>8</sup>. Bangladesh is very vulnerable to potential earthquake threats and damage. Earthquake vulnerability of any place largely depends on its geology and topography, population density, building density and quality, and finally the coping strategy of its people and it shows clear spatial variations. The distribution of recorded earthquakes indicates a major clustering of seismicity

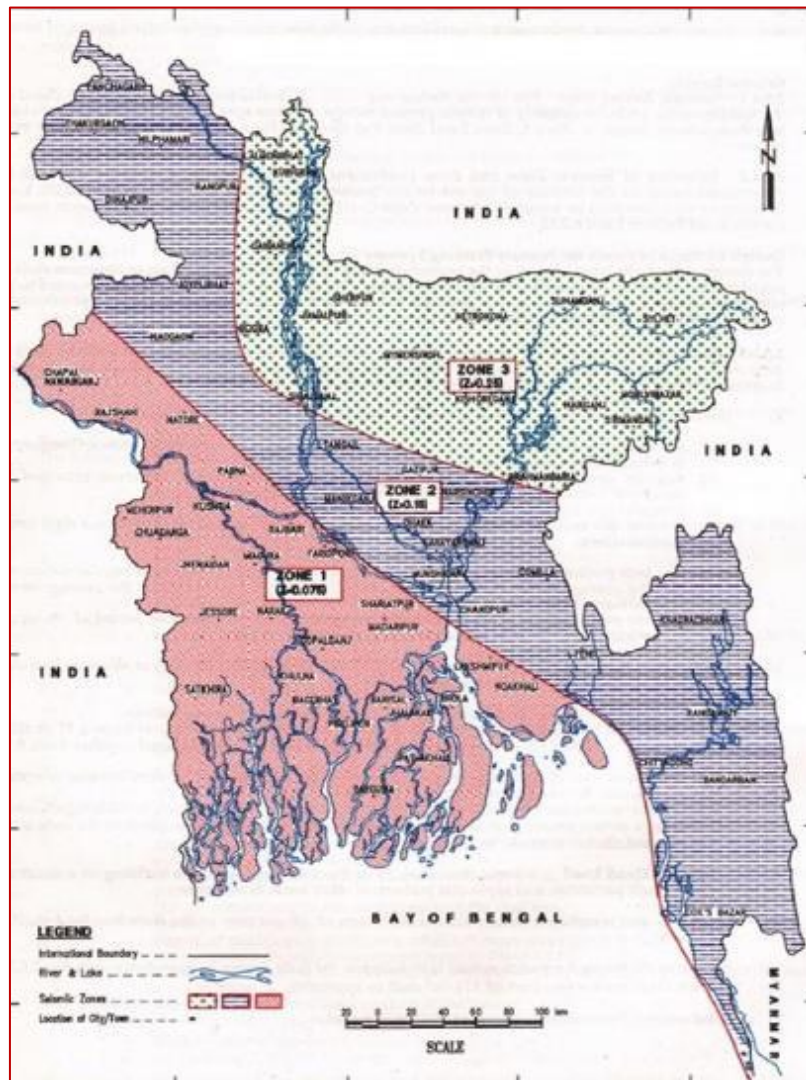
<sup>8</sup> Seismic Risk Assessment in Bangladesh; MoDMR

around the Dauki Fault and scattering of other events along other major fault systems of Bangladesh. The magnitude of the earthquakes are moderate (4-6) and majority of them are shallow depth.

Bangladesh has been divided into three generalized seismic zones. The northeastern regions of Bangladesh are the most active zones and belong to the zone-I. The zone II consists of the regions of recent uplifted Pleistocene blocks and considered as moderately active. The southwest Bangladesh is seismically quiet zone and represented by zone III. In the earthquake zoning map 26 percent of Bangladesh falls in high risk, 38 percent moderate and 36 percent in low risk zone in terms of earthquake vulnerability. Proposed site is located in Zone II.

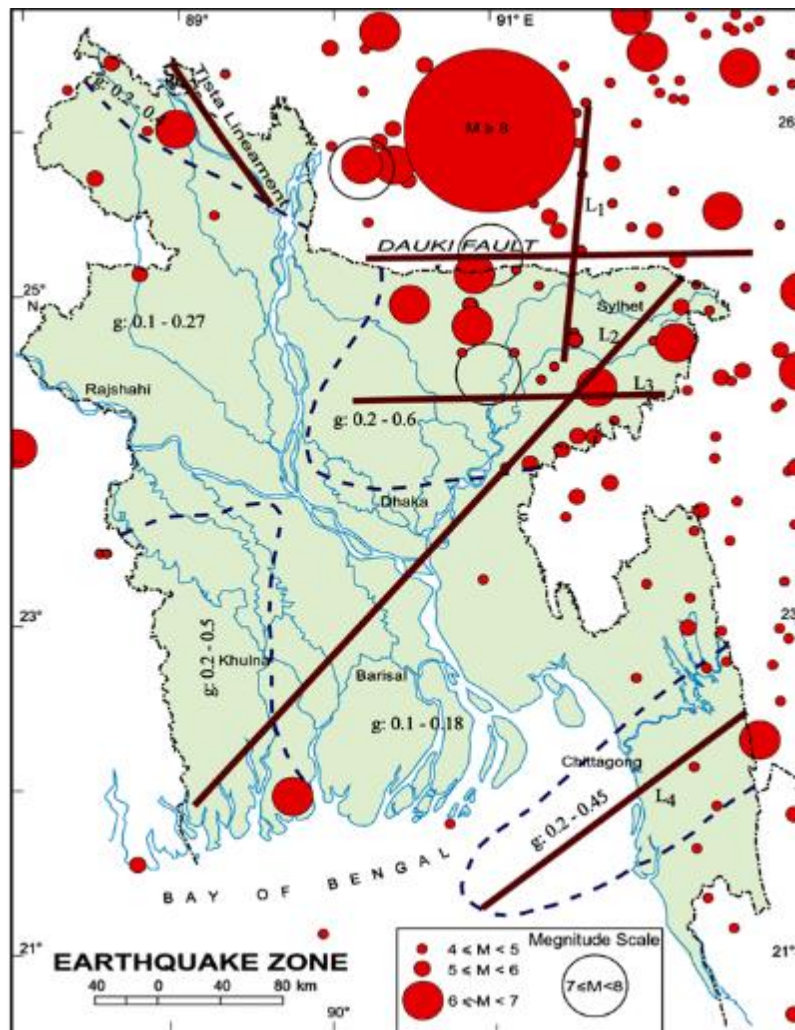
Seismic zoning map of Bangladesh is given in following figure.

*Figure 57: Seismic zone map of Bangladesh (BNBC)*



The most hazardous division in Bangladesh is Chittagong division. Northern and southern sections could expect to have maximum peak ground acceleration (PGA) ranging between 0.24g to 0.40g. The Chittagong Hill Tracts region can expect the highest PGA of up to 0.4g to 0.48g. In the basic seismic zoning map of Bangladesh, Chittagong and its surrounding region has been shown under Zone II with basic seismic coefficient of 0.15 (BNBC-1993), but recent repeated shocking around this region indicating the possibilities of potential threat of even much higher intensity like 0.35g than projected. If the Indian seismic zones were extended across the border into Bangladesh, the country would lie in zones IV and V. The seismicity of Bangladesh is shown in figure below.

Figure 58: Seismic Activity of Bangladesh



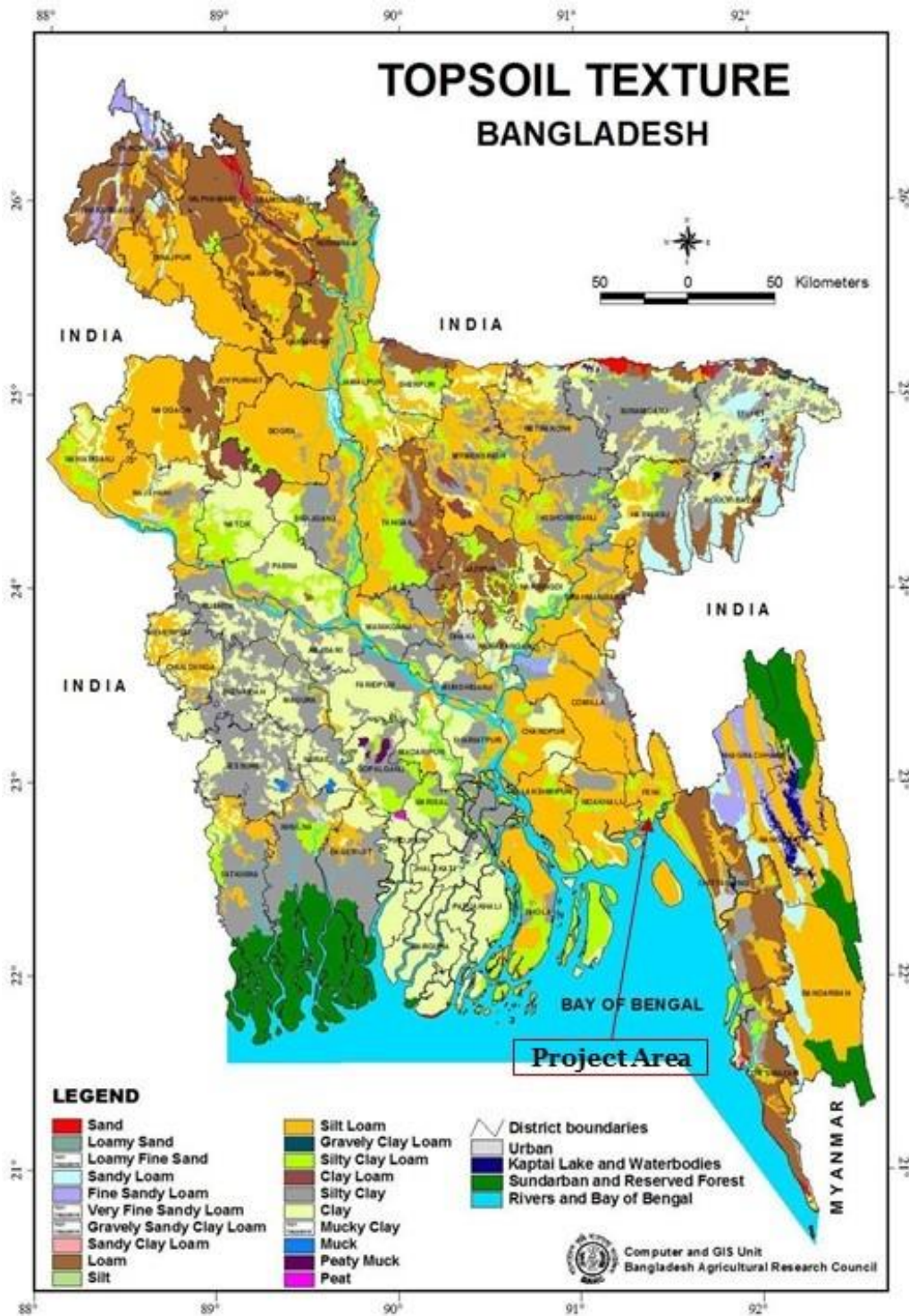
Source: Banglapedia

#### 4.3.4.5. Soil Texture

The soil of the Project area mainly “Calcareous Alluvium”. Calcareous alluvium soil is found extensively in the active Ganges floodplain and Meghna estuarine floodplain. This alluvium on the active Ganges floodplain mainly comprises brownish grey to pale brown sandy and silty deposits, which are moderately calcareous. 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 are slightly calcareous grey to olive, finely stratified silts. They are mainly Calcaric Fluvisols.

According to the Topsoil Texture Map by BARC Top Soil in the study area is of Silty – Clay-Loamy in nature. The soil become saline in the dry season. Risk of bank erosions alongside estuarine channels, exposure to cyclone and storm surges, the general lack of suitable water supplies for dry season irrigation as well as widespread salinity provide moderate or severe limitations on increased agricultural production.

Figure 59: Top Soil Texture of Proposed Project Area



Source: Bangladesh Agricultural Research Council

#### 4.3.4.6. Historical, Cultural and Archaeological sites

There is no archaeological resource present within EZ site.

### 4.3.5. Agricultural Resource

#### 4.3.5.1. Farming Practice

##### Agriculture

Farmers practice agricultural activity in this region for 3 seasons, i.e. Rabi, Kharif I and Kharif II. Source of irrigation in this region are storm water and rainwater harvesting ponds, ground water, khals/canal etc. Major crops of the region are paddy, betel leaf, betel nut, potato, corn, turmeric, tea, peanut, mustard, patol (heap), brinjal, ginger, cucumber and other vegetables. However, as informed by the Upazila Agriculture Office and locals, the proposed site area is predominantly single cropped in nature (Amon Paddy). Addition to that, some farmers also grow lentils like *Khesari and Musur*.

##### Aquaculture:

Pond fish culture in the influence and core area is mainly by pond, gher and semi closed aquaculture. In the core area, number of ponds is limited but very big in size. There many gher or large waterbodies created by in the influence area for fish culture. As per information of Upazila Fisheries Officer, Sonagazi Upazila few nursery operators contribute to fish culture. Rui, Catla, Mrigel and some exotic species are cultured in the pond. Shrimp culture (Bagda and Golda) is also practiced in the area. The culture period was typically four months for Bagda and six to seven months for Golda. Varieties of feeds such as cooked rice, fishmeal, oil cake and snail muscle are used for shrimp culture. Mainly virus disease was responsible for the great loss of shrimp in this area. Mud crabs are collected by people from the mudflats area, i.e. forest and along the canals.

#### 4.3.5.2. Cropping Pattern and Intensity

Major portion of the land within study area is under agriculture. Agriculture land comprise of fallow and agriculture land areas, seasonal gher and aquaculture ponds. As informed by Upazila Agriculture Office, there are three cropping seasons, i.e. Kharif-I, Kharif-II and Rabi. Major agriculture pattern in study area is Aman Rice, local vegetables, fruits, Aus Rice and Boro Rice. Major crops of each cropping season are given in table below

Table 59: Cropping Seasons in Area

S. No.	Cropping Season	Major Crops	Months
1	Kharif- I	Vegetable, Aus rice	March to May
2	Kharif - II	Aman rice	June to October
3	Rabi Season	Boro, vegetables, pulses	November to February

Source: Upazila Agriculture Office

#### 4.3.5.3. Cropped Area & Production

According to Upazila Agriculture Office, Sonagazi Upazilla has a land area of 28500 ha and cropped land is 22,000 ha. Among the cropped land, single crop, double crop and tri crop land is 3778 ha, 13,650 ha and 2,611 ha respectively. As per the upazilla agriculture officer, the cropped land area of the project area is mostly single crop land. The food production and Food Excess in the Upazila is 59942 MT and 13831 MT respectively.

*Table 60: Information on Cropped Area & Production of Sonagazi Upazila*

S. No	Particular	Number/Quantity
1	Number of farmer family	Total – 30550 Large – 755 Medium – 4050 Small – 12275 Marginal – 11830 Landless – 1640
2	Total cultivable Land	22000 Ha
3	Single Crop Land	3778 Ha
4	Double Crop Land	13650 Ha
5	Tripple Crop Land	2611 Ha
6	Total Cropped Land	38911
7	Net Cropped Area	20039
7	Food Excess (2016-2017)	13831 MT
8	Total Food production (2016-2017)	59942 MT

Source: Upazila Agriculture Office

#### **4.3.5.4. Crop Damage and Constraints of Crop Production**

Farmers of the district produce food crops, cash crops, fruits, vegetables, livestock and poultry, fish, timber and fuel wood. Majority of household also have poultry, livestock and produce poultry and livestock produce for daily consumption and selling.

Major constraints of agriculture in the study area is availability of arable land, crop damage, seasonal flooding of land, water logging, soil salinity and availability of high quality seeds and fertilizers. Crop damage is reported to occur due to both excess and scanty rainfall. Pre-monsoon and post-monsoon drainage congestion limits crop production. In monsoon season, the duration of water logging thus limit the crop choice.

#### **4.3.6. Livestock and Poultry**

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 households raise poultry and livestock, a practice that significantly reduce the poverty by generating employment and income. The office of livestock informed that the newly formed Charland, which is also located within the study area, is used as common grazing ground. The nearby villagers have livestock like cows, buffalos, goats and sheep and poultries like Duck, Chicken. The information on livestock of Sonagazi Upazila is furnished in below table.

*Table 61: Information on Livestock & Poultry Resources of Sonagazi Upazila*

S. NO.	Livestock & Poultry	Number
1.	Desi Cow	56,000
2.	Hybrid Cow	4,782
3.	Buffalo	3,526
4.	Goat	4,260
5.	Sheep	2,805
6.	Hen (Desi)	1,10,200



S. NO.	Livestock & Poultry	Number
7.	Hen (Commercial Layer)	1,20,000
8.	Hen (Broyler)	35,000
9.	Hen (Sonali)	28,130
10.	Duck	36,500
11.	Pigeon	20,000
12.	Turkey	2,740

Source: Upazila Livestock Office

#### 4.3.6.1. Feed and Fodder Shortage

The owners of the livestock population are facing problems in respect of availability of fodder and feeds during the month from March to December due to shortage of grazing fields. In dry and Kharif-I seasons, the lands are generally submerged with saline water in the study areas. Rice straw is the main fodder for cattle. Bran of wheat and rice, oil cakes, powder of cereal crops etc. are the other common fodders. Shortage of grazing area throughout the year aggravates the feed problem to the animal population. Poultry population at family level survives by scavenging and generally, no feed supplements are provided. However, at times kitchen waste becomes feed to the poultry.

As stated by Upazila Livestock Officer, the newly formed char land within proposed site and its surrounding area is used by cattle owners as grazing land. If the proposed area is acquired for EZ Development, the alternative land for grazing should be proposed by the project authority. Such grazing land can be proposed in Char Badamtali, Char Majispur

#### 4.3.6.2. Livestock/Poultry Diseases

Most common livestock diseases found in the study area are foot and mouth disease (FMD), Anthrax, Diarrhoea, PPR etc. The got/cyst in head is common disease of goat. Major poultry diseases are Duck Plague, Paralysis, New Castle, Fowl pox, and Dysentery etc. The most vulnerable period is between July to October (rainy season) months for spreading diseases to livestock and poultry populations. The duck plague generally occurs in summer.

### 4.3.7. Fisheries

#### 4.3.7.1. Introduction

In Bangladesh, fish accounts for 60% of national animal protein, and this sub-sector contributes about 5% of the national GDP and approximately 9% of total foreign exchange earnings. This sub-sector employs newly 1.2 million people directly, with another 11 million indirectly involved in related activities. The study area's fisheries resources are abundant and diverse. The study area includes estuaries, rivers, aquaculture ponds, canals, and Khals. The study area's fisheries, like other sectors of the country's fisheries, are not a major source of income, employment, or livelihood support for the local people. (Source: Sonagazi Upazila Land Zoning Report). The study's fisheries are described in detail in the sections below.

We used a mixed methods approach to assess the fisheries resources or fish biodiversity of the study area, collecting qualitative data (fisheries management, problem, and issues) through transect work, interviews, and focus group discussions (FGD) with local people, fisher community, and upazila fisheries officer. The quantitative data (fish production data, Fish and shrimp species recorded, fisheries in different seasons) was gathered from the fisheries offices in Sonagazi upazila and Feni district. The photos of the transect walk, and interview during the field visit are shown below:

Figure 60: Interviews with fisherman



#### *4.3.7.2. Habitat Description*

Fish habitats of the area are estuary, creeks, Khal, rivers, aquaculture ponds, natural ponds and beels. Water in these bodies varies from fresh to brackish. Both natural and cultured fisheries exist in the study area. The Feni River estuary has good species diversity. Species diversity is higher in the estuarine mouth compared to that of its upstream direction.

#### *4.3.7.3. Common Fisheries in the project area*

One of the beneficial uses of water resources is fisheries. On the project site, common fishes are Rui, Kalbaush, Tilapia, Pabda, and Mrigel. Pangas, Shing, Magur, etc. are also found in low amounts. These fishes are mainly cultured in aquaculture ponds. No fish sanctuary is found within a 5 km study area.

*Figure 61: Fisheries at the local market*



Sources: EIA report of WTP (Phase 1) of Mirsarai EZ, 2021

#### 4.3.7.4. Fish Production & Effort

According to Fisheries Statistics of Bangladesh, total annual inland fish production of Feni district was 30526 MT in 2017-2018. Contribution from River, Beel, Flood Plain, Pond, Seasonal Cultured Water Body, Baor, Shrimp/Prawn Farm, Pen Culture, Cage Culture is presented in below table.

Table 62: Fish Production (MT) effort in Feni District

District	River	Beel	Flood Plain	Pond	Seasonal Culture	Baor	Shrimp/Prawn Farm	Pen Culture	Cage Culture	Total
Feni	1390	0	6569	22368	109	0	63.53	0	26	30526

Source: Fisheries Statistics of Bangladesh, 2017-2018

People in study area extensively practice aquaculture and pisciculture both. People practice shrimps *Bagda pona* (*Penaeus monodon*) & *Goda pona* (*Macrobrachium resenberil*) and crab (especially mud crab/*Scylla serrata*) cultivation in the study area. Crabs are collected from inter-tidal creeks, khals, mangrove area and rivers. Fishes mainly Carps are cultivated in fisherie.

#### 4.3.7.5. Fish Biodiversity & Migration in Feni River Estuary

Project site is just adjacent to the Feni River Estuarine system. From study of Halder, G.C; Haroon, A.K.Y; Khan, M.A.A.; Tsai, C.F., 1991, it was found that Feni River Estuary are used by 34 species of upstream freshwater fishes, 11 species of estuarine dependent fish water species and nine species of marine fishes for various purpose and at different stages of their life. From study of Md. Iftakharul Islam et.al. it was found that 29 species of fisheries from 20 families are reported in Feni River Estuary system. These species are from variable habitats like fresh water, brackish water and marine water. All these fisheries migrate to Feni River Estuary system to complete one or more stage of their life. Out of these 29 species of fisheries found by Md. Iftakharul Islam et.al. it was found that 18 are fishes, 9 are shrimp and 2 are crab. The most abundant species was found to be *Odontamblyopus rubicundus* that constitute 42.64% of the total species found in the Feni River estuary, followed by *Pseudapocryptes elongates* (10.14%), *Stolephorus sp.* (9.22%), *Trypauchen vagina* (6.38%). Abundance of species in Feni River varies with season as per study of Md. Iftakharul Islam et.al. and is given in following table.

Table 63: Dominant Fisheries in Different Seasons

S. No.	Season	Dominant Species
1	Pre-monsoon season	<i>Trypauchen vagina</i> (26.05%), <i>Exopalaemon styliferus</i> (15.21%), <i>Mugil cephalus</i> (8.28%), <i>Parapenaeopsis styliferus</i> (5.57%), <i>Macrobrachium rosenbergii</i> (4.37%), <i>Matapenaeus monoceros</i> (4.07%).
2	Monsoon season	<i>Odontamblyopus rubicundus</i> (58.21%), <i>Pseudapocryptes elongates</i> (13.50%), <i>Tenulosa toil</i> (4.79%), <i>Stolephorus sp.</i> (4.23%).
3	Post monsoon season	<i>Odontamblyopus rubicundus</i> (40.12%), <i>Pseudapocryptes elongates</i> (16.68%), <i>Stolephorus sp.</i> (7.44%), <i>Macrobrachium mirabeli</i> (5.33%), <i>Parapenaeopsis sculptelies</i> (4.28%).
4	Winter Season	<i>Odontamblyopus rubicundus</i> (48.11%), <i>Stolephorus sp.</i> (25.26%), <i>Mugil cephalus</i> (7.86%)

Source: Islam, I, 2012, Temporal pattern of Fish Assemblage of Feni River, Feni, Bangladesh-Fish Biodiversity of Feni River

The fisheries diversity present in the Feni River Estuary along with their habitat is listed in the table below

Table 64: Fish and Shrimp Species Recorded in the Feni River Estuary

Family	Scientific Name	Local Name	Habitat	Climate
<b>Ambassidae</b>	Chanda nama	Chanda	Benthopelagic Freshwater brackish	<b>Tropical</b>
	Stolephorus sp.	Mola	Benthopelagic Freshwater brackish	<b>Tropical</b>
<b>Anguillidae</b>	Anguila sp.	Kuicha	Marine, brackish	<b>Tropical</b>
<b>Alpheidae</b>	Alpheaus spp.	Alphaed shrimp	Marine, brackish	<b>Tropical</b>
<b>Bagridae</b>	Mystus gulio	Guilla	Demersal, anadromous, freshwater, brackish	<b>Tropical</b>
<b>Clupeidae</b>	Tenuالosa toil	Illish	Marine, freshwater, Brackish, Pelagic- neritic, anadromous	<b>Subtropical</b>
<b>Cynoglossidae</b>	Cynoglossus lingua	Kukur jeeb	Demersal, amphidromous, Freshwater, brackish, marine	<b>Tropical</b>
<b>Cyprinidae</b>	Puntius ticto	Tit punti	Benthopelagic, Freshwater,	<b>Tropical</b>
<b>Engrualidae</b>	Coila ramkorati	Alua	Pelagic- neritic, amphidromous, brackish, Marine	<b>Tropical</b>
<b>Gobiidae</b>	Apocryptus bato	Chiring	Demersal, Amphidromous, freshwater, brackish, Marine	<b>Tropical</b>
	Pseudapocryptes lanceolatus	Goby	Amphidromous, freshwater, brackish, Marine	<b>Subtropical</b>
	Odontamblyopus rubicundus	Raja Cheoa	Marine brackish, benthopelagic, amphidromous	<b>Subtropical</b>
	Oxyurichthys microlepis	Nuna baila	Marine brackish,	<b>Tropical</b>
<b>Leucosiidae</b>	Matuta victor	Kakra	Marine brackish,	<b>Tropical</b>
<b>Mugilidae</b>	Mugil cephalus	Bata	Benthopelagic Amphidromous, freshwater, brackish, marine	<b>Subtropical</b>
<b>Mastacembelidae</b>	Mastacembelus armatus	Baim	Marine, Brackish, Freshwater	<b>Subtropical</b>
<b>Polynemidae</b>	Polynemus paradiseus	Taposi	Marine, freshwater, brackish, demersal, amphidromous	<b>Tropical</b>
<b>Sciaenidae</b>	Johnius belangerii	Poa	Demersal amphidromous brackish, marine	<b>Tropical</b>
<b>Taenioididae</b>	Trypauchen vagina	Lal cheoa	Marine brackish, benthopelagic, amphidromous	<b>Subtropical</b>
	Pangassius pangassius	Pangass	Freshwater, brackish,	<b>Subtropical</b>
	Macrobrachium rosenbergii	Golda chingry	Fresh water, Estuarine water	<b>Subtropical</b>

Family	Scientific Name	Local Name	Habitat	Climate
<b>Palaemonidae</b>	Macrobrachium villisimanus	Dimuaicha	Brackish,	<b>Tropical</b>
<b>Peneidae</b>	Penaeus monodon	Bagda chingri	Marine brackish	<b>Subtropical</b>
	Parapenaopsis sculptelies	Boro chama	Marine, brackish	<b>Tropical</b>
	Matapenaeus monoceros	Horina chingri	Marine, brackish	<b>Tropical</b>
	Parapenaopsis stylifera		Marine, brackish	<b>Subtropical</b>
<b>Palaemonidae</b>	Exopalaemon stylifera		Marine, brackish	<b>Subtropical</b>
	Macrobrachium mirabile		Marine, brackish	<b>Subtropical</b>
<b>Portunidae</b>	<b>Scylla serrata</b>	<b>Kakra</b>		<b>Subtropical</b>

Source: Islam, I, 2012, *Temporal pattern of Fish Assemblage of Feni River, Feni, Bangladesh-Fish Bio-diversity of Feni River*

#### 4.3.7.6. Fisheries Management, Problem, and Issues

According to Upazila Fisheries Office, there are 1,643 fisher registered/card holder and this year office provided subsidy (rice) to 1,661 fishers during banning period. It is estimated that about 250 to 300 fisher is fully dependent on Feni River for fishing and livelihoods in the project area. According to him major fish species of the river are bata, poa, hilsha, lal chewa, lattyta, baila (marine), tek chanda etc. During consultation with local fishermen and concerned fishermen it was understood that the Feni Regulator/Barrage under Muhuri project has caused negative impact on fish and aquatic life. This is mainly on quality of water (brackish vs fresh water), morphology (depth of the downstream part of the river). The barrage restricted downward and upward migration and movement of fish. This has also blocked movement of fishers using fishing boat. Many such boats found near the barrage. People are engaged in fishing activity in Feni River and number of channels passing through the proposed project area. Fishing activity by locals also conducted during hightide and in monsoon season, when the part of proposed site remains flooded. Development of EZ site will restrict the fishing activities in within EZ site. After construction of Superdyke along the proposed site, if adequate fish paths are not given, fish migration will also get hindered.

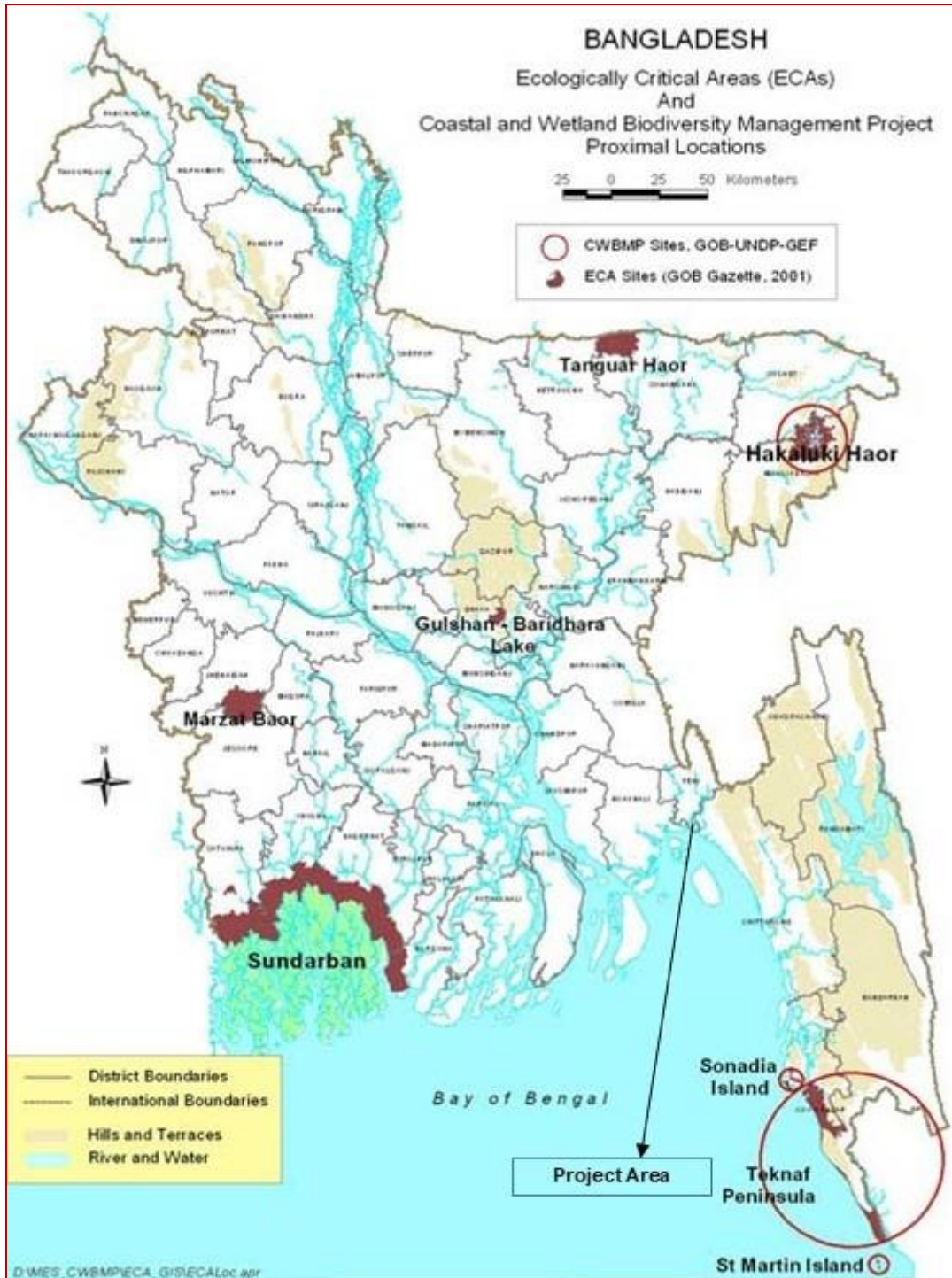
### 4.3.8. Ecological Resources

#### 4.3.8.1. Bio-ecological zone and Protected Area

The baseline ecological studies were carried out based on various secondary sources (Forest Department Data, Scientific Studies and previous similar studies) which are further validated through field observations and interaction with local people and concerned department. Present biological assessment was carried out for the study area.

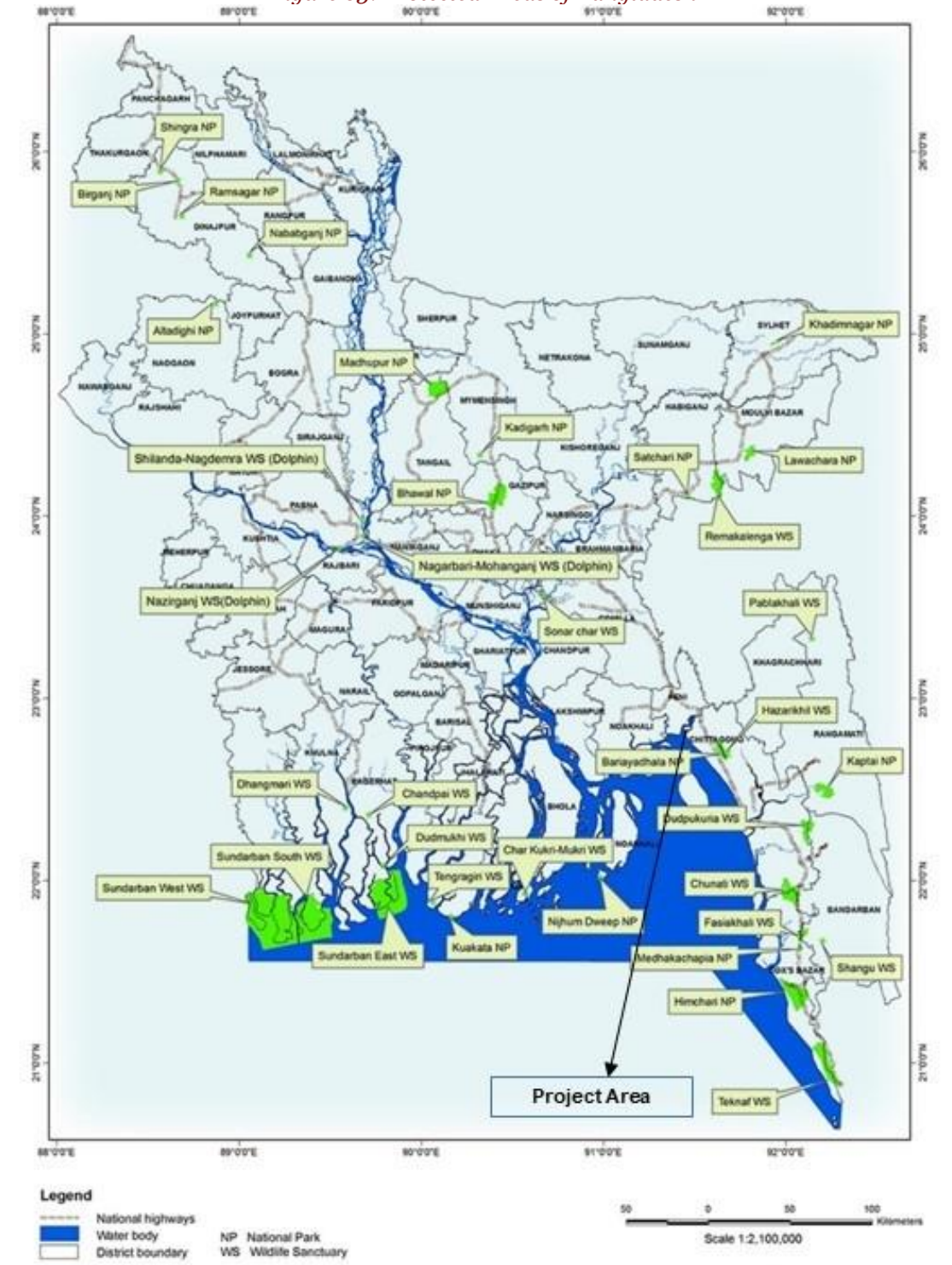
Under the Environmental Conservation Act, ecologically sensitive and precious areas are designated as Ecologically Critical Area (ECA) by Department of Environment in Bangladesh in cases where an ecosystem or biodiversity area is considered to be threatened to reach to a critical state. On the other hand, protected areas such as national parks and protected forests are designated by Department of Forest under the Wildlife Order and Forest Act. There is no protected area or ECA located within the study area of 10Km radius from proposed site boundary. Following figures show the map of Bangladesh showing location of various ECAs and protected areas distributed across the country.

Figure 62: Ecologically Critical Areas of Bangladesh



Source: <http://www.doe-bd.org/cwbmp/>

Figure 63: Protected Areas of Bangladesh



Source: Forest Department of Bangladesh



#### 4.3.8.2. Forest Area/Vegetation Cover

As stated by the concerned Forest Department, as per the Gazette Notification of Govt. of Bangladesh Dated 30<sup>th</sup> April'2015, Forest land is present in the Mouzas Bahir Char, Dakkhin Char Khandakar, Char Ram-Narayan and Char Elen (Please refer **Appendix E**). As stated by the concerned Forest Department, no *Dag* Nos are available for the Forest Locations. Even, map with proper delineation of Forest Boundary is not available with the concerned stakeholder. Due to this, it can't be stated whether the project requires the acquisition of Forest Land or not. The details are provided in below table.

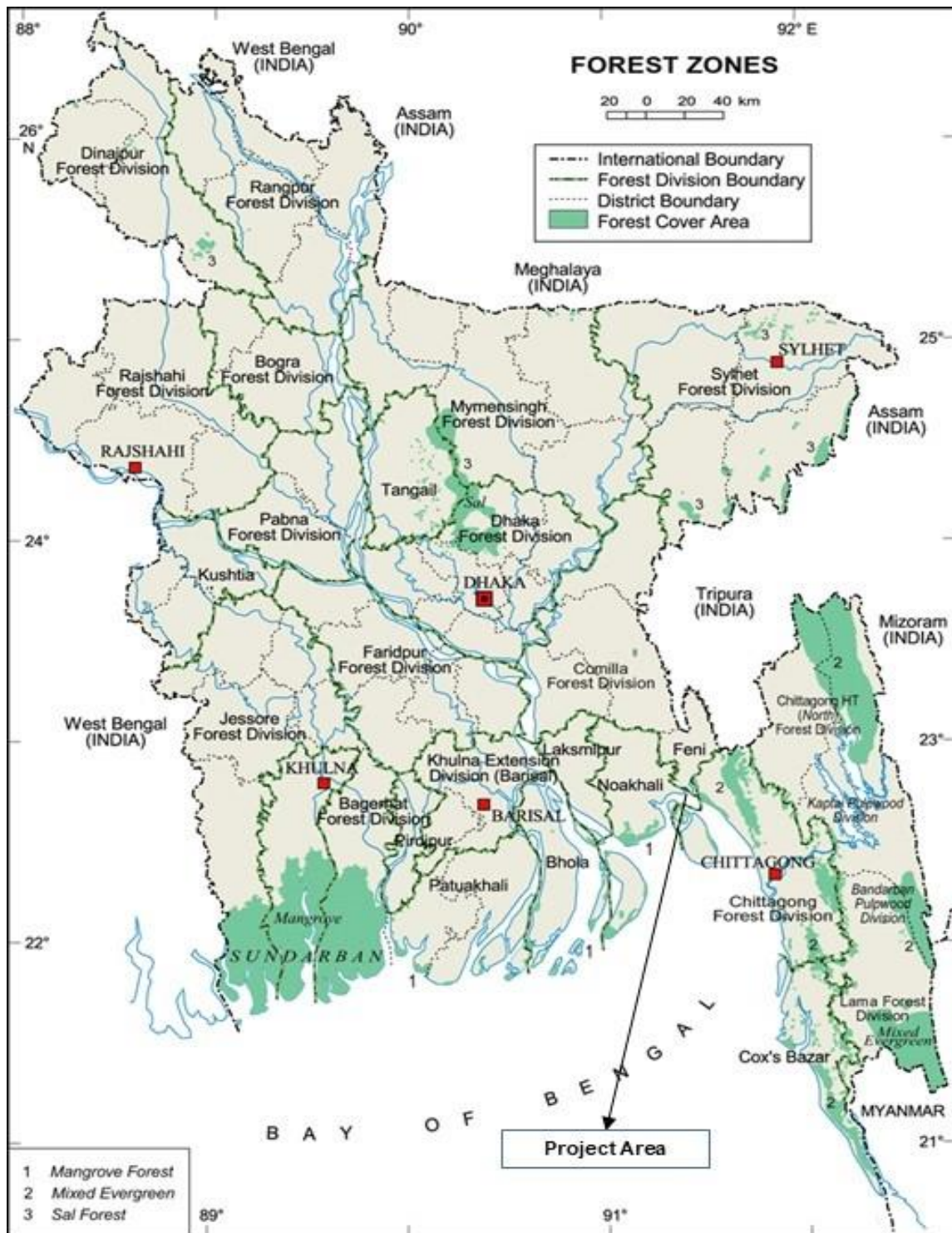
*Table 65: Forest Land as Per Gazette Notification*

S. No.	District	Upazila	Mouza Name	Forest Area (Acre)	Dag No
1	Feni	Sonagaji	Bahir Char	300.48	Not Provided
2	Feni	Sonagaji	Dakkhin Char Khandakar	100.00	
3	Feni	Sonagaji	Char Ram- Narayan	200.00	
4	Feni	Sonagaji	Char Elen	550.00	

*Source: Gazette Notification of Govt. of Bangladesh Dated 30th April'2015*

The proposed study area supports well grown mangrove vegetation. Two Mangroves patches is located within proposed site towards in Southern and North-Eastern side. The project area is located in a location where tidal influence is prominent. The Southern part of the project area remains submerged during high tide due to the proximity of Bay of Bengal. Proposed EZ is located just adjacent to confluence point of Feni River and Bay of Bengal. The mixing of saline water from sea and fresh water of River in the confluence area generates a brackish water ecosystem. The project area supports significant growth of various mangrove species as well. The project area is located in Mangrove-Intertidal Zone. The char land, which covers significant part of project area, has been chosen by the Forest Department for taking up plantation activity. The *Kalo Bain (Avicennia officinalis)*, *Sada Bain (Avicennia marina)* and *Keora (Sonneratia apetala)* are the predominantly planted mangroves species found in the area. *Gneoa (Excoecaria agallocha)*, a mangrove species grows here naturally. When the natural growth of *Uri* grass is observed on the Char, it implies the suitability of the land for taking up mangrove plantation. Following figures furnish the forest map of Bangladesh and map of Chiitagong Coastal Forest Division showing the project area.

Figure 64: Forest Areas of Bangladesh



Source: Prime Minister's Office Library, Dhaka

Figure 65: Project Area shown on Chittagong Coastal Forest Division's Map (Shown project surrounding area only)



Source: Chittagong Coastal Forest Division

### 4.3.8.3. Flora & Fauna

Tidal influence is prominent in the study area. The proposed site is located close to the confluence point of Bay of Bengal and Feni River. Muhuri Dam is located on Boro Feni River at about 1.7 Km upstream from the proposed site. From Muhuri Dam location, the river splits into number of streams before finally meeting Bay of Bengal. In the confluence area, the natural mixing of saline water (from Bay of Bengal) and fresh water (from Boro Feni River, its branches and other small creeks) create a brackish estuarine ecosystem. The study area also supports substantial biodiversity. Information pertaining to ecological resources were collected from Forest Department, local community, local fishermen and through site reconnaissance. The flora and fauna recorded from study area are presented in subsequent sections.

#### Flora

The study area is part of newly formed char land. Primary successor species like *Uri /Dhansi* grass is seen. Mangrove species like *Kalo Bain (Avicennia officinalis)*, *Sada Bain (Avicennia marina)*, *Keora (Sonneratia apetala)* planted by forest department are the predominant species of the project area. As stated by forest department, *Gneoa (Excoecaria agallocha)* grows here naturally. *Nona Jhau (Tamarix dioica)* is also seen here in abundance. Two Mangroves Forest patches is located within proposed site.

Among other floral components, *Eucalyptus sp*, *Casuarina sp*, Coconut (*Cocos nucifera*), Palm (*Borassus flabellifer*), *Azadirachta indica* (Neem), *Akashmani (Acacia auriculiformis)*, *Khalsi (Aegiceras corniculatum)*, *Bel (Aegle marmelos)*, *Sirish (Albizia lebbek)*, *Mehagani (Swietenia mehogani)*, *Jam (Syzygium cumini)*, *Jamrul (Syzygium samarengense)*, *Devil's Tree (Alstonia macrophylla)*, *Beetle Nut (Arecha catechu)*, *Jackfruit (Artocarpus heterophyllus)*, *Hijol (Barringtonia acutangula)*, *Akanda (Calotropis gigantean)*, *Papaya (Carica papaya)*, *Jambura (Citrus maxima)*, *Lime (Citrus aurantifolia)*, *Madar (Erythrina variegta)*, *Banyan (Ficus benghalensis)*. *Dumur (Ficus hispida)*, *Chinese rose (Hibiscus rosa sinensis)*, *Mango (Mangifera indica)*, *Moringa (Moringa olifera)*, *Banana (Musa itinerans)*, *Date Palm (Phoenix sylvestris)*, *False Ashoka (Polyalthia longifolia)* etc. are commonly found in the study area.

## Fauna

### Mammals

Beside domesticated mammals like cow, buffalo, goat, dog, cat etc., the recorded mammalian species from the project and its surrounding are Spotted Deer (*Axis axis*), Jackal (*Canis aureus*), Wild cat (*Felis chaus*), Common Otter (*Lutra lutra*), House shrew (*Suncus murinus*), Mole Rat (*Bandicota indica*), House Rat (*Rattus rattus*), Squirrel (*Callosciurus pygerythrus*), Indian Civet (*Viverra zibetha*), Mongoose (*Herpestes edwardsi*), Indian Flying Fox (*Pteropus giganteus*), Indian Pipistrelle (*Pipistrellus coromandra*). Forest department stated about presence of an estimated population of 5,000 spotted deer in the area.

### Aves

Commonly found bird's species in the project area are House Sparrow (*Passer domesticus*), Black Drongo (*Dicrurus macrocercus*), Pied Myna (*Sturnus contra*), Chestnut-tailed Starling (*Sturnus malabaricus*), Pale-bellied Myna (*Acridotheres cinereus*), Common Myna (*Acridotheres tristis*), Oriental Magpie-Robin (*Copsychus saularis*), Common Tailor Bird (*Orthotomus sutorius*), Common Pigeon (*Columba livia*), Eurasian Collared Dove (*Streptopelia decaocto*), Spotted Dove (*Streptopelia chinensis*), Red vented Bulbul (*Pycnonotus cafer*), Baya Weaver (*Ploceus philippinus*), White-breasted kingfisher (*Halcyon smyrnensis*), Common Kingfisher (*Alcedo atthis*), Chestnut-headed bee-eater (*Merops leschenaulti*), Asian palm swift (*Cypsiurus balasiensis*), Brown Fish Owl (*Ketupa zeylonensis*), Little Cormorant (*Phalacrocorax niger*), Indian Cormorant (*Phalacrocorax fuscicollis*), Little Egret (*Egretta garzetta*), Yellow-billed Egret (*Egretta intermedia*), Great Egret (*Casmerudias albus*), Cattle Egret (*Bubulcus ibis*), Pond heron (*Ardeola grayii*), Indian River Tern (*Sterna aurantia*), Night Heron (*Nycticorax nycticorax*) etc.

The Muhuri dam region, located adjacent towards northern side of Proposed site is known as an Important Bird and Biodiversity Area (IBA). IBA sites are identified by BirdLife International based on using an internationally agreed set of criteria as being globally important for the conservation of bird populations. Following species have been recorded from this IBA.

Table 66: Birds Recorded from Muhuri Dam IBA

Common Name	Scientific Name	Current IUCN Status
Ferruginous Duck	<i>Aythya nyroca</i>	NT
Tufted Duck	<i>Aythya fuligula</i>	LC
Garganey	<i>Spatula querquedula</i>	LC
Gadwall	<i>Mareca strepera</i>	LC
Eurasian Wigeon	<i>Mareca penelope</i>	LC
Northern Pintail	<i>Anas acuta</i>	LC
Common Teal	<i>Anas crecca</i>	LC

Source: IBA

The site is located in the close proximity of Ganges-Brahmaputra-Meghna Delta IBA as well. This IBA is located towards southern side of EZ.

Table 67: Birds Recorded from Ganges-Bhrahmaputra-Meghna Delta IBA

Common Name	Scientific Name	Current IUCN Status
Bar-headed Goose	<i>Anser indicus</i>	LC
Common Shelduck	<i>Tadorna tadorna</i>	LC
Eurasian Curlew	<i>Numenius arquata</i>	NT
Spoon-billed Sandpiper	<i>Calidris pygmaea</i>	CR
Spotted Greenshank	<i>Tringa guttifer</i>	EN
Indian Skimmer	<i>Rynchops albicollis</i>	VU

Source: IBA

### Herpetofauna

Commonly seen herpetofauna are Southeast Asian toad (*Bufo melanostictus*), Green frog (*Euphlyctis cyanophlyctis*), Cricket frog (*Fejervarya sp*), garden lizard (*Calotes versicolor*), Skink (*Mabuya mabuya*), Gekko (*Gekko gecko*), House Lizard (*Hemidactylus brooki*), Indian Black Turtle (*Melanochelys trijuga*), Median Roofed turtle (*Pangshura tentoria*), Common Vine snake (*Ahaetulla prasina*), Checkered keel back (*Xenocrophis piscator*), Cobra (*Naja naja*) etc. Bengal Monitor Lizard (*Varanus bengalensis*) also recorded from project area.

### Fishes

Fishes recorded from area are Lote (*Harpadon nehereus*), Churi Fish (*Trichiurus lepturus*), Ilish (*Hilsa ilsa*), Bhola/Poa (*Pama pama*), Air (*Sperata aor*), Bele (*Awaous grammepomus*), Bhetki (*Lates calcarifer*), Kharu (*Pisodonophis boro*), Spined anchovy (*Stolephorus tri*), Speigler's mullet (*Valamugil speigleri*), Spottail needlefish (*Strongylura strongylura*), Ambassis sp, Tailla (*Eleutheronema tetradactylum*), Bele (*Glossogobius giuris*, *Awaous grammepomus*), Lal Chewa (*Odontamblyopus rubicundus*), Sada Chewa (*Trypauchen vagina*), Borguni (*Terapon jarbua*), Koi (*Anabas testudineus*), Bengal Tongue Sole (*Cynoglossus cynoglossus*). Other species like Golda Chingri (*Macrobrachium rosenbergii*), Badga Chingri (*Penaeus monodon*), Harina Chingri (*Metapenaeus Monoceros*), various crabs, snails, etc. are also found in abundance.

Figure 66: Biodiversity of Study Area



Bengal Monitor Lizard (*Varanus bengalensis*) spotted from project area



Oriental Magpie-Robin (*Copsychus saularis*)



Common Myna/ Salikh (*Acridotheres tristis*)



Pied Myna / Gang-Salikh (*Sturnus contra*)



Collared Dove (*Streptopelia decaocto*)



Intermediate egret (*Ardea intermedia*)



Black Drongo (*Dicrurus macrocercus*)



Mud Crab (*Scylla serrata*)



Cormorant (*Phalacrocorax niger*)



Nest of Weaver Bird in Palm Tree



Naturally grown Gneoa (*Excoecaria agallocha*) in front row (of lesser height); Planted Keora (*Sonneratia apetala*) of taller size in back row



Naturally grown Gneoa (*Excoecaria agallocha*)



Planted Keora (*Sonneratia apetala*)



Nona Jhau (*Tamarix dioica*)



Eucalyptus



Casuarina

#### ***4.3.8.4. Ecosystem Service and Function***

The ecosystem of the study area is mainly terrestrial and aquatic (including estuarine ecosystem). Presence of rich flora and fauna in the study area currently provides good situation for maintaining good climatic condition of the area. Ecosystem services and function help local people and vice versa. Major benefits of the ecosystem services of the study area are given below

- The photosynthetic processes remove carbon dioxide in the air and supplies oxygen to the environment.

- Trees serve as sources of fruits, fuel wood etc.
- Fishery, livestock & poultry cater the protein and nutritional needs of community
- The watershed provides water for human consumption and irrigation
- Trees (specifically mangrove plantation) serve as buffer against storms preventing destruction of household properties by strong winds

Humus from decomposition of organic matter serve as natural fertilizer in areas

### **4.3.9. Socio Economic**

#### **4.3.9.1. Socio Economic Condition**

The key parameters that are required to establish a baseline socio-economic profile of population within the project's area of influence include gender, ethnicity, social structure, employment patterns, sources of income, local tenure and property rights arrangements, common property resources (CRP) use of community and natural resources. Primary information gathered by undertaking the survey, consultations and other stakeholder interaction and secondary information sourced from published references have been analyzed to establish the socio-economic baseline. As, the proposed economic zone is located within the jurisdiction of Sonagazi Upazila in Feni district, the socio-economic profile of Sonagazi Upazila and Feni District is detailed below.

Sonagazi upazila is located at 22.8500°N 91.3917°E. It has 49,810 households and spread over a total area of 284.9 km<sup>2</sup>. It is situated in the southern part of the district, the only Upazila in Feni district to have a coastline with the Bay of Bengal. Sonagazi is noted for its natural environment and a sluice gate, known as "Muhuri Project", built in the late 1970's to control water flow of the Feni River.

#### **4.3.9.2. Demographic Profile of Sonagazi Upazila**

Sonagazi is an upazila of Feni District within Chittagong Division, Bangladesh. There are 97 villages, 1 Poursava, 9 Unions Parishads, and 94 Mouza's in Sonagazi upazila.

According to Census 2011, total population of Feni district is 1,437,371, of which male is 694,128 and female is 743,243. It is estimated that in the year of 2019 the total population of the district is approximately 1,610,952 (Male – 777,954; Female – 833,000).

As per the 2011 census, Sonagazi Upazila has a total population of 262,547 and the total male and female population at the Upazila is 123,653 and 138,894 respectively. The population density per sq. km is 921. It is estimated that in the year of 2019 the total population of the Upazila is approximately 285,868 (Male- 134,636; Female- 151,232).

*Table 68: Demographic Details: Sonagazi Upazila*

Administrative Unit	Area (Sq.KM)	Population	Total HH	Aver. HH size	Population Density
Sonagazi Upazila	284.89	262,547	79545	5.16	921

*Source: Bangladesh Bureau of Statistics 2011*

In Sonagazi Upazila, majority of the population fall within the age group of 10-49 (61.4%). The percentage of young population is quite high than the dependent population implying that most of the population belongs to the employable age group, which is vital for fuelling the economic growth of the local area.



*Table 69: Population- age wise details: Sonagazi Upazila*

<b>Age Distribution</b>	<b>Population</b>	<b>%</b>
<b>0-9 years</b>	63,992	24%
<b>10-19 years</b>	63,321	24%
<b>20-29 years</b>	45,480	17%
<b>30-39 years</b>	29,611	11%
<b>40-49 years</b>	21,851	8%
<b>50-59 years</b>	15,448	6%
<b>60-69 years</b>	12,369	5%
<b>70-79 years</b>	6,589	3%
<b>80+ years</b>	3,886	1%

*Source: Census 2011*

#### **4.3.9.3. Social Infrastructure**

Sonagazi Upazila has the following social infrastructure and public utility infrastructures.

*Table 70: Social Infrastructure: Sonagazi Upazila*

<b>Social Infrastructure</b>	<b>Numbers</b>
<b>GoB Primary Schools</b>	108
<b>Secondary High Schools</b>	24
<b>Secondary Girls High Schools</b>	3
<b>Jr. High Schools</b>	02
<b>Dakhil Madrasa</b>	13
<b>Alim Madrasa</b>	03
<b>Non-government secondary school</b>	20
<b>Government Degree college</b>	01
<b>Non-government Degree college</b>	1
<b>Non-government college</b>	1
<b>Kawmi madrasah</b>	30
<b>Non-government Women college</b>	1

*Source: Bangladesh Bureau of Statistics*

#### 4.3.9.4. Religion & Culture

The majority of the population in Sonagazi Upazila is dominated by Muslims (94.1%), followed by Hindus (5.88%), Buddhists (0.005 %) and Christians (0.004 %).

Table 71: Religious Practice

Religion	%
Muslim	94.103
Hindu	5.886
Christian	0.004
Buddhist	0.005
other	0.002

Source: Bangladesh Bureau of Statistics, 2011

#### 4.3.9.5. Quality of Life Indicators

##### Literacy rate and educational facilities

The literacy rate of the Upazila is 51.6% (higher than the country average) where Feni district rate is 59.6%. The male literacy rate (52.8 %) is almost equal to the male literacy rate (51.0%).

#### 4.3.9.6. Income & Poverty

##### Employment Status

According to Bangladesh District Statistics, the economy of Feni is predominantly agricultural. *Main sources of income* Include: Agriculture 36.40%, non-agricultural laborer 3.35%, industry 1.58%, commerce 12.67%, transport and communication 4.40%, service 15.62%, construction 2.11%, religious service 0.56%, rent and remittance 14.04% and others 9.27%.

**Poverty information:** No poverty related data is directly provided in the latest Census. But the data on occupations, education and household types are presented to give an idea of the locality. From these variables, the area seems impoverished and not many well-off families live in the proposed EZ area. Thus, the EZ will contribute to the improvement of all the unions within the Upazila and also the adjacent ones. It can be expected to change the poverty scenario in a positive way.

#### 4.3.9.7. Common Property Resources

No common property resources (CPRs) exist within EZ zone. Thus, no impact on CPRs will be caused due to the project development.

#### 4.3.9.8. Conflict of Interest and Law and Order Situation

No conflict of interest is associated with the development of EZ site

#### 4.3.9.9. Historical, Cultural and Archaeological sites

There is no archaeological resource present within EZ site and study area.

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#### *4.3.9.10. Ownership Pattern & PAHs of Proposed EZ Area*

Preparation of Social Impact Assessment Report is under process. Information pertaining to Ownership Pattern, Project affected Households (PAHs) and Project Affected People (PAPs) shall be provided in final EIA Report.

# 5. Identification and Analysis of Key Environmental Issues

## 5.1. Environmental Sensitivity Investigation

Environmental impact assessment has been carried out considering the impacts of proposed interventions with associated activities on important components of the environment and society. Firstly, all of the environmental components sensitive to proposed activities were identified during reconnaissance field visit based on expert observation, local people’s perception and standard practice of EIA. The scoping process, followed to identify the environment and social sensitive features included professional judgments of the multi-disciplinary EIA team members and stakeholder consultation. The preliminarily identified environmental and social sensitive components are listed in sections below.

## 5.2. Environmental Asset

Environmental assets identified in the study area are listed below:

1. Air Quality of the area
2. Noise level of the area
3. Water Quality of the area
4. Transportation system of the area
5. Ecosystem of study area
  - a. River Feni and various canals
  - b. Mangroves Plantation
  - c. Agriculture land and Aquaculture ponds

Identified environmental assets of the project are likely to be impacted due to development of the EZ and off-site facilities at all the pre-construction, construction, and operation stages of the project. Project activities which may have an impact on the environmental assets and the associated impacts are listed below. The detailed impact identification and mitigation measures are given in next chapter.

*Table 72: Environmental Assets of the project area*

S. No.	Environmental Assets	Impact	Related Project Activity
<b>Pre-Construction &amp; Construction Phase</b>			
1	Air Quality of Study Area	Degradation	<ul style="list-style-type: none"> <li>• Dust generation from               <ul style="list-style-type: none"> <li>○ Site preparation</li> <li>○ Construction activities</li> <li>○ Excavation</li> </ul> </li> <li>• Emission from construction vehicles/machinery</li> </ul>
2	Noise Level of Study Area	Increase in Noise levels	Construction activities Movement of construction vehicles/machinery

S. No.	Environmental Assets	Impact	Related Project Activity
3	Transportation System	Traffic congestion on the local roads (Sonagazi - Muhuriganj Project Road, Sonagazi-Olabazar-Chardarbeshpur – Companigonj Road)	Increased nos. of vehicles carrying construction raw material and construction debris
4	Fisheries of Study Area	Increased sedimentation of water body	Increase in run-off from construction/excavated site. Restriction on fishing, navigation
5	Surface water system of Study area	Increased sedimentation of water body, accidental contamination	Increase in run-off from construction/excavated site Accidental spill of construction material
Operation Phase			
1	Air Quality of Study Area	Air pollution	Industrial emissions and emissions from plying vehicles
2	Noise Level of Study Area	Increase in Noise levels	Increased traffic movement and industrial operations
3	Transportation System	Traffic congestion	Increased nos. of vehicles carrying industrial raw materials and workers for existing roads. Access roads required to be widened further to accommodate the expected vehicles during operational stage of EZ.
4	Fisheries of Study Area	Entry of pollutant into the water bodies from upcoming industries in EZ zone may impact the aquatic life Restricted fishing activity in the charland of proposed EZ site after development of EZ	Industrial operation
5	Surface water system of Study area	Degradation of Water Quality & Aquatic life	Discharge of effluents from the industries which are proposed to be located in economic zone
6	Eco-system of Study area	Degradation of Water Quality & Aquatic life Impact on Mangrove vegetation and associated biodiversity	Discharge of effluents from the industries Surface runoff Construction of dyke to protect EZ site may also have impact on Mangroves plantation as it may restrict entry of sea water during high tide

### 5.3. Environmental Hotspot

The proposed site is located adjacent to the confluence point of Bay of Bengal and Boro Feni River. The two blocks of proposed EZ is located at either bank of the river. Muhuri Dam is located on Boro Feni River at just about 1.2 Km upstream from the proposed site. From Muhuri Dam location, the river splits into number of streams before finally meeting Bay of Bengal. 2 streams of the river flows through prosed EZ blocks as well. The Bay of Bengal forms entire southern boundary of the site. The mixing of saline water from sea and fresh water of River in the confluence area generates a brackish water ecosystem. The region is quite rich in biological diversity. The Bay of Bengal and Boro Feni River are identified as key environmental features of the site surrounding and has a significant role on the topography, livelihood and ecology of the area. Another river, named Choto Feni located about 5 km west of proposed site also converges to sea at the south-west side of proposed site. However, EZ site does not lie within Eco-sensitive/Ecological critical area. Two Important Bird and Biodiversity area i.e. Muhuri Dam IBA and Ganges-Bhrahmaputra-Meghna Delta IBA are located adjacent to the proposed EZ site towards Northern and South-Western side respectively. The proposed project area supports well grown mangrove vegetation. A larger mangrove patch is falling in the eastern block of site. Significant mangroves are also present on southern and eastern side of western block of proposed EZ. The newly formed Char land of the area is declared as Government Land. In case of the project area, such Char land was handed over to forest department for taking up afforestation activities.

### 5.4. Likely Beneficial Impacts

The project involves development of EZ and off-site facilities. The land use plan of the Feni EZ area is as follows:

Table 73: Land Use Plan of Feni EZ

Precinct	Land Use Designation	Size in Acres	Percentage
EZ	FENI EZ		
A	Residential and Support Amenities	4606.57	48.24%
B	City Center/Business Hub	178	1.86%
F	Light/Medium Industrial Area	2,393.00	25.06%
J	Open Space	2013.69	21.09%
K	Leisure/Entertainment Area	350.89	3.67%
L	Cultural Center	7.46	0.08%
Total		9549.61	100.00%

Source: Draft Master Plan of BSMSN

About 75% of the land parcel is earmarked for non-industrial development. Only 25% of the land area will be developed for industrial use- containing mostly light and medium industries. The proposed industrial location is likely to have the following industries:

- Textile and textile accessories
- Pharmaceuticals
- Food and Agro Processing Industry
- Electronics Industry

- Automobile Industry
- Power and Energy
- Leather Product Industries
- Light Industry (motorcycle assembly, machinery parts and general assembly)

The likely benefits from the proposed development are listed as below:

- a) Rapid Economic development
- b) Large scale direct and indirect employment generation
- c) Development of infrastructure facilities
- d) Technological enhancement for management of environmental management (like water treatment, waste management, environmental monitoring)
- e) Permanent source of employment, fixed monthly income.
- f) Better living standards

## ***5.5. Community Recommendations***

As per the focused group discussions carried out with people, it was learned that people are in favour of development of EZ. They are expecting overall development in their neighbourhood due to development of EZ. Also, they expect that large scale employment will be generated in the area for both male and females which will enhance their standard of living.

## ***5.6. Alternate Analysis***

Various sites have been identified by BEZA or development of economic zone. Pre-feasibility study for various sites has been carried out to analyze suitability of site for EZ development by BEZA. As per pre-feasibility study it was found that Mirsarai and adjoining Feni is one of the most potential & suitable zones for development of EZ. Strength and weakness of the site are well discussed in Project Description Chapter. Sites considered for development of economic zone other than Feni are listed below:

- Area of app. 205 acres in Mongla Upazila, Bagerhat District
- Area of app. 353 acres in Sherpur, Maulvi Bazar
- Area of app. 1390 acres in Anwara, Chittagong

These sites are analyzed on basis of location, accessibility, potential for industrial growth, availability of raw material, infrastructural development, availability of manpower, vulnerability to natural and man-made disasters, availability of the basic amenities and utilities for industrial development. After analysis ranking has been done for these sites. As per ranking it is found that Mirsarai and adjoining Feni has potential to be developed as EZ site due to its strategic location on Dhaka Chittagong Industrial Corridor. Mongla has already being approved for development of EZ. Factors responsible for selection of Feni as site for development of economic zone are given below:

1. Sufficient land area for development of EZ
2. Availability of significant of Government Land
3. No Resettlement & Rehabilitation Issues
4. Located outside city Corporation, Municipality and Cantonment Board Area
5. Located Near to Chittagong Port (app. 75 km)
6. Nearest Railhead: Boraiyarhat station (15 Km) located at NE direction; Nearest railway junction: Chattogram Station (75 Km) located at SSE direction
7. Close proximity to Feni River and also well-developed inland water transport
8. Close vicinity to Dhaka Chittagong Highway (10 kms) connected through Sheikh Hasina Sarani
9. Project site does not lie within any eco-sensitive zone or ecological critical area

# 6. Environmental and Social Impacts

## 6.1. Introduction

The environmental impacts assessment was carried out considering present environmental setting of the project area, and nature and extent of the proposed activities. The proposed project involves development of EZ and off-site facilities for upcoming EZ in Feni. Potential environmental impacts associated with EZ and proposed off-site facility are classified as

- impacts during preconstruction stage
- impacts during construction phase and
- Impacts during operation phase.

During the study Sensitive environmental components were identified during the site visits and qualitative and quantitative techniques have been applied for direct and indirect assessment of impacts on these components. Table below provides the classification of environmental components.

*Table 74: Classification of Social and Environmental Components*

Components	Sub-component	Parameters
<b>PHYSICAL</b> Water Air Land	Surface water, Ground water Air, noise, and Soil.	Hydrology, water quality Air quality, noise level Erosion, soil quality
<b>ECOLOGICAL</b> Aquatic/Marine Terrestrial	Fisheries/ Aquatic species Aquatic/Marine Biology Vegetation Wildlife	Species, diversity, economic value Density, species Species, population Species, population
<b>INFRASTRUCTURE</b> Water Supply Electricity Transport Land use Drainage	Surface/ground water — Highways/Roads/ Rail Change in Land use Water	Frequency, quality Generation, Transmission, requirement, Access, availability, type, utility of each mode Land use pattern Flooding, drainage

The environmental impacts of the specific project activities listed above have been assessed separately for both construction and operational phases of the project, with special emphasis on the issues that could generate significant adverse impacts, such as (i) social impacts, (ii) Ecological impacts affecting water bodies, and (iii) Possible disruption to road communication and navigation during the construction phase. This section provides an assessment of the potential environmental impacts of the proposed project, especially focusing on these issues.

## 6.2. Risk Assessment

This section identifies the potential impacts that the various elements of the proposed Project may have on aspects of the physical, biological, and socio-economic environment. The identification of the potential impacts will be considered for the pre-construction, construction and post-construction phases. The activities undertaken during each of these Project stages form the basis for potential impact identification and analysis.

Assessment of potential impacts requires a multi-disciplinary approach in which a wide range of issues are taken into consideration to identify and determine which potential Project impacts may be significant and therefore



require the application of reasonable and effective management and/or mitigation. Most projects result in positive and negative potential impacts on the environment, society, and economy, all of which are identified and assessed in this section.

Certain impacts identified in this section have the potential to be significant. The determination of whether a given potential impact is significant depends on several factors:

- The potential for on-site and off-site impacts.
- The potential for direct and indirect impacts.
- The frequency and duration of a potential impact.
- The sensitivity of the receiving environment; and

Measures of potential impact significance as part of the project planning and assessment phase presented in this EIA have been determined using a risk-based model. The risk-based model is a two-dimensional matrix of ‘magnitude of impact’ and ‘likelihood’. Both are assigned scores between 1 and 5 based on severity or probability and multiplied to obtain the ‘risk band’. The ‘magnitude of impact’ is a 5-point based scale set by an expert’s judgment. The scale and its explanation are given in the table below.

*Table 75: Explanation and Assignment of Scores to 'Magnitude of Impact'*

Color Band	<b>Incidental</b>	<b>Minor</b>	<b>Moderate</b>	<b>Major</b>	<b>Severe/Catastrophic</b>
Score	<b>Score: 1</b>	<b>Score: 2</b>	<b>Score: 3</b>	<b>Score: 4</b>	<b>Score: 5</b>
Explanation	Impacts such as localized or short term effects on habitat, species, or environmental media.	Localized, long term degradation of sensitive habitat or widespread, short-term impacts to habitat, species, or environmental media	Impacts such as localized but irreversible habitat loss or widespread, long-term effects on habitat, species, or environmental media	Widespread and persistent changes in habitat, species, or environmental media	Persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.

The ‘likelihood’ is also a 5-point based scale set by the expert’s judgment. The scale and its explanation are given in the table below.

*Table 76: Explanation and Assignment of Scores to 'Likelihood'*

Color Band	<b>Rare</b>	<b>Unlikely</b>	<b>Seldom</b>	<b>Occasional</b>	<b>Likely</b>
Score	<b>Score: 1</b>	<b>Score: 2</b>	<b>Score: 3</b>	<b>Score: 4</b>	<b>Score: 5</b>
Explanation	Rare or unheard of	Reasonable to expect that the consequence will not occur during this project though has occurred several times in the industry	Exceptional conditions may allow consequences to occur within the project	Conditions may allow the consequence to occur during the project lifetime, or the event has	Consequence can reasonably be expected to occur in life the project

			lifetime	occurred within similar projects	
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Therefore, “Risk” factor is derived from the following equation: Risk = Magnitude x likelihood

The score of ‘Risk’ ranges from 1 to 25. The score is classified into 3 classes. The explanation is given in the following Table. The score matrix for risk assessment has been used to identify the priority environmental impact and their mitigation plan.

*Table 77: Two-Dimensional Risk Assessment Matrix*

		Magnitude of Impact					
		Incidental	Minor	Moderate	Major	Severe/Cats.	
		Score: 1	Score: 2	Score: 3	Score: 4	Score: 5	
Likelihood	Rare	Score:1	1	2	3	4	5
	Unlikely	Score:2	2	4	6	8	10
	Seldom	Score:3	3	6	9	12	15
	Occasional	Score:4	4	8	12	16	20
	Likely	Score:5	5	10	15	20	25

Based on the above discussion, a risk assessment matrix has been developed for this project. This assessment will be used as a guideline to monitor the project during implementation. Though some issues do not need to monitor it is still included in the environmental management plan in the later section of this report if required in any case.

### 6.3. Impact Identification

During the site visit, various environmentally sensitive features were identified which may potentially be impacted by the project at various stages. Identified impacts of the project activities on the environment components are given below along with the associated activities.

*Table 78: Impact Assessment Matrix for Proposed Off-site Infrastructure*

Ref. No.	Activities/Issues	Impacts	Risk Assessment		Risk Factor	Mitigation & Monitoring Required		Required Controls
			Magnitude	Likelihood		Yes	No	
<b>1.0 Pre-Construction Phase</b>								
1.1	Land Acquisition for site, access road and utility supply system	Change in land use pattern	2	2	4	x		Mitigation measures are already given in the EMP.
		Impact on livelihood	2	2	4	x		Mitigation measures are already given in the EMP.
		Shifting of Utilities	1	1	1	x		Mitigation measures are already given in the EMP.
1.2	Site Preparation	Removal of Vegetation.	2	2	4	x		Mitigation measures are already given in the EMP.
		Impact on aesthetic aspects	2	3	4	x		Mitigation measures are already given in the EMP.
		Impact on estuary	1	1	1	x		Mitigation measures are already given

2.0 Construction Phase							
2.1	Development of EZ and Construction of Boundary wall, embankment, Access Road, super dyke, electrical & water supply system and administration building.	Loss of Topsoil	2	2	4	x	Mitigation measures are already given in the EMP. A soil quality test is proposed for monitoring.
		Soil contamination due to spillage of material	2	2	4	x	Mitigation measures are already given in the EMP.
		Surface water contamination	1	2	2	x	Mitigation measures are already given in the EMP. A water quality test is proposed for monitoring.
		Air pollution	1	2	2	x	Mitigation measures are already given in the EMP. An air quality test is proposed for monitoring.
		Noise pollution	2	2	4	x	Mitigation measures are already given in the EMP. Noise level measurement is proposed for monitoring.
		Waste Generation	2	2	4	x	Mitigation measures are already given in the EMP.
		Increase in traffic	3	3	9	x	Mitigation measures are already given in the EMP.
		Community Health & safety	2	2	4	x	Mitigation measures are already given in the EMP.
		Workers Health and Safety	3	3	9	x	Mitigation measures are already given in the EMP.
		Social impact	3	3	9	x	BEZA will maintain this issue.
		Removal of Trees	3	3	9	x	Mitigation measures are already given in the EMP.
		Disturbance to estuarine brackish ecosystem	2	2	4		Mitigation measures are already given in the EMP.
Loss of Mangrove vegetation	2	2	4		Mitigation measures are already given in the EMP.		
3.0 Post Construction Phase							
3.1	Development of Off-site Infrastructure, i.e. Boundary wall, embankment, access road, water supply system, electrical	Impact on the ambient Air Quality	2	2	4	x	Mitigation measures are already given in the EMP.
		Noise Pollution	2	2	4	x	Mitigation measures are already given in the EMP.

supply line and administration building and operation of industries	Potential surface/marine water pollution due to industrial waste discharge	2	4	8	x		Mitigation measures are already given in the EMP.
	Impact on river hydrology due to construction of long embankment along the river/super dyke structure along shoreline	2	4	8	x		Mitigation measures are already given in the EMP.
	Disturbance to estuarine brackish ecosystem	2	4	8	x		Mitigation measures are already given in the EMP.
	Waste Management	3	3	9	x		Mitigation measures are already given in the EMP.
	Health & Safety	3	3	9	x		Mitigation measures are already given in the EMP.
	Economic Development	3	3	9	x		The socio-economic status will be Improved.
	Accessibility	2	2	4	x		Mitigation measures are already given in the EMP.
	Groundwater depletion						Mitigation measures are already given in the EMP.
	Potential for land contamination due to industrial activities	2	2	4	x		Mitigation measures are already given in the EMP.
	Increased Run-off	2	2	4	x		Mitigation measures are already given in the EMP.
	Generation of Employment	3	3	9	x		The Long-term employment opportunity will be created
	Fisheries	2	4	8	x		Mitigation measures are already given in the EMP.
	Agriculture	2	4	8	x		Mitigation measures are already given in the EMP.

## 6.4. Impacts on Air Environment

### ◦ Pre-construction phase

The pre-construction phase will involve site preparation activity for the development of EZ, access road and water supply system which will lead to dust generation and other fugitive emissions. But these emissions will be localized and have impact for short duration only.

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To minimize the dust generation, water should be sprinkled regularly at the site and low sulphur diesel should be used in land levelling equipments, vehicle and construction equipments to control the SO<sub>2</sub> emissions.

### ◦ **Construction Phase**

The proposed project involves construction activities which includes:

- site development (land filling, earth work, excavation);
- civil construction.
- construction material handling and stockpiling; and
- Vehicular movement which will generate fugitive dust and vehicular emissions.

Air quality will be impacted from the following sources during the construction phase:

- Fugitive dust emissions from site development, excavation work, cutting and levelling work at sites and access/ internal roads, stacking of soils, handling of construction material, transportation of material, emission due to movements of vehicles, plying of heavy construction machinery etc.
- Vehicular emissions due to traffic movement on site and on the connecting roads.
- Exhaust emissions from construction machineries, other heavy equipment as bull dozers, excavators, compactors; and
- Emissions from diesel generator required for emergency power during construction period.

Gaseous emissions containing PM<sub>10</sub>, PM<sub>2.5</sub>, SPM, CO, HC, NO<sub>x</sub>, SO<sub>2</sub> and lead will be released from the vehicles, construction equipment and dredger exhaust. The vehicular movement on the unpaved roads will also result in the fugitive dust emissions. The movement of trucks carrying construction material to the site during the construction will lead to fugitive and exhaust emissions which would impact the people in the project area of influence. The movement of heavy trucks also increase the potential for road accidents.

### **Mitigation Measures:**

To mitigate the construction impacts, Economic Zone authority should have contract agreements with contractors as well as sub-contractors to implement the measures provided in EMP.

- Sprinkling of water at construction site and haul roads
- Construction of barricades between the settlements and the site to minimize travel of fugitive emissions towards settlements
- Tree/shrub Plantation (native species) on either side of the approach road to mitigate the fugitive dust emissions
- Tree plantation shall be done keeping in mind the native species. Some of the species of plants which are the native species and can be grown on both the side of the roads are *Neem (Azadirachta indica)*, *Gab (Diospyros ecbryopteris)*, *Guava (Psidium guava)*, *Jam (Syzygium spp)*, *Aam (Mangifera indica)*, *Supari (Areca catechu)*, *Tal (Borassus flabellifer)*, *Kul (Zizyphus jujube)*, *Zizyphus mauritiana etc.*
- Having fruit bearing trees shall not only minimize the impacts of air pollution but also attract birds and aves because of the fruits.
- Apart from having trees along side the approach road and the internal road, patches of land shall also be dedicated for taking up plantation activities. All these trees (mentioned above) shall be planted to enhance the greenery of the area and also attract more tourists and birds.

- Minimizing stockpiling by coordinating excavations, spreading, re-grading, compaction and importation activities
- Cease or phase-down work if excess fugitive dust is observed, investigate source and take suppression measures such as water spray
- Adequate parking space should be provided for the construction vehicles so as to prevent idling of the vehicles and the emissions generating from them
- Vehicles carrying construction material and debris should be covered with tarpaulin cover
- Raw materials, excavated soil and other debris should be stored under covered sheds or cover with tarpaulin
- Green buffer should be developed all along the EZ boundary
- Provision of face mask to workers to minimize inhalation of dust particles
- Construction vehicles and machinery should be regularly serviced and check for pollution control
- Low sulphur diesel should be used for running construction equipment and vehicles
- Covering the scaffolding (in case of building) to reduce the dust emission in outside environment
- Speed of vehicles on site is recommended to be 10-15 km/hr which will help in minimizing fugitive dust emissions due to vehicular movement

### ◦ **Operation Phase**

Industrial development in Feni EZ will only be limited to Precinct F (25% of the Feni EZ). Precinct F is intended to house only light and medium industry sectors in order to properly separate, buffer and protect the area from heavier, more polluting industries. The Precinct will be constructed to international standards, ensuring proper truck/cargo movements and easy access to arterial roads leading in and out of BSMSN. The area will be designed to provide state-of-the-art infrastructure and utility networks, which are eco-friendly, sustainable and resilient. Based on analysis of the masterplan, the following industries may be established in the Feni EZ:

- Textile and textile accessories
- Pharmaceuticals
- Food and Agro Processing Industry
- Electronics Industry
- Automobile Industry
- Power and Energy
- Leather Product Industries
- Light Industry (motorcycle assembly, machinery parts and general assembly)

The impacts on the air quality of the area will be from (a) air emissions from the proposed industries and (b) emissions from increased vehicular movements. The cumulative effect of the industries along with upcoming other EZs in the area may have severe negative impact on the air quality of the site and the nearby areas. Nature of Air emissions due to various industrial operations are furnished in below table-

*Table 79: Emissions from various industries*

<b>Industry Type</b>	<b>Nature of Emission</b>
Textile & Textile Accessories	The major air pollutants generated from textile mills include Suspended Particulate Matter (SPM), sulphur dioxide gas, oxide of nitrogen gas, etc. The hydrocarbons are emitted from drying ovens and from mineral oils in high temperature drying/curing. The residues from fibre preparation

<i>Industry Type</i>	<i>Nature of Emission</i>
	<p>also emit pollutants during heat setting processes. Carriers and solvents may be emitted during dyeing operations depending on the types of dyeing processes used and from wastewater treatment plant operations. Carriers used in batch dyeing of disperse dyes may lead to volatilisation of aqueous chemical emulsions during heat setting, drying, or curing stages. Inhalation of the dust generated where cotton fibre is converted into yarn and fabric significantly contributes to byssinosis (an occupational lung disease).</p> <p>Textile accessories are likely to have minimum air emission considering most textile accessories are plastic products like hangers, packaging materials, buttons, etc.</p>
Leather Products: Finished leather products	No significant emission from finished leather products manufacturing industries is envisaged. Minor fumes due to use of adhesives / gums may generate from such industries
Electronics Industry	Chlorofluorocarbons (CFCs) used manufacturing of refrigerators, freezers, chillers, and air conditioners in electrical and electronic industries are having potential to damage ozone layer of atmosphere. Release of VoCs due to painting may also occur.
Light Industry (motorcycle assembly, machinery parts and general assembly)	No significant air emissions is generated from light machinery industries. However, volatile organic compounds may be released due to painting, finishing activities. Thermal cutting processes of base metals such as stainless steel, low alloy steels, hard facing materials and other alloys may release pollutants that contain manganese, chromium, cadmium, lead, nickel or other known hazardous substances.
Automobile Industry	Air emissions are envisaged due to burning of various fuels and emission in the process of fabrication, welding, cutting, blasting, metal plating, surface finishing and painting process
Pharmaceuticals	Prevailing public concern in respect of air pollution in these industries are odor and toxic emissions. Generation of VOC in the industry caused due to use of varieties of solvents. The major VOC emission is caused from reactor vents, man ways, material loading and unloading, acid gases (halogen acids, sulfur dioxide, nitrous oxides). Other probable emitted pollutants from process are N <sub>2</sub> , CO <sub>2</sub> , H <sub>2</sub> and NH <sub>3</sub> . The emission from the process is mainly liberated gases from various reactions. Emission from boiler (if applicable) & DG Stack
Power and Energy	Renewable Energy Power Plants do not generate air emission. However, the envisaged combined cycle and gas power plants are likely to generate CO <sub>2</sub> , SO <sub>2</sub> , NOX and other air emissions.
Food and Agro Processing	Air emissions from food processing industry contains some volatile organic compounds but do not contain any hazardous compounds. These industries emit low process-air emissions. Most of the processes uses electrical power and rarely emit harmful compounds to

<i>Industry Type</i>	<i>Nature of Emission</i>
	<p>environment. But air emissions from effluent treatment plant of these industries are a major concern.</p> <p>Beside this, Chlorofluorocarbons (CFCs) used as cooling agents in many refrigeration and cooling systems in food and beverage industries are having potential to damage ozone layer of atmosphere.</p>

### ***Mitigation Measures***

- Provision should be made for peripheral green belt all along the EZ boundary. Green belt should have minimum of three rows of local variety of tree.
- Tree species should be selected such that first inside row is of smaller height, middle row of tree is of medium height and last row of tree is of higher height so that green belt formed appears like a canopy.
- Development of thick green belt and organized greens within each industrial plots. Broad-leaved species, which can absorb pollutants, should be planted as they help to settle particulates with their higher surface areas along with thick foliage
- Power Generators should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission.
- Process emission if any should be controlled with the installation of adequate air pollution control systems like Venturi scrubbers, wet scrubbers, Electrostatic precipitator, cyclone separator & bag filter etc. as applicable to the individual industry
- All industries should obtain clearance from DoE, Bangladesh as applicable. Air pollution control measures shall be adopted by respective industries in line with DOE permission
- Air pollution monitoring should be carried out by all industries to check the air pollution level.
- Preference of usage of clean fuel like LPG, low sulphur diesel should be explored
- Energy conservation should be adopted by opting the alternate energy options like solar power
- Odour should be managed at the site using odour suppressant and planting fragrant flowering trees.
- For industries, periodic checkups should be done for the workers. Rotating of workers shall be done to reduce exposure levels. Monitoring units for air quality must be installed and periodically checked at upstream and downstream wind flow directions and the analysis results should be within the limits as provided by the DoE.

## ***6.5. Impact on Noise Environment***

### ***Pre-construction and Construction Phase***

Pre-construction phase will involve site preparation activity for development of access road and utilities. The site clearance will involve vegetation clearance and land levelling activities. Operation of different machineries and equipments for construction activities, running of heavy load traffic for construction materials transportation, and regular traffic movement may generate noise during construction period. The heavy equipment, machineries, transportation and earthworks used for the construction activities are the major sources of noise. It is envisaged that there will be an increase in traffic and thereby in traffic noise impacts on the receptors near the approach road from the transportation of equipment, construction materials. The residents in the vicinity of the site would be impacted due to the noise generation. Table below shows the typical noise levels generated by some of the construction equipment expected to be used during the construction phase. As seen from the Table below, the



local peak noise level for non-continuous construction activity may reach to as high as 96 dB(A), depending on the type of equipment. The impact, however, is expected to be temporary and localised.

*Table 80: Noise levels generated by construction equipments*

Equipment	Sound Level at Operator	
	Average	Range
<i>Background*</i>	86	
<i>Earth Moving:</i>		
Front End Loader	88	85-91
Back Hoe	86.5	79-89
Bull Dozer	96	89-103
Roller	90	79-93
Scraper	96	84-102
Grader	<85	
Truck	96	89-103
Paver	101	100-102
<i>Material Handling:</i>		
Concrete Mixer	<85	
Concrete Pump	< 85	
Crane	100	97-102
Derrick	<85	
<i>Power Units:</i>		
Generators	<85	
Compressors	<85	
<i>Other Equipment:</i>		
Poker Vibrator	94.5	87-98
Compressed Air Blower	104	
Power Saw	88.5	78-95
Electric Drill	102	
Air Track Drill	113	
<b>Noise Standards</b>		<b>Noise Level</b>
OSHA (at workers ear)		90 dB (A)
Day Time Community (at property line)		65 dB (A)

*Source: Laborers' Health & Safety Fund of North America*

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

### **Mitigation Measures**

The following mitigation measures will be implemented to minimize potential noise impacts during the construction phase:

- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted.
- Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during idle time.
- Acoustic enclosure will be provided for the DG set.
- Equipment known to emit noise strongly in one direction should be orientated so that the noise is directed away from nearby sensitive receptors as far as practicable.
- Provision of temporary noise barrier in working area should be kept
- Honking should be avoided.
- Construction work should be carried out only during daytime (from 8.00am to 6 pm); and
- Machinery to be used should comply with the noise standards prescribed by DoE.
- To deal with noise exposure by construction workers in construction site, pocket guide by OSHA is helpful.

The following noise reduction measures are suggested in the pocket guide.

**Reduce It:** Reduce the noise by using the quietest equipment available. For example, choose a smaller, quieter generator.

**Move It:** Move the equipment farther away with the use of extension cords, additional welding leads, and air hoses. Noise levels go down as we increase our distance from a noisy object. Move the generator (example) farther away or face it in a direction that is away from where most people are working. If you are not required to be in a high noise area, move to a quieter area.

**Block It:** Block the noise by building temporary barriers of plywood or other on-site materials to keep the noise from reaching workers. Place a five-sided, oversized wooden box over the generator. Add fire-resistant acoustical absorbing material (foam) inside the box. If the generator sits on soil or sand, that will help absorb some of the noise.

At individual worker level, the construction contractor should be insisted to provide earmuffs to the workers exposed to high noise levels.

### ◦ ***Operation Phase***

After development of offsite infrastructure and economic zone, the noise levels may rise due to vehicular movement, DG set, pump sets, Boilers, mechanical and industrial operations, Auxiliary activities like operation of water pumps, booster pumps etc. Operations of ventilation units and fans can also add up to the noise generation. High noise levels are generally found in the textile process from fiber to fabric (spinning and weaving mill) and automated machines. From other type of industries proposed in the EZ the major source of noise generation is vehicular movement, machinery operation and use of DG in case of power failure. The following mitigation measures are suggested to mitigate the noise pollution during operation phase.

#### ***Mitigation Measures***

- Pumps should be fitted in close room, preferably acoustic enclosure to reduce the noise generation
- Green buffer should be developed all along the project boundary and buffer zone. This will help in reducing the noise level significantly.

- Noise regulators must put a strong mandate and fine on vehicle operators which are not properly maintained, produce noise (silencers not proper).
- All industries should obtain clearance from DoE before establishing industrial unit and should comply with all the conditions mentioned in the environment clearance
- All industries should install the new machinery of modern make which complies with the noise standards prescribed by DoE.
- Job rotations should be practiced for workers in working at noise intensive locations to prevent prolonged exposure to high noise level as it may lead to deafness, fatigue, headache, nausea and drowsiness. Proposed PPEs must be made compulsory for workers working at locations where the intensity of noise is high.
- Acoustic design with soundproof glass paneling will be provided for critical operator cabins / control rooms of individual modules as well as central control facilities.
- Proper greasing, periodic checkups for frictionless movements.
- Honking should be prohibited within the economic zone

## ***6.6. Impact on Water Environment***

### ***Pre-Construction and Construction Phase***

#### ***Impact on Water Availability***

Impacts on Ground & Surface Water Resources Significant quantity of water will be required for various construction activities & domestic purpose. As per the pre-feasibility study, for the initial demand it is planned to build three to four new bore wells within the proposed site to draw the ground water. Exact location of water intake (i.e., the locations of the tube wells) within the site needs to be finalized during the construction stage. Since the site is situated adjacent to Bay of Bengal on its Southern side, it is proposed to provide desalination plant adjacent to site to meet the water demand of EZ on a long-term basis. Excess withdrawal of ground water may lead to depletion of aquifers. Thus, measures should be taken to minimize the water extraction by reducing water consumption and wastage. Mitigation measures are given below.

#### ***Mitigation Measures***

- Water for curing can be saved by carrying out curing in early morning or late evening and covering structures with gunny bag so as the moisture can be restored for longer time.
- Regular inspections at site to monitor leakages in water storage tanks
- Temporary storm water drains and rainwater harvesting ponds should be constructed so as to store rainwater for construction activities.
- Creating awareness among construction workers about the importance of water conservation
- Storing the curing run-off and waste from other construction activity and using the same for sprinkling.
- Regular inspections at site to monitor leakages in water storage tanks.
- Covering the water storage tanks at site to prevent evaporation losses.
- Undertake Step-Test and Pump Test before abstracting groundwater (if ground water is withdrawn) to understand the sustainable rate of groundwater withdrawal. The rate of groundwater withdrawal shall not exceed the sustainable flow rate which have minimum impact on the groundwater table.
- Tapping should be made at a different aquifer from the aquifer from where the local people have tapped for water for drinking and domestic purposes.

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## ***Impact on Surface Water and Groundwater Quality***

A super dyke structure has been proposed all along the periphery of EZ to protect low-lying coastal areas from inundation of the sea. This structure will have significant impact on the tidal flow and generation of brackish water.

The major source of wastewater generation during construction phase is from the labor camp, which will be established for project construction activity. There is a potential for contamination of surface and groundwater resources resulting from improper management of sewage. The storage of used engine oil and lubricants as waste materials has a potential to create impacts if spillage occurs.

The quality of surrounding water bodies including the estuary, bay, River and creeks could also be affected due to surface runoff from contaminated soil (soil contamination due to oil/ fuel spillage and leakages), particularly during monsoon season. The surface runoff carrying the loose topsoil will lead to increased sedimentation in the receiving water bodies. Contamination to water bodies may also result due to oil spilling during construction activities and/or surface runoff from the construction site to the adjacent estuarine and marine system. Thus, measures are required to be taken to minimize the surface water pollution during construction phase.

### ***Mitigation Measures***

- Provision for channels at suitable location of embankment to allow the tidal flow (in and out) to some acceptable volume
- Provision should be kept by the contractor for effective spill management plan
- To avoid excavation activities during rains
- To prevent piling up of excavated soil, raw material and construction debris at site by proper management and disposal
- Minimize run-off by using sprays for curing
- Maintaining appropriate flow of water sprinklers at site
- Construction of storm water drains along with sedimentation tanks with sandbags as partition as barrier for direct flow of run off to river
- Collection & reusing of curing overflow, tyre wash water etc within the site
- Construction of adequate nos. of toilets and proper sanitation system for workers to prevent open defecation along the riverbanks/water supply lines
- Construction of soak pits/septic tanks to dispose-off the domestic wastewater generated from labour camps to prevent disposal of sewage in surface water bodies
- Proper collection, management and disposal of construction and municipal waste from site to prevent mixing of the waste in run-off and entering the water bodies
- It should be ensured that no debris/construction material should enter the waterbody in the area
- Labourers should be given training towards proactive use of designated areas/bins for waste disposal and encouraged for use of toilets.
- To prevent surface and ground water contamination by oil/grease, leak proof containers shall be used for storage (preferably in paved area) and transportation of oil/grease
- Spill/ leakage clearance plan to be adopted for immediate cleaning of spills and leakages

## ◦ **Operation Phase**

To cater the industrial water requirement water from Bay of Bengal after desalination will be used. The development of economic zone shall lead to the generation of process and domestic effluent. Liquid waste from the proposed industries will be having potentiality to affect the water quality. The direct discharge of the untreated process and domestic effluent waste will lead to impacts in the surface water quality. Also, it is anticipated that surface run-off may significantly increase post development of economic zone which may impact surface water quality. The nature of waste and effluent likely to be generated from various industries are discussed in the following section.

*Table 81: Waste Generation from various industries*

<b>Industry Type</b>	<b>Nature of Waste</b>
Textile & Textile Accessories	Dyeing units which are an integral part of textile units are the main source of process wastewater. The wastewater generally has high TDS, high BOD, COD and the color quotient of the water is also high.
Leather Products: Finished leather products	Finished leather products industries, though less polluting, also use chemical adhesives and tanning chemicals. Examples of some of these chemicals include Chlorinated phenols, tribromophenol, chlorinated paraffins, dimethylfumarate etc. which are used to preserve the materials. These chemicals are easily leaked into the environment through the discharge from the factories
Electronics Industry	Effluent from electronic/electrical industry, light machinery, auto mobile and accessories may contain heavy metals, paint residue etc.
Light Industry (motorcycle assembly, machinery parts and general assembly)	
Automobile Industry	Effluent contains suspended and total solids such as oil, grease, dyestuff, chromium, phosphate in washing products, coloring; significant number of dissolved organics, resulting in high BOD or COD loads
Pharmaceuticals	Effluents to contain high BOD and COD load.
Power and Energy	Combine cycle power plants are likely to generate warm water used for cooling.
Food and Agro Processing	Effluent likely to contain grease and oil resulting in BOD.

Beside effluents, domestic and cleaning waste likely to be generated from kitchens, canteens, toilets and also from the residential/administrative unit set-ups within the EZ for staffs shall contribute to the domestic wastewater.

The direct discharge of the untreated process and domestic effluent waste will lead to impacts in the surface water quality. Also, it is anticipated that surface run-off may significantly increase post development of economic zone which may impact surface water quality.

Following measures should be adopted during operation phase to minimize impacts of development of Economic zone on water quality:

### **Mitigation Measures**

- Each industry should obtain consent of DoE Bangladesh before construction and operation and should comply to the conditions laid by them
- The industry should also obtain the consent of the water abstraction limit from DoE, Bangladesh.

- No leachate, wastewater and waste material should be stored in pervious unlined area/pond.
- Effluent and sewage generated by each industry should be treated in Effluent Treatment Plant (ETP) and Sewage Treatment Plant (STP) respectively and no untreated effluent/sludge should be discharged into any water body.
- A water balance between the abstracted water and the water diverted for process purposes and domestic purpose shall be developed and based on the volume of the process and domestic waste, ETPs and STPs shall be designed.
- Baseline water quality assessment shall be done. Analysis of the process wastewater shall also be done and based on that (peak hours and maximum load concept basis) the ETP and STP shall be designed.
- The effluent treated process wastewater shall be analysed and the analysed parameter should be well below the Bangladesh Standard (ECR, 1997).
- Each industry should practice rainwater harvesting to minimize the water consumption and reduce run-off from the site
- Proper management of waste should be done to prevent any contact between the waste and storm water
- Storm water drains should be lined to separate from effluent drains
- Storm water system should be inspected & cleaned before monsoon every year
- The topsoil shall be preserved and used for covering the sand layer at EZ site. Vegetation turffing shall be made at the side slopes of the EZ areas to prevent erosion and siltation in the river.
- Surface water quality shall be monitored periodically
- Ground water quality shall be monitored periodically.
- Sludge should be dried into cakes and used as manure for green belt.
- The industries within the EZ shall comply with the “Zero Discharge” clause recently introduced by DoE, Bangladesh. Proper design and application methodology shall be determined before the industrial set-up
- Based on the site gradient, the drainage pattern has been decided. It has been planned to discharge the flow of the internal drain into nearby highway drain to be developed.
  - The drainage system is planned to cater for the entire EZ through gravity flow
  - Drains are proposed to be provided on both sides of the roads
  - Open trapezoidal drain is considered for the surface run off collection due to easy maintenance for the primary road. Stone pitching is considered for the side walls and PCC for the base
  - Covered rectangular brick masonry drain is considered for the remaining areas for optimization of area under drainage
  - RCC box / pipe culverts of suitable sizes are considered for road crossings
  - Rainwater harvesting structures are envisaged all along the drain at every 30 m interval

## ***6.7. Impact on Land Resource***

### ***○ Pre-construction and Construction Phase***

The average natural ground level for the proposed EZ is +6 m level. Some part site remains submerged in high tide. To avoid inundation during monsoon season, the land filling of 5 m above the existing natural ground level is considered. The finished ground level for the proposed EZ will be around +11 m from above Mean Sea Level. An average depth of 16 feet to 17 feet of land filling has been envisaged for the proposed EZ area. Moreover, to prevent tidal blow, an embankment (super dyke structure) has been proposed all along the periphery of the EZ site for both the blocks. It will hinder mixing of fresh and marine water that naturally occurs in the estuarine zones. The impacts on land due to the project are as follows:

- Dredging and landfilling activity

- 
- Removal of mangrove vegetation
  - Construction of super dyke and hindered mixing of fresh and marine water
  - Soil erosion due to vegetation clearance and excavation activities
  - Topsoil degradation
  - Generation of waste (hazardous and non-hazardous) from site clearance, excavations, civil works and activities of construction workers (general waste and sewage)
  - Possible contamination of soil due to potential spills of lubricating oil, fuel oil, concrete etc.
  - There could be alteration with the natural water flow pattern of the subject site due alteration of the natural contours. It may create problem pertaining to water logging, soil erosion, contamination of soil

### ***6.7.1. Soil Erosion***

During the pre-construction and construction phase, the site clearance activities including clearing of vegetation, construction of the structures, labor camps, storage area, toilets will involve removal of topsoil which will result in slope destabilization and the land will be more susceptible to soil erosion.

The soil erosion will result in the run-off of the silt to surface water affecting estuarine and marine ecosystem with increased suspended sediment load and associated nutrients.

Most importantly after landfilling, if the land is be kept for long without further development, it leads to soil erosion due to lose topsoil.

### ***6.7.2. Soil Compaction***

During construction activities, there will be compaction of soil in the project area due to construction of the internal access roads, movement of vehicles/ construction machinery and work force movement. The soil compaction would impact the soil physical properties such as reduction in pore spaces, water infiltration rate and soil strength etc. The extent of soil compaction is primarily limited to the Project footprint area and surroundings within 100 m distance. The impact is restricted to the construction phase of the project.

### ***6.7.3. Landfilling with dredged material***

The project site is located in low lying area and landfilling up to +11 m above mean sea level will be done during site development activity. About 71,287,978.9 cum filling material is required for landfilling. It is proposed that sand for the backfilling operations will be obtained by dredging from the Bay of Bengal. Dredging activity may be carried out near the site location or away from site. Dredging activity will have two-fold impacts - firstly as a result of the dredging process itself and secondly as a result of the landfilling of the dredged material. Impacts due to dredging are given in the separate section.

In case the soil quality at dumping site is different from the sediment from the dredging sites, the ultimate soil quality of the disposal site can be affected. The soil used for landfilling should be free of any type of contamination and have similar characteristics as that of native soil to avoid impacts on the soil quality.

### ***6.7.4. Waste Generation***

The construction waste generated onsite comprises of materials such as excavated soil, rocks, concrete, wooden pallets, steel cuttings/filings, packaging paper or plastic, wood, metals etc. Municipal domestic wastes consisting of food waste, plastic, glass, aluminum cans and wastepaper will also be generated by the construction workforce and labor camp site.

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The waste generated during the construction phase will also include hazardous waste such as used oil, hydraulic fluids, waste fuel, grease and waste oil containing rags. If improperly managed, solid waste could create impacts not only to land but also to local air quality, water quality, and human health. Since the site will be raised about more than 11 m above Mean Sea Level, it is likely that the surface run off from site surrounding area will be drawn to the nearby surface water system and marine water. From the drainage pattern it is observed that, in general the flow of the surrounding area will be towards the river/estuary, eventually to the sea. If the wastes and raw materials are poorly managed, it will also be carried away by surface run off which will ultimately contaminate the aquatic system.

### ***6.7.5. Soil Contamination***

Soil contamination during the construction phase may result from filling activity, leaks and spills of oil, lubricants, or fuel from heavy equipment and wastewater. Such spills could have a long-term impact on soil quality but are expected to be localized. Storm water run-off from the contaminated area can pollute the downstream soil and water quality of adjacent river, other waterbodies and sea.

Spill control measures such as the storage and handling of chemicals and fuel in concrete areas with secondary containment will be implemented to minimize impacts in the event of a spill.

The soil characteristics of the native soil may also be changed due to import of soil for filling and levelling purpose. It is envisaged that the filling activity may impact the native soil due to spillages during transportation of soil and run-off during filling and compaction.

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

#### ***Mitigation Measures***

- Stripping of topsoil should be scheduled as the last mile activity in order to prevent the erosion (wind and water) of soil.
- Topsoil should be preserved and should be reused in borrow area or green area development
- Care should be taken to minimize percolation of soil used for filling to adjacent rivers and sea during filling operations. Proper embankment should be provided in the downstream areas to minimize soil percolation to river/sea. Proposed super dyke structure will also help to resist soil erosion due to tidal influence.
- Provision for channels at suitable locations should be kept maintaining flow of marine water towards the riverine system
- Vegetation should be planned and maintained for slope stabilization and to prevent soil erosion after construction period.
- The disturbed areas and soil stockpiles should be maintained moist to avoid wind erosion of soil.
- The routes for movement of heavy machinery should be designated to avoid the soil compaction in other areas.
- Transport vehicles and equipment should undergo regular maintenance to avoid any oil leakages; designate routes for bringing construction material and outside soil.
- Construction contractor should designate the sites to be used for disposal of hazardous wastes including waste oils, solvents, paint and batteries. The Contractor should ensure that no unauthorized dumping of hazardous waste is undertaken from the site.
- Fuel and other hazardous substances should be stored in areas provided with roof, impervious flooring and bund/containment wall.



- For landfilling, dredging should be carried out considering the mitigation measure as referred in dredging section
- The soil used for landfilling should have similar characteristics to the native soil and free of any type of contamination.
- Prior to dredging activity, analyse the soil sample to prevent impacts on the receiving environment as a result of mismatch in soil characteristics.
- During dredging activity, physical barriers such as silt screen/ curtains should be employed to prevent the spread of suspended sediments.
- Maintain the extent of the turbidity plumes close to the dredging and disposal areas to minimise impacts on marine fauna habitat.
- Visually inspect for any marine life and terrestrial organisms and stop dredging activity in case of any organism in the vicinity.
- Monitoring should be done continuously during dredging to observe impacts on the marine life and in case of visible impacts, stop the dredging activity.
- Dredging should be carried out during daytime to minimize impacts on marine life.
- The storm water drainage system shall be designed in synchronization with the existing natural drainage pattern. The direction of the flow shall be engineered to be same as that of the natural flow direction of storm and rainwater.
- Post excavation, while achieving compaction, engineering designs shall be implemented to achieve the same level of compaction, which was before excavation. Cement, lime is few of the additives that can be added in recommended doses to strengthen the compaction ability of the soil.
- The construction debris and high silt content of the virgin soil, post excavation, should be kept in a designated location so as to prevent leaching during monsoons. Storm water drains shall be designed and shall be connected with rainwater harvesting pits. All the construction wastes, and excavated soil shall be temporarily stacked on tarpaulin sheet (in order to prevent leaching to groundwater) and a temporary tin sheet shall be placed on the top to prevent rainwater to maximum extent from carrying the soil and construction wastes to the adjacent aquatic system
- As a directive from Bangladesh Government and to demonstrate the commitment towards better environment, 14 % of total area has been designated for green and open spaces.
- Based on drainage pattern study it was seen that number of channels/distributaries/streams of Boro Feni River crisscrosses both the blocks of proposed EZ. The flow of Boro Feni River through these channels/distributaries/streams must be ensured so that it doesn't erode the adjacent area. Drainage study also envisaged need of peripheral embankment on all sides of the proposed site (both blocks) to safeguard the EZ area from flooding. At the same time, the flow of river should also be ensured

## ◦ **Operation Phase**

### **6.7.6. Impact on Soil Quality**

After development of economic zone, disposal of industrial domestic and process waste may contaminate land and soil quality of the area. The impact can be significant and long term in case of uncontrolled discharges. Improper disposal of waste (hazardous and non-hazardous waste) may degrade soil, water, air quality and ecology of the area. As per the preliminary planning, heavy machineries, Iron, and Steel, Ship Building & Ship Breaking, Petroleum Bottling plant, Textile & RMG, finished leather products, electrical/electronic, light machinery, automobile, cement industries are envisaged for this EZ. These industries are anticipated to be polluting to some severe extent and hence discharge of the generated sludge, effluent and solid waste shall be

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done in a structured manner. The nature of waste likely to be generated in the EZ are described in the subsequent section.

### ***Mitigation Measures***

- Provision shall be made for proper storage and disposal of industrial waste by respective industries.
- Provisions shall be made to segregate e-waste with rest of the wastes generated.
- Alliance shall be done with e-waste recycling vendor and the segregated e-waste shall be send to the vendor for recycling purposes
- A Common waste storage area shall be designated for industrial domestic waste.
- Domestic waste shall be kept away from industrial waste. Dried domestic waste could be used as manure.
- Waste should be segregated at source into hazardous and non-hazardous waste. Further, the waste should be segregated into recyclable and rejected waste. Recyclable waste should be sent to authorize vendors for recycling and rejected waste should be disposed off as per the norms specified by DoE for the particular waste.
- Industrial waste generated should be stored on sealed surfaces and should be disposed off as per the guidelines of DoE, Bangladesh.
- Local environmental bodies shall be consulted for the initiation for designing and constructing localized landfill for the disposal of process waste.
- No chemical/hazardous raw material should be allowed to spill over the land and should be operated in covered systems
- Excessive packaging should be reduced and recyclable products such as aluminum, glass, and high-density polyethylene (HDPE) are being used where applicable.
- Organic waste should be resold to value addition industries or can be fed to livestock.
- The use of advanced techniques to control specific portions of the manufacturing process to reduce waste and increase productivity may be explored.

## ***6.8. Impacts due to Super Dyke***

The proposed site is located in a location where tidal influence is prominent. The part of the site remains submerged during high tide due to the proximity of Bay of Bengal. Moreover, the proposed area is crisscrossed by many channels/distributaries/streams of Boro Feni River. Muhuri Dam is located on Boro Feni River at just about 1.2 Km upstream from the proposed site. From Muhuri Dam location, the river splits into several streams before finally meeting Bay of Bengal. 2 streams of the river flow through proposed EZ blocks as well. The Bay of Bengal forms the entire southern boundary of the site. In the project area, the natural mixing of saline water (from Bay of Bengal) and freshwater (from the River and other small creeks) create a brackish estuarine ecosystem. The area supports significant growth of various mangrove species as well. A super dyke structure has been proposed all along the periphery of EZ site (for both of the EZ Blocks) to protect the low-lying site from inundation by the sea and river. This structure will have a significant impact on the tidal flow and generation of brackish water. It may eventually cause a decline in the mangrove species population.

### ***Mitigation Measures***

Though the impact due to the structure is likely to be irreversible, the following measures must be taken as a compensatory act and an effort to negate the impact -

- Provision for channels at suitable location on embankment to allow the tidal flow (in and out) to some acceptable volume

- Plantation and its maintenance on the buffer zones as shown in the master plan
- Effort to plant mangrove species on the *Char* Land which is likely to be formed on the outer periphery of proposed super dyke

## **6.9. Impacts due to dredging**

The average natural ground level for the proposed EZ is +6 m level. To avoid inundation during monsoon season, the land filling of 5 m above the existing natural ground level is considered. The finished ground level for the proposed EZ will be around +11 m from above Mean Sea Level. An average depth of 16 feet to 17 feet of land filling has been envisaged for the proposed EZ area. It is envisaged that sand for the backfilling operations will be obtained by dredging from the Bay of Bengal/estuary. The possible physical impacts due to dredging are as follows:

- Resuspension of bottom sediments, thereby increasing turbidity
- Riverbank erosion
- Dispersion from and accumulation into bottom sediment of toxic substances
- Reduced primary productivity due to decrease in the depth of the euphotic zone
- Impact on habitat and breeding/spawning ground of fishes and other aquatic fauna due to bottom disturbances
- Temperature alteration
- Increase in nutrient levels
- If the dredged material is polluted, it may affect the ecosystem, and fisheries activities at both dredging and dumping locations

The extent of impacts due to dredging activity is highly varied and site specific, depending upon a number of factors shown below:

- Method of dredging and disposal
- Channel size and depth
- The size, density and quality of the material
- Background levels of water and sediment quality, suspended sediment and turbidity
- Current direction and speed
- Rate of mixing
- Presence and sensitivity of animal and plant communities (including birds, sensitive benthic communities, fish and shellfish)

### **Mitigation Measures**

- Prior to dredging activity, analyse the soil sample to prevent impacts on the receiving environment as a result of mismatch in soil characteristics.
- During dredging activity, physical barriers such as silt screen/ curtains should be employed to prevent the spread of suspended sediments.
- Maintain the extent of the turbidity plumes close to the dredging and disposal areas to minimise impacts on aquatic fauna habitat.
- Visually inspect for aquatic life and terrestrial organisms and stop dredging activity in case of any organism in the vicinity.

## 6.10. Impacts on Agriculture resources

The land for proposed Feno EZ site yet to be transferred to BEZA is privately owned and consist of ~36% of total area. As informed by the Upazila Agriculture Office and locals, the proposed site area is predominantly single cropped in nature (Amon Paddy). Addition to that, some farmers also grow lentils like *Khesari and Musur*. Therefore, not significant impact on agricultural resource is envisaged since the proposed site is not proposing acquisition of fertile land.

## 6.11. Impacts on Fisheries

Considering the pattern of drainage, number of khals/nala, Feni River in the area it looks that the ecosystem is supported by tidal influence and brackishwater was very much functioning. The edge of the khals/nalas still dominated by reeds densely and luckily the nalas are not yet brought under fish culture thus allowing population growth of many species of fish and aquatic invertebrates. During monsoon, water remain for 2-3 months (July-August-September) in the floodplain habitat within proposed project site area. About 25-30 percent area of this habitat is used rain fed T Aman paddy cultivation where water remains for few months and support small fishes as well. Common fishes of the floodplain habitat within proposed project site are Chewa (Chiring), small chingree, Tengra (Gulla). Apart from this in the semi closed waterbodies, these fishes are also available. Subsistence fishers and some commercial fishers also catch fish by cast net mainly from this area. It is estimated<sup>9</sup> that about 25 kg/ha of fish is being harvested from these shallowly inundated paddy fields. However, this is quite high in comparatively deeper areas, nala/khal and areas which are under strong tidal influence. It is reported by local community that about 500 subsistence fishermen catch fish from the proposed site every day during monsoon.

Once the EZ site is developed and Dyke is constructed, the movement of fish and aquatic invertebrates from estuary will be hindered. The populace dependent on fisheries for livelihood, will also be economically affected since their access to site will be restricted due to development of EZ.

### Mitigation Measures

- Fish pass/channels should be kept along the dyke at suitable locations to ensure fish migration
- It must be ensured that waste or wastewater/effluent not released in the waterbody, or such aquatic system are not contaminated due to surface runoff
- The river section travelling through the project area should have adequate set back clearance to allow monsoon water. Development activities should not be up to bank of river, river corridor should be kept open
- Alternate Livelihoods Options must be created for Fishermen who are likely to be economically affected

## 6.12. Impact on Ecosystem

The impact on the ecosystem may occur due to loss of habitat and threat to biodiversity. As a part of site preparation activity, backfilling will be done to reach ground level of +11 m above Mean Sea Level and vegetation cover including precious mangrove species will be cleared. Material for backfilling will be dredged from Bay of Bengal. A super dyke structure has also been proposed all along the periphery of EZ zone to protect low-lying coastal areas from inundation of the sea. As a result of these, following impacts on biodiversity is envisaged

- Dredging- Impact on habitat and breeding/spawning ground of fishes and other aquatic fauna due to bottom disturbances. Affect bottom dwellers; the Benthos are likely to be majorly affected. Possibility for loss of wildlife
- Site preparation- Vegetation cover including significant Mangrove cover will be lost from the area. The loss will be irreversible in nature. Various Avifauna, Herpetofauna, Pisces, Arthropods dependent with on the

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<sup>9</sup> Stakeholder consultation

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intertidal Char Land, Mangroves and other vegetation for various reason like shelter, basking, Hunting resting will be affected.

- Construction of Dyke- Almost in the entire project area, the natural mixing of saline water (from Bay of Bengal) and fresh water (from Boro Feni River, its' branches and other small creeks) creates a brackish estuarine ecosystem. The proposed dyke may act as a physical barrier and will have significant impact on the natural tidal flow. This will affect creation of brackish water which may eventually cause decline in mangrove population in the area. It will also hinder the movement of aquatic species specifically fishes which flows in and out in the freshwater stream during high tide and low tide respectively.
- Contamination- Accidental spillage, poor management of waste may contaminate the water, eventually affect aquatic life and ecosystem.

Once the site is developed on proposed land, which is currently being used as habitat by various species, will be lost. It is envisaged that, during operational period very limited diversity will be found in the EZ area if adequate mitigation measures are not taken. Poor waste-effluent-sewage management, mishandling of raw material, accidental spillage may contaminate the river as well as marine ecosystem. This kind of occurrence can threat wildlife of a vast area of the EZ surrounding. Also, the Muhuri Project (Irrigation Management Improvement Project-IMP) already has an impact on the habitat quality and morphology of Feni River, therefore, proper mitigation measure is essential.

### ***Mitigation Measures***

Following measures must be taken as a compensatory act and an effort to negate the impact on biodiversity-

- Provision for channels/fish pass at suitable location of Super Dyke Structure to allow the tidal flow (in and out) to some satisfactory volume and ensuring fish migration.
- Plantation on the buffer zones as shown in the master plan and monitoring of its survival
- Effort to plant mangrove species on the Char Land which is likely to be formed on the outer periphery of proposed super dyke
- Wildlife awareness program among the workers (during preconstruction, construction and operation phase) should be conducted. Workers should report sighting of any uncommon species to the environmental expert, who immediately should inform the incidence to local forest/wildlife authority/ conservationists
- Strict instruction to the workers must be passed on, so that they do not harm-catch-kill any wildlife or cut down trees for any reason
- Awareness program on wildlife conservation among local community should be conducted so that they can also feel the necessity for conservation of wildlife of the area
- It must be ensured that waste or wastewater/effluent not released in the waterbody, or such aquatic system are not contaminated due to surface runoff
- The river section travelling through the project area should have adequate set back clearance to allow monsoon water. Development activities should not be up to bank of river, river corridor should be kept open
- Emission, effluent and waste must comply to GoB standard norms
- Effort should be given to plant mangrove species on the Char Land which is likely to be formed on the outer periphery of proposed super dyke
- No waste shall be discharged in water bodies
- Accidental spill management plan should be developed
- No infrastructure development activities shall be encouraged close to the river/seashore line
- A half-yearly ecological assessment (preferably in winter and monsoon) during preconstruction, construction, operation phase should be conducted through specialists to record chronological trend of biodiversity in the project area surrounding.

- Muhuri Dam located just adjacent to proposed site is known as one of the IBA of Bangladesh. Hence, close monitoring of Avifaunal population would help to understand the change of population structure and develop necessary action plan accordingly.

### **6.13. Impacts on socio-economy**

The project proposes acquisition of privately owned land (consist of ~36% of total area) which is predominantly agricultural (Single Crop) in nature. However, the proposed site area does not have any inhabitant / homesteads. The site also does not have residential settlements, structures, CPRs, commercial and business outlets. A separate Social Impact Assessment (SIA) is being conducted. Impact on socio economy and mitigation measures due to impact on socio-economic condition shall be furnished in the Final EIA Report.

### **6.14. Impacts on Occupation Health and Safety**

The lack of adequate mitigation measures on the health and safety of the workers will result in accidents and injuries leading to loss of life or property. It is proposed to implement the following mitigation measures to ensure safe workplace for the construction labor as well as industrial workers. Individual industries should ensure safe workplace during industrial operation.

#### **Mitigation measures:**

- The EZ owner should ensure that the contractor (make part of contractor's contract) to have and occupational health and safety plan. The contractor should provide for all the workers accidental insurance and medical insurance.
- The contractor should conduct daily toolbox meeting for all workers to discuss potential work-related hazards and other safety aspects.
- The contractor should conduct training for all workers on safety and environmental hygiene at no cost to the employees.
- The contractor should maintain first aid facilities for the workers and will instruct and induct all workers in health and safety matters (induction course) including construction camp rules and site agents/foremen will follow up with toolbox talks on a weekly basis. Workforce training for all workers starting on site will include safety and environmental hygiene.
- Fencing on all areas of excavation greater than 1m deep and sides of temporary works should be observed.
- Workers should be provided with appropriate personnel safety equipment such as safety boots, helmets, gloves, protective clothes, dust mask, goggles, and ear protection at no cost to the workers.
- Reversing signals (visual and audible) should be installed on all construction vehicles and plant.
- Contractor should at all-time keep the first aid kit at the construction sites.
- Contractor should be responsible for evacuation injured person to the nearest medical center
- Pertinent H&S trainings should be provided to all the workers with respect to hazards linked to the activities. Additionally, the workers will be informed of precautions to be taken to avoid impacts to the local community.
- Monitoring of the PPE usage can be strengthened, in that, a mechanism can be adopted whereby defaulters receive a warning on non-usage and stringent actions can be taken on subsequent offences.
- Maintain H&S records of occupational H&S incidents, accidents, diseases and dangerous occurrences
- Ensure that PPE is available at all times at site.
- In event of accidents, the contractor will be responsible for immediate evacuation of injured person to the nearest medical center. The contractor should bear medical and other expenses of the injured person.

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- The contractors should ensure H&S standards of labour camps. The labour camps will be established in the proposed site area. Additionally, the Environmental Expert of EZ authority should conduct random spot checks to determine any issues related to improper waste disposal or the living conditions in these camps (i.e. presence of secure shelter and flooring, number of persons per room, number of toilets for the manpower, water availability etc.);
  - Strong protocols should be built as part of contractual obligations around zero tolerance of child labour or harassment of women workers and even health and safety aspects. These should also be monitored by supervision and monitoring team.
  - During operation phase, individual industries should ensure necessary mitigation measure to ensure safe workplace

### ***6.15. Sanitation and Disease Vectors***

Potential sanitation and impacts from disease need to be controlled by maintaining hygienic conditions in the EZ area throughout the operational phase as well during construction by implementing appropriate social and health programs for the Project. EZ authority should ensure that improvements are made to site sanitation and should implement the mitigation measure below for all operational activities and also that the contractor ensures it.

- Measures to prevent malaria should be implemented by installation of proper drainage to avoid water stagnation, etc.
- Standing water should not be allowed to accumulate in the drainage facilities or along the warehouse sides to prevent proliferation of mosquitoes.
- Temporary and permanent drainage facilities should be designed to facilitate the rapid removal of surface water from all areas and prevent the accumulation of surface water ponds.
- HIV/AIDS awareness and HIV-AIDS education and prevention program should be implemented.

### ***6.16. Construction of Buildings***

Buildings and structures shall be constructed based on the Building Code by BEZA. Apart from that, preliminary soil testing, Optimum Moisture Content, Optimum Density Content Analysis, Procter Test, Load Bearing Capacity testing must be done before initiating with the foundation and footings.

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# ***7. Public Consultation and Disclosure***

## ***7.1. Introduction***

This section provides the stakeholder identification and analysis as well as a brief understanding of the engagement process for the project. “Stakeholder” refers to those who have plausible stake in the environmental/social impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate. It is highly desirable for all key stakeholders to arrive at a consensus on sensitive features, impacts and remedial actions. Stakeholder identification was done by examining the potential impacts of the project in terms of:

- Who may be affected directly (project affected people);
- Which agencies might have responsibility for the impact management?
- Which other organizations might have an interest in monitoring proponent activities or have local knowledge to contribute; and?
- Which private/non-government sector entities might face financial and social hardships if the predicted impacts occur?

The stakeholders identified in the project comprise of project impacted people, project beneficiaries, various government officials etc.

## ***7.2. Objectives of Public Consultation & Disclosure***

The main objective of the consultation process is to minimize negative impacts of the project and to maximize the benefits from the project to the local populace. The objectives of public consultation as part of this project are:

- Promote public awareness and improve understanding of the potential impacts of proposed projects
- Identify alternative sites or designs, and mitigation measures
- Solicit the views of affected communities / individuals on environmental and social problems
- Improve environmental and social soundness
- Clarify values and trade-offs associated with the different alternatives
- Identify contentious local issues which might jeopardise the implementation of the project
- Establish transparent procedures for carrying out proposed works
- Inform the affected populace about the entitlement framework and to settle problems with mutual consent
- Create accountability and sense of local ownership during project implementation; and
- To obtain information on baseline environment



### 7.3. Approach and Methodology

Different techniques of consultation with stakeholders were used during project preparation, viz., in-depth interviews, public meetings, group discussions etc. to understand the socio-economic profile of the community, baseline environment, their concerns etc. In this regard, Focused Group Discussion (FGD) was conducted with different group at the study area. Various institutional stakeholders like Forest Department, Fishery Department, Department of Agriculture, Department of Livestock etc. were also consulted during the study for collection of baseline information various environmental components and to seek their suggestion about the proposed project.

### 7.4. Consultation and Disclosure Meeting

Types of consultations conducted with various participants using various tools including, interviews with government officials, focused group discussion etc. are presented in the table below.

Table 82: Type of Consultations

S. No	Type of Stakeholders	Key Participants
1	Institutional Stakeholders	<ul style="list-style-type: none"> <li>• Forest Department</li> <li>• Fishery Department</li> <li>• Department of Statistics</li> <li>• Upazila Agricultural Office</li> <li>• Upazila Livestock Office</li> </ul>
2	Community	<ul style="list-style-type: none"> <li>• Potentially affected fishermen, PAPs &amp; local residents</li> <li>• Local women</li> <li>• Local youths</li> </ul>

#### 7.4.1. Consultation with Institutional Stakeholders

##### Consulted Officials

Name of Person	Designation	Department	Date of Consultation
Mr. Irfan Ali	Range Forest Officer, Coastal Division, Mirsarai Range,	Department of Forest	02/05/2019
Babul Ch. Bhowmick	Special Officer In Charge, Feni Division		02/07/2019
Shamshul Islam	Beat Officer, Feni Division		02/07/2019
Md. Zakir Hussain	Upazila Statistical Officer,	Department of Statistics	01/07/2019
Md. Aminul Islam	Upazila Livestock Officer	Department of Livestock	01/07/2019
Mr. Turja Saha	Upazila Fisheries Officer	Department of Fishery	01/07/2019
Sajjad Hossein Majumdar	Upazila Agricultural Officer	Department of Agriculture	01/07/2019

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## **Salient points of Consultation**

### Department of Forest

- The project area (area covering 10 Km radius of proposed site) is located in a location where tidal influence is prominent. The part of the project area remains submerged during high tide due to the proximity of Bay of Bengal. Proposed EZ is located adjacent to the confluence point of Feni River and Bay of Bengal. The mixing of saline water from sea and fresh water of River in the confluence area generates a brackish water ecosystem.
- The project area supports significant growth of various mangrove species as well. The project area is located in Mangrove-Intertidal Zone. The char land, covering significant part of project area, has been chosen by the Forest Department for taking up plantation activity. The Kalo Bain (*Avicennia officinalis*), Sada Bain (*Avicennia marina*) and Keora (*Sonneratia apetala*) are the predominantly planted mangroves species found in the area. Gneoa (*Excoecaria agallocha*), a mangrove species grows here naturally. When the natural growth of Uri grass is observed on the Char, it implies the suitability of the land for taking up mangrove plantation.
- The project area is quite rich in terms of number of species (i.e. species richness) for being a part of estuarine ecosystem.
- Livelihood of many local fishermen is dependent on the ecosystem of the project area.
- Forest land is present in the Mouzas Bahir Char, Dakkhin Char Khandakar, Char Ram-Narayan and Char Elen
- There is no protected area or Ecologically Critical Area located within the project area

### Department of Fishery

Received information about fishery production potential in the region, habitat description of fishery resource.

### Department of Agriculture

Farmers practice agricultural activity in this region for 3 seasons, i.e. Rabi, Kharif I and Kharif II. Source of irrigation in this region are storm water and rainwater harvesting ponds, ground water, khals/canal etc. Major crops of the region are paddy, betel leaf, betel nut, potato, corn, turmeric, tea, peanut, mustard, patol (heap), brinjal, ginger, cucumber and other vegetables. The proposed site area is predominantly single cropped in nature (Amon Paddy). Addition to that, some farmers also grow lentils like Khesari and Musur.

### Department of Livestock

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 households raise poultry and livestock, a practice that significantly reduce the poverty by generating employment and income. The office of livestock informed that the newly formed Charland, which is also located within the study area, is used as common grazing ground. The nearby villagers have livestock like cows, buffalos, goats and sheep and poultries like Duck, Chicken. Obtained the statistical information about livestock, challenges etc.

### Department of Statistics

Received various statistical information about demographic pattern, social infrastructure etc.

*Figure 67: Consultation with Institutional Stakeholders*



*Consultation with Forest Department*



*Consultation with Department of Fisheries*



*Consultation at Upazila Livestock Office*



*Consultation with Upazila Agricultural officer*

### **7.4.2. Consultation with Community**

The Focused Group Discussions (FGD) were carried out with different group at the proposed EZ area on 30-06-2019 and 01/07/2019. PWC personnel discussed about the future developments and benefits to the community due to the development of the EZ. The FGD was carried out in presence of local farmers, potential PAPs, local elites and youth group. Locals from Char Chandia and Char Khondokar participated in the discussions. The details of the Focused Group Discussions are furnished below. The details of attendees have been attached in **Appendix F**.

#### **Date and Location:**

Meeting -1: Date on 30-06-2019 at Char Chandia with local elites

Meeting-2 & 3 : Date on 01-07-2019 at Char Khondoker with Land owner and Farmers group

#### **Outcome of Community Stakeholders' Consultation:**

Relevant Stakeholders	Issues Discussed	Outcome of Discussion
<b>Char Chandia</b>		
Local Elites, Land Owners (Titled EP), Farmer group	<ul style="list-style-type: none"> <li>• Hindrance to Navigation for fishing boats;</li> <li>• Loss of fishing place</li> <li>• Loss of Grazing field</li> <li>• Employment opportunity</li> <li>• Improved communication and social infrastructure</li> <li>• Skills training to enhance the competency</li> <li>• Priority for local manpower</li> <li>• Fair land price</li> <li>• Compensation for transferred land (particularly khas land)</li> </ul>	<ul style="list-style-type: none"> <li>• The stakeholders welcomed the project. They believe it will bring various economical opportunity to them. The local elites were concerned about the acquisition of the land on which, route of navigation from village to sea is being practiced. Some cases, small scale fishermen using the branches of boro Feni River following within the proposed EZ boundary. Their livelihood could be affected.</li> <li>• Currently small-scale fishermen are dependent on the submerged land for fishing activity where EZ site is proposed. It is envisaged that their livelihood will get affected due to acquisition of land for EZ Project.</li> <li>• Local people using the char land (where the EZ is proposed) as grazing for cattle. Acquisition of char land shall have impact on grazing activity.</li> <li>• At the same time, they also expect that the development of EZ will bring new opportunities to the community widely. The fore-mentioned communities will also be benefited in various ways and new livelihood opportunities will be created to them as well.</li> <li>• They are expecting that, as a foremost need for EZ development, the connectivity and mode of transport will be improved. The social infrastructure like schools, colleges, medical facilities will gradually be developed in the area.</li> <li>• They fear that the people in this region will not get job in EZ as they are neither technically skilled nor literate. The project authority should undertake skill development program in neighbouring areas. This will ascertain that the priority will be given to the local youths for various employment opportunities during development and operation stage of EZ.</li> <li>• The land owner group raised concern about getting fair land price from the project authority.</li> <li>• The leased land owner group raised concern about getting compensation for transferred land (khas land transferred by DC for 99 years to landless or famers) similarly like title-holders.</li> </ul>
<b>Char Khondokar</b>		
Local Elites, Land Owners, Farmer group; Youth Group	<ul style="list-style-type: none"> <li>• Livelihood options</li> <li>• Environmental Quality</li> <li>• Compensation for acquisition of land and assets</li> <li>• Loss of Grazing Land</li> <li>• Employment Opportunity</li> <li>• Improved communication and social infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Livelihood of the local populace predominantly dependent on agricultural practice though the area mostly supports one crop (Amon Rice) in a year (monsoon season) and agriculture is indispensably dependent on rainwater. Apart from Aman Rice, some farmers in the area produce small scale of <i>Khesari</i>. Due to proximity of sea, the salinity of soil is on higher range. Few are also dependent on grazing and most of the households raise poultry and livestock.</li> </ul>

Relevant Stakeholders	Issues Discussed	Outcome of Discussion
		<ul style="list-style-type: none"> <li>• The ground water available at 30 feet depth is high in salinity. However, water available at 80 feet is potable. Air quality is quite clean. The key environmental concern in the area is poor sanitary condition mostly due to open defecation and lack management of sewage. Indiscriminately discharged sewage contaminates nearby surface water bodies most of the time.</li> <li>• The landowner group raised concern about getting fair land price from the project authority. The leased landowner group raised concern about getting compensation for transferred land (khas land transferred by DC for 99 years to landless or farmers) similarly like titleholders.</li> <li>• Local people using the char land (where the EZ is proposed) as grazing for cattle. Acquisition of char land shall have impact on grazing activity. People in this area and outside are extremely dependent on the charland for grazing purpose. Alternative grazing site should be arranged in the nearby region.</li> <li>• At the same time, they also expect that the development of EZ will generate new livelihood opportunities to the community widely. The project authority should undertake skill development program in neighbouring areas. This will ascertain that the priority will be given to the local youths for various employment opportunities during development and operation stage of EZ. The elderly population who will be losing livelihood due to EZ development, alternative livelihood options like shops, food stalls may be created as at they would be too old to get trained and make themselves suitable for job in EZ.</li> <li>• They are expecting that, as a foremost need for EZ development, the connectivity and mode of transport will be improved. The social infrastructure like schools, colleges, medical facilities will gradually be developed in the area.</li> </ul>

*Figure 68: Consultation with Community*



**Consultation at Char Khondokar**



**Consultation at Char Chandia**

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# ***8. Environmental Management Plan and Monitoring Indicators***

## ***8.1. Introduction***

This section outlines the suggestive mitigation measures, monitoring and management responsibilities during the construction, and operational phases of the project.

The purpose of EMP is to:

- List all suggested mitigation measures and control technologies, safeguards identified on generic understanding of the impacts.
- Provide an institutional mechanism with well-defined roles and responsibilities for ensuring that measures identified in EIA designed to mitigate potentially adverse impacts, are implemented.
- Provide project monitoring program for effective implementation of the mitigation measures and ascertain efficacy of the environmental management and risk control systems in place; and
- Assist in ensuring compliance with all relevant legislations at local and national level for the Project.

The EMP will reduce adverse environmental impacts and help Economic Zone Authority in complying with environmental standards and regulations of the Department of Environment, Bangladesh.

## ***8.2. Mitigation Plan***

### ***8.2.1. Preconstruction Operations***

***Site filing operations:*** As mentioned earlier it is proposed to carry out landfilling with dredged material from Bay of Bengal/estuary. Necessary measures as discussed in impact assessment chapter should be followed to mitigate impact associated with dredging

### ***8.2.2. Construction Activity***

The following are the major construction activities:

- Construction of buildings
- Bore holes and pumping station
- Construction of power lines and substation
- Contrustion of Dyke all along the periphery of the EZ
- Associated infrastructure like water supply, road, sewerage, effluent management system etc.

The impacts associated with construction of road network, civil work, Dyke, boundary wall, building, water supply & sewage network along with proposed mitigation measures are given below. The Contractor shall ensure all mitigation and enhancement measures (including those related to mitigation of air/noise/water pollution; drainage/traffic congestion) as tabulated below.

*Table 83: Environmental Impacts and Mitigation Plan*

Impact	Mitigation Measures
<p><b>Setting up of construction camps/labour camps</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Location for stockyards for construction materials will be identified at least 1 km from water sources</li> <li>• The living accommodation and ancillary facilities for labour shall be erected and maintained to standards and scales approved by the resident engineer</li> <li>• All sites used for camps will be adequately drained. There should not be any risk of periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water</li> <li>• The camps will be located such that the drainage from and through the camps will not endanger any domestic or public water supply</li> <li>• All sites will be graded, ditched and rendered free from depressions such that water may get stagnant and become a nuisance</li> <li>• Construction camps shall be provided with sanitary latrines (1 per 25 pax), bathing facility and urinals.</li> <li>• Sanitary latrines shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings</li> <li>• Adequate and suitable facilities for washing clothes and utensils shall be provided and maintained for the use of contract labour employed therein.</li> <li>• Sewerage drains will be provided for the flow of used water outside the camp.</li> <li>• Drains and ditches will be treated with bleaching powder on a regular basis.</li> <li>• 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.</li> <li>• Clean potable drinking water facility should be provided at the site and the water quality should be monitored regularly</li> <li>• Crèche facility should be provided for children if female workers are employed</li> <li>• 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 sal volatile, snakebite lancet, bottle of potassium permanganate crystals, scissors, Ointment for burns &amp; surgical antiseptic solution</li> <li>• 1 first aid box should be available per 50 labours</li> <li>• A person trained in first-aid treatment should be made in charge who will always be readily available during emergency</li> <li>• A suitable motor transport shall be kept readily available to carry injured or ill person to the nearest hospital.</li> </ul>
<p><b>Landfilling and Dredging</b></p>	<ul style="list-style-type: none"> <li>• Residential facility or sensitive facilities like hospitals, schools etc. shall not be located in downwind direction of the identified sites for getting landfilling material.</li> <li>• The material used for landfilling should have similar characteristics to the native soil and free of any type of contamination.</li> </ul> <p>For dredging activity for landfilling purposes:</p> <ul style="list-style-type: none"> <li>• Dredging should not impact natural drainage courses</li> <li>• Dredging sites should be located away from sensitive locations</li> <li>• Permission from concerned local body should be taken before finalizing the location</li> <li>• Magnitude and frequency of dredging activity should be monitored to avoid impacts on the natural drainage</li> </ul>



Impact	Mitigation Measures
<b>Creation of Dyke</b>	<ul style="list-style-type: none"> <li>• Provision for channels at suitable location on embankment (Dyke) to allow the tidal flow (in and out) to some acceptable volume</li> <li>• Plantation and its maintenance on the buffer zones as shown in the master plan</li> <li>• Effort to plant mangrove species on the Char Land which is likely to be formed on the outer periphery of proposed dyke</li> </ul>
<b>Soil Erosion and Sedimentation control</b>	<ul style="list-style-type: none"> <li>• Contractor should plan the activities so that no naked / loose earth surface is left out before the onset of monsoon.</li> <li>• Topsoil along the roadside should be stripped and kept under covered shed for plantation</li> <li>• After the construction activity is over, topsoil will be utilized for landscaping activity.</li> <li>• To avoid soil compaction along the transportation routes, only identified haul roads would be used for transportation.</li> <li>• Turfing of low embankments and plantation of grasses and shrubs should be done in slope stabilization.</li> <li>• Soil erosion checking measures as the formation of sediment basins, slope drains, etc., should be carried out.</li> </ul>
<b>Disposal of Debris and any waste generated</b>	<ul style="list-style-type: none"> <li>• Waste from construction camp should be segregated at site. Food/wet waste should be composted in pit at the site, recyclable should be sent to recyclers if any and rejected waste should be disposed regularly through responsible agency in the area</li> <li>• Dustbins should be provided at the site and construction camps to prevent littering of waste</li> <li>• Storage area of minimum 2 days should be provided at construction camp for storage of the waste generated from labour camps</li> <li>• Construction debris should also be segregated at the site. This debris should be used for filling to the extent possible. Recyclable waste should be sold in the local markets and reject waste should be sent to the identified debris disposal site</li> <li>• All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary will be considered incidental.</li> <li>• Construction debris should be stored under covered sheds on paved surfaces to prevent leaching</li> <li>• Utmost care shall be taken to ensure safe collection, transport and disposal of construction waste and debris.</li> </ul>
<b>Dust Generation &amp; Air Emission</b>	<ul style="list-style-type: none"> <li>• Vehicles delivering materials should be covered with tarpaulin to reduce spills and dust blowing off the load.</li> <li>• Compaction of prepared site to re-strain the fugitive emissions.</li> <li>• Water should be sprayed in the cement and earth mixing sites as well as after compaction.</li> <li>• In high dust areas, workers should be provided and encouraged to use masks.</li> <li>• Regular maintenance, servicing of the vehicles and periodic emission check for equipment and machinery would be carried out in conformity with Schedule 6 – ‘Standards for Emission from Motor’ of The Environment Conservation Rules 1997 (Amended 2002);</li> <li>• Water will be sprayed on the haul road.</li> <li>• All the vehicles entering the project site will be checked for Pollution-Under-Control Certificates.</li> <li>• Air quality monitoring to be carried out during construction phase to check the pollutants level in the air</li> </ul>
<b>Procurement &amp; setting up of Crushers, Hot-mix plants, other Vehicles, Equipment and Machinery</b>	<ul style="list-style-type: none"> <li>• Specifications of crushers, hot mix plants and batching plants, other Construction Vehicles, Equipment and Machinery to be procured should comply to the DoE Standards/ norms</li> <li>• Residential facility or sensitive facilities like hospitals, schools etc. shall not be located in downwind direction of the identified plant site</li> <li>• Adequate stack height and emission control devices such as bag house filters, cyclone separators, water scrubbers etc., should be attached</li> <li>• Impervious platform for storage of bituminous and other liquid hazardous chemical</li> </ul>

Impact	Mitigation Measures
	<ul style="list-style-type: none"> <li>• Pollution control measures for Diesel Generator (DG) set i.e. stack height, acoustic enclosure etc.</li> <li>• Provision of readily available first aid kit, firefighting equipments at the plant site at appropriate location to respond in case of accident.</li> <li>• Periodical monitoring of air quality and noise levels as per conditions stipulated under the statutory clearance from DoE. Whenever the emission exceeds the permissible level, the plants should be stopped, and necessary repairing works of faults should be done to bring down the emission levels</li> </ul>
<b>Contamination of soil</b>	<ul style="list-style-type: none"> <li>• Impervious platform and oil and grease trap for collection of spillages from construction equipment vehicle maintenance platform will be appropriately provided at construction camp, servicing area and liquid fuel and lubes at storage areas.</li> <li>• Proper management of waste from labour camps and construction site</li> <li>• Proper disposal of wastewater generated from labour camp and construction site</li> </ul>
<b>Contamination of surface &amp; ground water</b>	<ul style="list-style-type: none"> <li>• Car washing / workshops near water bodies will be avoided.</li> <li>• Avoid excavation during monsoon season</li> <li>• Loosened soil will be stabilized by Contractor through landscaping and developing vegetation, wherever possible, once construction activity is completed at any site.</li> <li>• Sanitation facility with septic tank followed by soak pit will be developed. Common toilets will be constructed on site during construction phase and the wastewater would be channelized to the septic tanks and soak pits in order to prevent wastewater to enter into the water bodies.</li> <li>• Provision of oil &amp; grease traps upstream of storm water drains</li> <li>• Surface run off due to construction activity will not be discharged in open without treatment.</li> </ul>
<b>Loss of water bodies/ surface / ground</b>	<ul style="list-style-type: none"> <li>• No excavation should be carried out from the bund of the water bodies.</li> <li>• No debris disposal should take place near any water body.</li> <li>• Prior written permission from authorities is required for use of water for construction activity.</li> <li>• Construction labours to be restricted from polluting the source or misusing the source.</li> <li>• Labour camps will be located away from water bodies.</li> </ul>
<b>Drainage and runoff</b>	<ul style="list-style-type: none"> <li>• The Contractor will always clear all the cross-drainage structures and natural drainage before onset of monsoon in order to keep all drainage unblocked Earth, stones, wastes and spoils will be properly disposed off, to avoid blockage of any drainage channel.</li> <li>• All necessary precautions will be taken to construct temporary or permanent devices to prevent inundation or ponding.</li> </ul>
<b>Noise from Vehicles, Plants and Equipment</b>	<ul style="list-style-type: none"> <li>• Construction activities would be carried out in the daytime only.</li> <li>• The construction equipment would be provided with adequate noise control measures and should comply with the noise standards as prescribed by DoE</li> <li>• Regular maintenance of vehicles and equipment would be carried out and corrective action taken in case of any deviation.</li> <li>• Earmuff/ear plug shall be given to the workers working around or operating plant and machinery emitting high noise levels.</li> <li>• DG sets if installed should be provided with acoustic enclosures</li> <li>• Labour working in noise prone area should be provided with ear plugs and job rotation should be practiced preventing the prolonged exposure of any workers to high noise levels</li> </ul>
<b>Loss or damage to vegetation</b> <b>Loss, damage or disruption to fauna</b>	<ul style="list-style-type: none"> <li>• Plantation on the buffer zones as shown in the master plan and monitoring of its survival</li> <li>• Effort to plant mangrove species on the Char Land which is likely to be formed on the outer periphery of proposed super dyke</li> <li>• Wildlife awareness program among the workers (during preconstruction, construction and operation phase) should be conducted. Workers should report sighting of any uncommon</li> </ul>

Impact	Mitigation Measures
	<p>species to the environmental expert, who immediately should inform the incidence to local forest/wildlife authority/ conservationists</p> <ul style="list-style-type: none"> <li>• Strict instruction to the workers must be passed on, so that they do not harm-catch-kill any wildlife or cut down trees for any reason</li> <li>• Awareness program on wildlife conservation among local community should be conducted so that they can also feel the necessity for conservation of wildlife of the area</li> <li>• No waste shall be discharged in water bodies</li> <li>• Accidental spill management plan should be developed</li> <li>• No infrastructure development activities shall be encouraged close to the river/seashore line</li> <li>• A half-yearly ecological assessment (preferably in winter and monsoon) should be conducted through specialists to record chronological trend of biodiversity in the project area surrounding</li> </ul>
<b>Accidents</b>	<ul style="list-style-type: none"> <li>• Safety officer should be appointed at site to ensure all the safety guidelines are being followed at site</li> <li>• Cautionary guidance should be provided at site to aware people about the associated risk with the area. Entry to the fuel storage room or machinery operation room should be restricted only to authorized trainer personnel</li> <li>• All Accidents shall be reported immediately and incident analysis, preventive measures shall be implemented.</li> </ul>
<b>Clearing of Construction of Camps &amp; Restoration</b>	<ul style="list-style-type: none"> <li>• Contractors shall prepare site restoration plans. The plans shall be implemented prior to demobilization.</li> <li>• On completion of works, all temporary structures shall be cleared, all rubbish burnt, excreta or other disposal pits or trenches filled in and sealed and the site left clean and tidy.</li> </ul>
<b>Occupational Health &amp; Safety Plan</b>	<ul style="list-style-type: none"> <li>• All construction workers should wear PPEs including safety jacket, helmet, gloves, gum boots, ear plugs, mask while working at the site</li> <li>• Workers should be made aware about the health issues related with open defecation</li> <li>• Training to workers should be provided for handling the construction equipment and machinery</li> <li>• Training to the workers should be provided to handle the emergency situations like fire, floods etc.</li> <li>• First aid facility and sufficient nos. of trained personnel should be available at all the time at construction camp</li> <li>• Cautionary signage and notice should be displayed in local language and English at the required places like fuel storage area so that hazards can be avoided. A security guard should be deputed in these areas and entry should be restricted</li> <li>• A register of all toxic chemicals delivered to the site shall be kept and maintained up to date. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.</li> </ul>
<b>Disaster Management</b>	<p>Precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during work.</p>

### ***8.2.3. Mitigation Plan Suggested to Individual Industries***

Individual Industries should obtain environment clearance individually from DoE prior to establishment and commencement as per the applicability.

Measures that should be taken by individual industry owners during development and operation phase of respective industries are tabulated in table below.

*Table 84: Mitigation Measures Suggested for Individual Industries*

Impact	Mitigation Measures During Development (Construction) Phase	Mitigation Measures During Operation Phase
Air Pollution	<ul style="list-style-type: none"> <li>• Sprinkling of water during construction phase on all unpaved roads, site and haul roads</li> <li>• Avoiding excess piling of raw material and debris at site</li> <li>• Storage &amp; transportation of raw material and debris in covered conditions</li> <li>• Regular cleaning of site</li> <li>• Provision of adequate parking space at site so as to prevent idling of vehicles during construction phase</li> <li>• Up keeping and maintenance of all the construction vehicles, machinery and equipment used for construction purpose</li> <li>• Guiding signage should be provided at the site for vehicles entering the site to minimize the movement of vehicle within the site</li> <li>• Timings of the construction material vehicles should be fixed and should be during non-peak hours to prevent traffic congestion and traffic jams</li> <li>• Construction vehicles should follow the speed limits as set up for EZ zone</li> <li>• Usage of low energy intensive building material like fly ash mix cement and bricks</li> <li>• Usage of low Sulphur diesel for running DG sets, construction vehicles and equipments</li> <li>• Open burning of wood or any other material should be prohibited at site and all the workers should be made aware about the same</li> </ul>	<ul style="list-style-type: none"> <li>• Installation of air pollution control devices like Electro-static precipitator, bag filters, separators, cyclones, multi-level condensers &amp; evaporators, scrubbers, quenchers, stacks of height as per DoE norms</li> <li>• Disposal of the waste material at the designated site for waste disposal in covered condition</li> <li>• All the roads within the plot should be paved &amp; water sprinkling should be practiced minimizing dust generation.</li> <li>• Adequate stack height should be provided for dispersion of the emissions</li> <li>• Chemicals having potential to release VOCs should be stored, handled and used in closed system</li> <li>• Quarterly monitoring should be carried out for testing ambient air quality</li> <li>• Development of thick green belt of 10 m width all along the industrial plot periphery</li> </ul>
Water Pollution & water Conservation	<ul style="list-style-type: none"> <li>• Minimizing the run-off from the site by construction of temporary storm water drainage, sediment basins for collection of storm run-off and re-using that water for curing purpose and wheel washing</li> <li>• Curing of structures to be done by spraying and during early morning and evening hours only to minimize the water requirement</li> <li>• Maintaining the flow of water sprinklers so as to avoid wastage of water and ponding of water</li> <li>• No debris should be thrown or disposed off in any water body like river, pond, canal etc. or ground water source like functional or abandoned well</li> <li>• Excavation should not be carried out during monsoon</li> </ul>	<ul style="list-style-type: none"> <li>• Separation of the effluent streams depending on the nature of pollutants and connecting it to EZ's sewage/effluent network</li> <li>• Monitoring the quality of sewage, treated water, drinking water quality and ground water quality regularly</li> <li>• Tank alarms should be installed so as to prevent idle running of pumps</li> <li>• Provision of storm water drainage system at site and it should be connected to rainwater harvesting system. Storm water drains should also be connected to storm water drainage of EZ</li> <li>• Provision of rainwater harvesting system so that water can be collected and used to meet daily water demand.</li> <li>• Provision of oil &amp; grease traps with the storm water drains draining the parking and fuel storage area</li> </ul>

Impact	Mitigation Measures During Development (Construction) Phase	Mitigation Measures During Operation Phase
	<ul style="list-style-type: none"> <li>Excavated pits should be provided with garland drains to prevent entrance of water inside the pit</li> <li>Provision of septic tanks and soak pits at the site for disposal of sewage generated by construction labour</li> <li>Waste generated during construction should be disposed off regularly at the identified site for debris disposal</li> </ul>	<ul style="list-style-type: none"> <li>Leakage detection system should be provided, and the water supply system should be regularly inspected to detect leakages</li> <li>Untreated effluent should not be discharged in open areas</li> <li>No hazardous waste, municipal waste, industrial waste should be disposed off in the water bodies or in ground</li> <li>Leachates, if any or untreated sewage should be stored only in lined ponds to prevent contamination of ground water</li> </ul>
Soil Quality	<ul style="list-style-type: none"> <li>Topsoil, if excavated from the project site should be stored in covered condition and should be used later for landscaping purpose</li> <li>Storage of raw materials, debris, and fuel on paved surfaces</li> <li>Training the workers to handle the material to minimize spillage of material on soil</li> <li>Disposal of construction debris, municipal waste, and hazardous waste at designated sites</li> </ul>	<ul style="list-style-type: none"> <li>All industries should use best technologies for optimal utilization of the raw material and re-use &amp; recycling of waste material in the process to reduce waste generation as well as raw material demand for the project.</li> <li>All industries should be responsible for management of the solid and hazardous waste generated from their plots. Industries should be liable to pay penalty in case of noncompliance of conditions laid down by DoE</li> <li>It should be mandatory for all industries to provide storages for different category waste, its processing and safe disposal. Options for composting of compostable waste, segregation and selling recyclable waste should be opted</li> <li>Waste storage area should be paved surfaces and covered</li> <li>No open area should be left without the vegetation to protect the soil.</li> <li>Hazardous Waste should be stored in designated area and should be disposed as per the best industrial practice.</li> </ul>
Noise Pollution	<ul style="list-style-type: none"> <li>Construction vehicles, machinery and equipment used for construction purpose should meet the standards prescribed by DoE</li> <li>Up keeping and regular maintenance of all the construction vehicles, machinery and equipment used for construction purpose</li> <li>Speed limits should be restricted for all construction vehicles and equipment</li> <li>Honking should be prohibited at the site</li> <li>Provision of acoustic enclosures, noise mufflers, silencers etc. with the DG sets and any noise generating machinery</li> <li>Provision of temporary noise shield/barrier in areas where more noise will be generated</li> </ul>	<ul style="list-style-type: none"> <li>Usage of machineries of modern make and adoption of latest available technology which complies to noise levels standards laid by DoE</li> <li>Provision of personal protective equipment to workers exposed to noisy operations. Audiometric tests should be carried out for workers exposed to high noise levels. Job rotation should be practiced preventing continual exposure.</li> <li>Noise levels in industries should be monitored regularly using noise meters.</li> <li>Minimal usage of horns within industrial plot.</li> <li>Regular maintenance of vehicles &amp; construction machinery involved in industrial operation</li> <li>Noisy operation should be taken up in covered conditions so that no disturbance due to noise is caused</li> <li>Thick green belt should be developed within each industrial plot that will act as noise barrier.</li> </ul>
Ecology	<ul style="list-style-type: none"> <li>Plantation should be carried out within individual industrial plots</li> <li>Native plant species should be considered for plantation</li> </ul>	<ul style="list-style-type: none"> <li>Green belt of 10 m thickness should be developed all along the periphery of the industrial plot</li> </ul>

Impact	Mitigation Measures During Development (Construction) Phase	Mitigation Measures During Operation Phase
	<ul style="list-style-type: none"> <li>• Timber should be purchased only from authorized vendors</li> </ul>	<ul style="list-style-type: none"> <li>• Native plant species requiring should be considered for plantation</li> </ul>
Socio-economy and aesthetics	<ul style="list-style-type: none"> <li>• All proposed air, water, noise and soil pollution control measures should be taken</li> <li>• Provision of employment opportunity during construction phase to local people</li> <li>• Provision of personal protective equipment to all the workers</li> <li>• Job rotation should be practiced for workers exposed to high noise levels</li> <li>• Site should be covered from all the site during construction phase</li> <li>• Drinking water facility, adequate nos. of toilet, septic tank/soak pit, bathing facility, lighting should be provided for construction labour</li> <li>• Storm water drainage system should also be provided at site to prevent water ponding and breeding of mosquitoes</li> </ul>	<ul style="list-style-type: none"> <li>• Social welfare activities shall be carried out by each industrial owners in nearby areas of EZ like development of cattle sheds, arranging trainings for villagers for best agriculture practices, providing skill generation training to locals so as they can be employed in industries</li> <li>• Providing employment to local people preferably</li> <li>• Adoption of adequate air, noise, soil and water quality measures</li> </ul>
Disaster and Risk Management	<ul style="list-style-type: none"> <li>• Provision of first aid kit and first aid room and well trained first aid practitioner at the site all the time</li> <li>• Ambulance facility should be provided at the site</li> <li>• Tie-ups with local hospital should be made to handling emergency case, if any</li> <li>• Availability of safety officers and supervisors at all the time on the site</li> <li>• Workers should be given training for handling construction vehicles, equipment and handling emergency situations like fire, floods, earthquake and cyclone</li> <li>• Cautionary signage should be provided in the areas associated with risks like storage of explosives, fuels, heavy construction material etc. Entry for only trained authorized personnel should be allowed in such areas with adequate safety measures</li> <li>• Emergency handling cell &amp; room should be developed at the site and should be headed by project &amp; safety manager</li> <li>• Contact no. of nearest fire-station and hospitals should be displayed within the emergency handling room</li> </ul>	<ul style="list-style-type: none"> <li>• Provision of first aid kits at the site</li> <li>• Tie-ups with local hospital should be made to handling emergency case, if any</li> <li>• Regular medical check-ups of the employees</li> <li>• Training should be given to workers for handling the equipment and managing emergency situations</li> <li>• Material safety data sheets of chemicals to be used should be displayed on local languages at workstation</li> <li>• Provision of personal protective equipment to the workers as per requirement</li> <li>• Cautionary signage should be provided in the areas associated with risks like storage of chemicals, explosives, fuels etc. Entry for only trained authorized personnel should be allowed in such areas with adequate safety measures</li> </ul>

### 8.3. Enhancement Plan

The proposed project involves development of Feni EZ and ancilliary facilities for the upcoming EZ. Development of the EZ will attract the investors and make the proposed site location more accessible for trading and business. Proximity of the proposed project site to the Chittagong Dhaka Highway and an already existing inland water transportation system further adds to the suitability of site for setting up the industries. As enhancement plan, it is proposed that EZ authority should develop green belt all around the EZ site, proper storm water drainage to

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prevent flooding and rainwater harvesting system to harvest rainwater and use it to meet daily water demand and reduce pressure on ground/surface water resources.

### ***8.3.1. Greenbelt Development***

Development of a greenbelt will be strictly mandatory and green coverings along the internal roads and open areas will be beneficial. Provision for approximately 2013 acres (815 ha.) of area (21 % of total EZ area) within proposed EZ has been kept for developing Green & Open area. The tree plantation will have the following objectives:

- restoration of green cover in the project area
- restoration/preservation of genetic diversity
- prevention from dust
- attenuation of noise pollution from EZ to surroundings
- creation of aesthetic environment

At least three rows of trees may be planted along the boundary. Later, new trees can be planted to make up the gaps devoid of trees. The selection of trees and plants for greenbelt/tree plantation should be those which could grow in the existing agro climatic conditions. They should be able to survive in the local soil conditions. Based on the above considerations, the plant species should be native in nature. The selected plant species would need minimum level of maintenance including fertilisation and other soil amelioration.

Apart from trees, the shrubs and other herbaceous species may also be planted in between the trees along the boundary wall and other suitable areas. This will act as green cover, prevent soil erosion by increasing the binding capacity of the soil, and importantly act as noise barrier together with trees.

### ***8.3.2. Process wastewater***

Based on estimated quantity of sewage and effluent, Sewage Treatment Plant (STP) – two STPs are proposed for the entire BSMSN area of capacity 45 MLD and 80 MLD. In 2040, the Feni portion of the BSMSN area is estimated to generate 43.28 MLD of sewage. Four sets of ETPs are proposed for the BSMSN area of 16, 32, 150 and 370 MLD respectively. In 2040, Feni portion of the BSMSN area is likely to generate 39.02 MLD of effluent. It is proposed that treated effluent from industrial units and sewage from industrial units and other facilities shall be directed to ETPs and STPs. Post treatment from the ETPs and STPs, the effluent water shall be analysed and compared as per the regulatory standards of ECR, 1997. Each industry should treat the effluent and sewage generated by them to achieve zero discharge and no untreated effluent should be discharged into any water body. Sludge generated from STP shall be dried using a filter-press and the dried sludge could be used as manure.

### ***8.3.3. Drainage and Rainwater Harvesting***

Based on the site gradient, the drainage pattern has been decided. It has been planned to discharge the flow of the internal drain into nearby highway drain to be developed.

- All the existing drainage channels, passing through BSMSN are connected to the sea and have got strong tidal influence. To prevent ingress of sea water to the drainage channels during high tide condition, at all the existing outlet positions sluice gates are to be installed. Consequently, gravity discharge of storm water to the sea will not be possible during the time of closure of the gates owing to high tide condition. Under such situation the only left out option will be to pump out the storm runoff generated to the sea.

- To encourage ground water recharging and to attenuate the flow rate through the drainage channels, several water bodies are going to be established for the entire BSMSN. This, in addition, will have the advantage of storage of water to meet fire demand, in case of exigency.
- Covered rectangular brick masonry drain is considered for the remaining areas for optimization of area under drainage.
- RCC box / pipe culverts of suitable sizes are considered for road crossings.
- A rainwater harvesting system designed to capture roof run off from a minimum of 200m<sup>2</sup> (or 50% of the available roof catchment area for roof areas less than 400m<sup>2</sup>) during regular rainfall events must be incorporated into each building. The collected rainwater shall be plumbed to supply aseasonally independent water use. IE. Toilet flushing and landscaping etc.

### ***8.3.4. Renewable Energy Generation***

To minimize the dependency on non-renewable sources of energy, Economic Zone Authority will take initiative and take a step towards green energy. A Renewable Power Plant is envisaged within the BSMSN area.

### ***8.3.5. Community development plan***

It is recommended the EZ owners/developers to involve the local community during the project development. The EZ authority/its contractors/industrial units may recruit local workforce to the extent possible during construction and operation phase. The authority would identify technically qualified unemployed youth around the project location and other nearby areas and employ as far as practical. The EZ authority should form a forum/ association/ trust along with its industrial units to look after community development activities of EZ. All the industrial units should periodically contribute to this Trust. The Trust would represent EZ and its industries for all matters related to community and its development. This would act as interface between EZ and community. The Trust should encourage its industrial units to recruit local unemployed youth in the jobs during operational phase. For this if required arrange training for the local people to develop skilled manpower required if sufficient skilled manpower is not available to carry out technical work in the industrial units during operational phase.

The Trust will organise a community advisory group involving local representatives, representatives from EZ industries; that would help them in finding ways to participate with its neighbours in addressing socio-economic concerns. With the advice of its community advisory panel, local officials, and other key individuals and groups, the Trust along with its constituent industries may sponsor appropriate programs and projects to benefit its community.

Some specific community development programs that could be considered by the Trust in the locality are suggested here:

- Importance of wildlife and necessity for its Protection
- Conducting awareness programs in surrounding villages on health impacts due to environmental pollution (air, noise, water, solid waste, etc.), and precautions to be taken to minimise health impacts.
- Conducting periodic health check-ups to the EZ (including industries) staff and in the surrounding villages to identify pollution related diseases.
- Encouragement to residents in the nearby localities for self-employment ventures, such as by assisting them in arranging micro finances to develop them as artisans/ skilled personnel.
- Periodic training programs on health and sanitary education, women and child development, and income generation schemes.



- Participation in improving the existing medical and educational facilities of the area - for this purpose, it is suggested that the Trust provide funds for facilities improvement (providing toilets, furniture, additional space creation, any other needed) to the local hospitals and schools
- Development of greenbelt/greenery or tree plantation in the nearby vacant government lands to build a green and clean environment in the surrounding areas and to reduce pollution impacts to some extent.
- Sponsoring fellowships to students in surrounding villages to encourage them to go for higher education
- Conduct or sponsor camps to clean upriver ghats, jetties and terminals in the surrounding areas.

## ***8.4. Contingency Plan (Emergency Preparedness Plan)***

In order to be in a state of readiness to face adverse effects of accidents, an emergency preparedness plan is required to be prepared which includes on-site and off-site emergency plan by the individual industry and industrial estate. Economic Zone Authority will be committed to develop an emergency preparedness plan in consultation with district authorities and industry association.

The Emergency Preparedness Plan will have the following minimal components but not limited to:

- Accident's preventions procedures/ measures
- Fire prevention planning and measures
- Fire water storage and foam system
- Accident/emergency response planning procedure
- Grievance redress mechanism
- Emergency control centre
- Emergency information system with role & responsibility and command structure
- Recovery procedure
- Assessment of damages and rectification
- Evaluation of functioning of disaster management plan
- Accident investigation
- Clean-up and restoration

## ***8.5. Institutional Arrangement***

BEZA has developed Environmental Social Management Framework (ESMF<sup>10</sup>) with the help of World Bank. The institutional arrangement of EZ shall be aligned as per this framework. Proposed EZ will have an Environmental and social cell which will coordinate with site engineers and Project Monitoring Consultant (PMC).

### **Overall Project Implementation Arrangements**

The overall management of the project will be carried out by EZ which is the project implementing unit (PIU).

### **Institutional Set Up for Environment Management**

The institutional arrangements for the implementation of various aspects of ESMF and environment management of the proposed project envisaged to be implemented as part of the Private Sector Development and Support Project (PSDSP) comprise the following.

- Project Environment Cell (PEC) at PIU to ensure adequate integration of environment management measures in the design phase and supervise implementation of ESMF and specific requirements of EMP

<sup>10</sup> <http://www.beza.gov.bd/wp-content/uploads/2015/10/ESMF-of-BEZA.pdf>

- Environment Management Unit (EMU) at EZ to implement EMP and other regulatory requirements during construction & operation phase of EZ.

#### **Project Environment Management Cell (PEC) at PIU**

The Project Implementation Unit (PIU) will establish a Project Environmental Cell (PEC) headed by a ‘Manager – Environment’ and supported by environmental engineers. The PEC will function to:

- Supervise implementation of ESMF throughout project implementation period.
- Ensure integration of the EA and the EMP measures into the sub-project design and implementation plans such as contract documents, maintenance contracts, tenant lease agreements, etc.
- Supervise the implementation of the mitigation measures by the Master developers / Contractors.
- Assist the engineering staff and other PIU staff in addressing environmental issues during planning, design and implementation of the sub-projects.
- Prepare periodic progress reports on the implementation of the EMP throughout the project period.

#### **Environment Management Unit (EMU)**

In order to implement various environmental management measures at EZ, the master developer / contractor / operator will set up an Environment Management Unit (EMU). The EMU will consist of environmental engineers with relevant experience on environmental issues associated with EZ. The EMU will function all through construction and operation phase of the EZ and perform the following functions.

- Identify regulatory requirements of the sub-project and initiate necessary actions / studies to ensure compliance to the same.
- Co-ordinate with DoE and PIU and ensure securing SCC and ECC as applicable for the project(s);
- Co-ordinate with the technical professionals of contractors / sub-contractors and all other agencies involved in the development and operation of EZ / EPZ and ensure that all the requirements of EMP are fully complied.
- Ensure that all the common environmental infrastructure in EZ / EPZ is operated and maintained in compliance with the regulatory requirements of GoB;
- Liaise with individual enterprise/tenants and ensure that all environmental management conditions of the tenant lease agreement are fully complied.
- Prepare regular reports on environment management and submit to PIU/GoB.

## ***8.6. Monitoring Indicator***

To monitor the extent of environmental impact of the proposed EZ and proposed industries, it is advised to monitor the environmental quality around the project location periodically. This section describes the environmental quality monitoring detailing number and location of sampling stations, parameters to be monitored, frequency of sampling, etc. The EZ authorities must submit all the monitoring results to DOE, Bangladesh.

The physical, biological and social components which are of particular significance to the proposed project are listed below.

*Table 85: Monitoring Indicators*

S. No	Components	Indicative Parameters to be monitored
1	Micrometeorology	Temperature, Humidity, Rainfall, Evaporation, Wind Speed, Wind Direction, Sunshine Hours
2	Ambient Air Quality	SPM, PM10, PM2.5, SO2, NO <sub>x</sub> , CO, Pb, O3, hydrocarbons etc.
3	Ambient Noise Level	Noise level during daytime and nighttime
4	Surface Water Quality	Temperature, pH, colour, DO, BOD, COD, EC, TDS, TSS, Total Hardness, Salinity, Calcium, Magnesium, Total Coliform, Fecal Coliform, Oil & Grease, ammonia, nitrates, alkalinity, Sulphate, phosphate, Fluoride, Iron, Arsenic, trace metals such as Chromium, Lead, Cadmium, Mercury etc.
5	Ground Water Quality	
6	Soil Quality	Textural class, Gravel, Sand, Silt, Clay, pH, Bulk density, Infiltration rate, Specific gravity, Porosity, Moisture content, Organic matter, Alkalinity, Sodium absorption ratio, Conductivity, Nitrogen, Phosphorous, Potassium, Boron, NaCl, Na2CO3, Iron, Manganese, Copper, Zinc etc.
7	Ecological Components	Plantation success/survival rate Species richness and diversity Ecological condition

### 8.6.1.1. Micrometeorology

The nearest meteorological station is located at Sitakunda, which is about 25 Km away. Thus, it is advised to monitor the alteration of meteorological conditions in the area around EZ location, an automatic weather station for monitoring wind speed and direction, temperature, rainfall, and relative humidity will be installed within EZ premises.

### 8.6.1.2. Air Quality

Air quality monitoring includes ambient air quality monitoring and vehicular exhaust emission monitoring. During construction and operation phase, adequate ambient air quality monitoring stations will be established at and around EZ site depending on the predominant wind directions to assess the change in ambient air quality over the time. Air monitoring stations should be established within EZ and outside based on predominant wind direction. The EZ authorities would consult DoE while deciding the exact monitoring locations. In operation phase, individual industries should also conduct regular monitoring of ambient air quality, stack emission in their respective units.

### 8.6.1.3. Noise Quality

Noise monitoring at adequate locations during construction and operation stage. Portable noise meters could be used for monitoring daytime and nighttime noise level. All the air quality monitoring locations will be covered for noise monitoring.

#### 8.6.1.4. Surface Water & Ground Water

Surface Water quality should be monitored Feni River and Bay of Bengal from suitable locations neighbouring to the EZ. Beside surface water, adequate ground water sample should also be analysed from project area. Samples could be sent to other laboratories like DoE laboratory or any Research/Standard Analytical Laboratory for analysing the parameters. The results of the monitoring will be sent to DoE periodically.

#### 8.6.1.5. Soil Quality

Soil quality to be monitored at suitable locations in EZ. Both physical and chemical parameters need to be monitored. The parameters should be compared with the soil sample of undisturbed location.

#### 8.6.1.6. Ecological Components

It is recommended to carry out a yearly assessment of baseline flora and fauna surrounding the project location during development of the project (pre-industrial operation). Thereafter terrestrial and aquatic flora and fauna should be monitored during operation to observe any alteration in their species composition and replacement. This could be done in association with local universities and research institutions which carry out such studies frequently. Such monitoring would help in taking necessary steps at the appropriate stage to prevent further deterioration of the surrounding ecology and protect the flora-fauna. The frequency of sampling could be twice in a year during winter and monsoon season.

### 8.7. Monitoring Plan

The objective of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and for the protection of the surrounding environment. To monitor the extent of environmental impact of the proposed EZ and proposed industries, it is advisable to periodically monitor the ambient environmental quality around the project location. This section describes the environmental quality monitoring detailing number and location of sampling stations, parameters to be monitored, frequency of sampling, etc. The EZ authorities has to submit all the monitoring results to DoE, Bangladesh.

Table 86: Environmental Monitoring Plan

S. No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency	Executing Agency	Enforcement Agency
<b>1.0</b>	<b>Preconstruction and Construction Phase</b>					
1.1	Local Manpower Absorption	Construction Works	Contractor's report No. of people working in the project	Monthly	Contractor	BEZA
1.2	Soil Erosion	Excavation, disposal, cut & fill and site preparation activities for site levelling and internal roads, disposal	Survey & observation; Extent and degree of erosion; Structures for controlling soil erosion	Monthly	Contractor	BEZA
1.3	Greenbelt Development	-	Survival rate of species planted;	Half Yearly	Contractor	BEZA

S. No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency	Executing Agency	Enforcement Agency
			Density of vegetation			
1.4	Air Quality	Transportation of construction materials, road construction, construction of utilities	as referred in 'Monitoring Indicator' section	Once in each season for two weeks at 2-3 locations	Contractor	BEZA
1.5	Waste Management	Restoration of disposal sites and construction areas	Status of protection measures	Weekly	Contractors	BEZA
1.6	Noise Level	various construction/site preparation work	as referred in 'Monitoring Indicator' section	Daily at 6-8 locations	Contractors	BEZA
1.7	Ground/Drinking Water	Accidental contamination	as referred in 'Monitoring Indicator' section	Monthly at 1 location	Contractor	BEZA
1.8	Surface Water	Transportation of construction materials, various construction works, runoff from camp	All physio-chemical & biological parameters	Quarterly at suitable locations	Contractor	BEZA
1.9	Soil	Accidental contamination	as referred in 'Monitoring Indicator' section	Quarterly at 1 location	Contractor	BEZA
1.10	Ecological Assessment of surrounding area covering terrestrial and marine ecosystem	Various construction activity	Status of floral & Faunal community, Species richness, species diversity,	6 monthly (winter and monsoon)	Contractor	BEZA
<b>2.0</b>	<b>Operation Phase</b>					
2.1	Noise Levels	Noise levels compliance with respect to industrial standards	as referred in 'Monitoring Indicator' section	Daily at adequate locations for individual units	Individual Industrial Units	BEZA
			as referred in 'Monitoring Indicator' section	Daily at 6-8 locations covering Plant periphery, residential area (inside EZ and in the vicinity) and near noise generation sources	BEZA	BEZA
2.2	Biological Environment	Horticulture/Greenbelt Development	Survival rate of plants and shrubs	Quarterly	BEZA	BEZA
			Survival rate of plants and shrubs at individual unit	Quarterly	Individual unit	BEZA

S. No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency	Executing Agency	Enforcement Agency
2.3	Ambient air quality	Ambient air quality levels compliance with respect to industrial standards	as referred in 'Monitoring Indicator' section	Daily at adequate (2-4 points) locations for individual units	Individual Industrial Units	BEZA
		Ambient air quality levels		Daily at 2-3 locations covering Plant periphery, residential area (inside EZ and in the vicinity) and pollution generating sources	BEZA	BEZA
2.4	Ground /Drinking water quality	water quality levels compliance with respect to industrial standards	Bore-wells installed/ Drinking water source at site (All physio-chemical & biological parameters)	Monthly	Individual Industrial Units/BEZA	BEZA
				Quarterly	BEZA	BEZA
2.5	Surface water quality	To cross check accidental contamination	Nearby surface water resource (All physio-chemical & biological parameters)	Quarterly	BEZA	BEZA
2.6	Soil Erosion	River/water body	Survey & observation;	Monthly	BEZA	BEZA
2.7	Ecological Assessment of surrounding area covering terrestrial and marine ecosystem	Various industrial operation and traffic	Status of floral & Faunal community, Species richness, species diversity,	6 monthly (winter and monsoon)	BEZA	BEZA

## 8.8. Compensation Plan

For the development of EZ, the authority of BEZA proposes to acquire private land as well. The development of the EZ is proposed on area is a total 9,549.61 acres of land. In accordance with the Bangladesh Economic Zone Act, 2010 (Act No. 42 of 2010), BEZA transferred 4,512.56 acres land to Feni Economic Zone for long term basis. Remaining 2487.44 acres of land area is transferred to BEZA/ under process of transfer to BEZA. According to local consultation meeting, more than 1,500 PAPs would be directly and indirectly affected as a result of development of this project. Hence proper compensation based on present market rates to be provided to the PAPs. Based on stakeholder consultation meeting, the total number of projects affected persons (PAPs) are more than 1500 (directly and indirectly); thus, a Resettlement Action Plan needs to be prepared.



## 9. Cost Estimation for Environmental Mitigation Measures and Monitoring

The cost of EMP given here includes only that for the CETP, Environmental Monitoring, Audit and greenbelt development. The costs are approximate and need calibration at the time of detailed design stage.

Table 87: Estimated cost for Environmental Mitigation and Monitoring

Feni EZ			
S. No	Components	Unit Cost (Tk)	Cost (Tk.)
<b>A</b>	<b>Fixed Cost</b>		
<b>A.1.</b>	<b>Construction Phase (10 Years)</b>		
A.1.1.	PPEs for staffs of Project Proponent	100,000/year	1000000
A.1.2.	CETP/STP construction	To be covered under engineering cost	-
A.1.3.	Enviornmental Monitoring (Quarterly) from site and surrounding area Ambient Air Ambient Noise Surface Water Ground/Drinking Water Soil Quality	10,00,000/Quarter	40000000
A.1.4.	Greenbelt Development at suitable locations and Maintatinace	Lumpsum 400000/ Acre	805476000
	Marine and Terrestrial Ecological study (Half Yearly)	3000000/year	30000000
A.1.5.	Enviornmental Audit (Half Yearly)	250000/study	5000000
A.1.6.	Environmental Specialist - Full Time: 2 Nos	1500000/year/person	30000000
A.1.7.	Social Analyst- Full Time	1500000/year	15000000
A.1.8.	occupational health specialist and a safety specialist- Full Time: 2 Nos	900000/year/person	9000000
<b>A.2.</b>	Fund for proposed community development activities	Lumpsum	100000000
<b>A.3.</b>	Development and maintenance of Embankment along Feni River, maintenance of flow & Flood Protection	To be covered under engineering cost	
	<b>Total Fixed Cost (BDT)</b>		<b>1,035,476,000</b>
<b>B</b>	<b>Recurring Cost (Yearly)</b>		
<b>B.1.</b>	<b>Operation Phase (per year)</b>		



Feni EZ			
S. No	Components	Unit Cost (Tk)	Cost (Tk.)
B.1.1.	PPEs for staffs of Project Proponent	30000/year	30,000
B.1.2.	Solid waste bins for common areas	50,000/year	50,000
B.1.3.	CETP/STP operation	To be covered under project cost	0
B.1.4.	Enviornmental Monitoring (Quarterly) from site and surrounding area Ambient Air Ambient Noise Surface Water Ground/Drinking Water Soil Quality	500000/Quarter	2000000
B.1.5.	Maintenance of Green Belt	Lumpsum	80547600
B.1.6.	Enviornmental Audit (Half Yearly)	300000/half	600000
B.1.7.	Environmental Specialist - Full Time: 2 Nos	2000000/year/person	4000000
B.1.8.	Social Analyst- Full Time	2000000/year	2000000
B.1.9.	occupational health specialist and a safety specialist- Full Time: 2 Nos	1500000/year/person	3000000
B.1.10.	CETP/STP Incharge: 4 Nos	100000/year/person	4000000
B.1.11.	Ecological Assessment (Halfyearly)	4000000/year	4000000
<b>Total Yearly Recurring Cost (BDT)</b>			<b>100,227,600</b>
<p><b>Note:</b> The costs are approximate and need calibration at the time of detailed design and estimation stage  * Monitoring/Mitigation cost at individual industry level has not been covered  ** If there is need of any specific mitigation according to environmental audit during construction/Operation phase/recommendation of regulatory authority, the cost for the same will be additional</p>			

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# ***10. Emergency Response Plan and Disaster Impact Assessment***

A disaster is called when following one or the more incidents occur:

- Risk of loss of human lives in one single situation
- A situation which goes beyond the control of available resource of the plant.
- Loss of property because of the incident.
- A situation apparently may not have much loss, but its long-term severity can affect loss of life, production and property.
- Emergencies on account of
  - ✓ Fire
  - ✓ Explosion
  - ✓ Spillage of toxic chemicals
  - ✓ Electrocution
- Natural calamity on account of:
  - ✓ Flood
  - ✓ Earthquake/cyclone/storm/cloud burst/lightning
  - ✓ Natural calamity on account of
- External factor on account of:
  - ✓ Food poisoning
  - ✓ Sabotage

The objective of the study is to assess the likely hazards and risk associated with process and preparation of preliminary Disaster Management Plan (DMP). The main objectives of DMP are:

- To control and contain the incident/accident and if possible, eliminate it
- To minimize the effects of the incident on person, property and environment.

## **On site disaster**

If an accident/incident takes place within the proposed project site and its effects are confined to the premises, involving only the persons working in the proposed project site and the property inside the proposed project site, it is called as on-site disaster.

## **Offsite disaster**

If the accident is such that its affects inside the proposed project site are uncontrollable and it may spread outside the premises, it is called as off-site disaster.

### ***10.1.1. On-site disaster impact assessment***

Main elements on on-site emergency plan are the following

- Leadership and administration
- Role and responsibilities of key personnel

- 
- Emergency action
  - Light and power
  - Source of energy control
  - Protective and rescue equipment
  - Communication
  - Medical care
  - Public relation
  - Protection of vital records
  - Training
  - Periodical revision of plan

#### **Action plan for on-site disaster management plan**

- Designated control center/room
- Key personnel

##### *10.1.1.1. Control Center*

This is the main center from where the operations to handle the emergency are directed and coordinated. Facilities to be made available in the control centre are:

- i) Internal and external communication
- ii) Computer and other essential records
- iii) Daily attendance of workers employed
- iv) Storage of hazardous material records and manufacturing records
- v) Pollution records
- vi) Walky-talky

##### *10.1.1.2. Fire prevention facilities*

The unit will be provided with appropriate firefighting equipment including pumps for emergency requirement in the power plant. Any one or combination of the following system will protect all yards and plant.

- Hydrant system
- High velocity and medium velocity sprinkler system
- Water spray (emulsifier system)
- Foam system
- Chemical extinguishers

##### *10.1.1.3. The key personnel for onsite emergency*

1. Works main controller
2. Works incident controller
3. Other key officer
  - a. Communication officer
  - b. Security and fire officer
  - c. Telephone operators
  - d. Medical officers

- e. Personnel/administrative officers
- f. Essential work team leaders

### **Alarm system**

Alarm system varies and will depend on the size of the works area - simple fire bell, hand operated siren – break open type, fire alarm etc.

### **Communication System**

Communication is a key component to control an emergency. The following communication system may be provided in the project:

- ✓ Walky-talky
- ✓ Telephone
- ✓ Cell phone
- ✓ Intercom/paging
- ✓ Runners (verbal or written messages)

### **Siren for emergency**

Siren for emergency should be different from the normal siren. The emergency siren should be audible to a distance of 5km radius. The emergency siren should be used only in case of emergency.

### **Escape Route**

The escape route from each and every plant should be clearly marked. The escape route is the shortest route to reach out of the plant area to open area, which leads to assembly point. This route should be indicated on the layout plan attached to the on-site management plan.

### **Evacuation**

All non-essential staff should be evacuated from the emergency site. As soon as the emergency siren rings the workers have to shut down the units and move to the assembly point. The shutdown procedure in case of emergency should be prepared and kept ready and responsible persons should be nominated for the purpose.

### **Counting of personnel**

All personnel working in the EZ should be counted. Time office persons should collect the details of personnel arriving at the assembly point. These should be checked with the attendances of regular workers, contract workers present in the site on the day of emergency. The accident control should be informed and arrangement should be made for searching missing persons in the emergency affected area. The employees address, contact number of next to kin should be maintained in the time office so that during emergency relatives of those affected due to emergency may be informed accordingly. Information in respect of emergency should be given to the media and other agency.

### **All clear signal**

After control of emergency the work incident controller will communicate to the works main controller about the cessation of emergency. The main controller can declare all clear by instructing the time office to sound “All Clear Sirens”.

### **Emergency facilities**

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The following facilities should be provided to tackle any emergency at any time.

- Fire protection and firefighting facilities
- Emergency lighting and standby power
- Emergency equipment and rescue equipment
- Breathing apparatus with compressed air cylinder
- Fire proximity suit
- Resuscitator
- Water gel blanket
- Low temperature suit
- Fire aid kit
- Stretchers
- Torches
- Ladders
- Safety equipment

#### **On-site emergency plan should contain**

1. Site plan and topographic plan
2. Plan showing the firefighting facilities
3. Plan showing hazardous material storage area
4. Material safety data sheet for hazardous chemicals
5. Facilities available in main control center
6. List of emergency equipment
7. List of safety equipment
8. List of important telephone numbers and addresses
9. Names, address and contact numbers of key personnel

The on-site emergency plan shall be documented in a printed form in sufficient copies to give all concerned for knowledge, study and easy follow up. The emergency plan shall be rehearsed and practiced at regular intervals to test efficiency of personnel, equipment coordinated efforts and to increase confidence and experience to operate such plan. The plan so prepared should be updated annually and uploaded in the factory website for easy reference.

### ***10.1.2. Off-site disaster impact assessment***

The main objective of the off-site emergency plan are:

- i) To save lives and prevent injuries;
- ii) To prevent or reduce property losses and;
- iii) To provide for quick resumption of normal situation or operation

### ***10.1.3. Risk assessment plan***

Risk involves the occurrence or potential occurrence of some accident consisting of an event or sequence of events. Risk (R) can be mathematically expressed as  $R = fD$  where R is the risk (individual or societal), f is the frequency of occurrence of an undesired event and D is the expected damage distance due to likely occurrence of that unfortunate event. The main objectives of the study are as follows:

- 
1. Identification of hazard prone area and estimation of damage distance for the maximum creditable accident scenario visualized for storages;
  2. Computation of frequency of occurrence of hazards and evaluation of risks;
  3. Based on the studies, suggest risk mitigation measures and arrive at guidelines for Disaster Management and Emergency Preparedness Plan (DMP and EPP).

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# **11. Conclusions and Recommendations**

## **11.1. Conclusions**

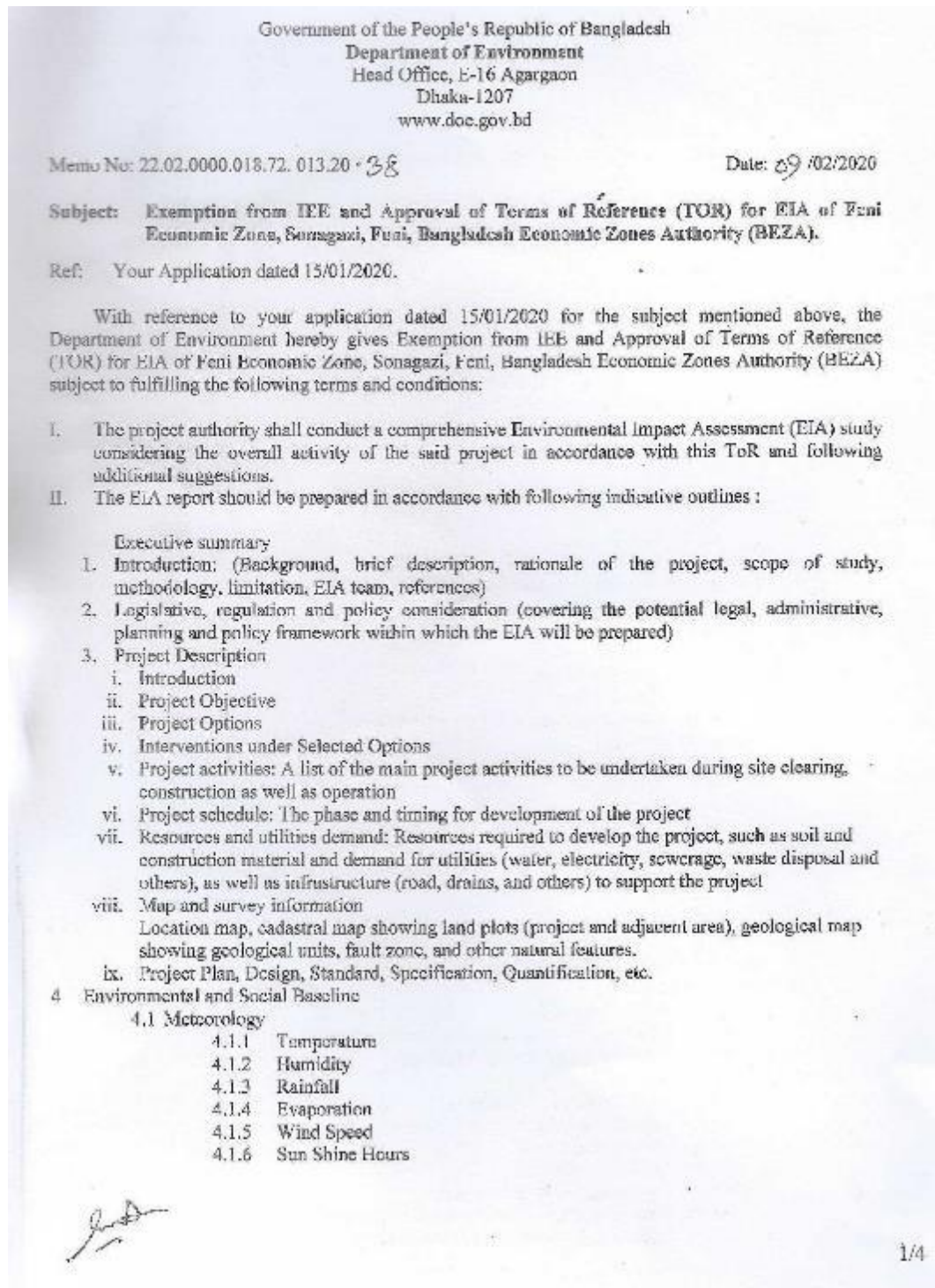
Considering the sensitivity of the proposed site, it can be said that overall the impacts from preconstruction, construction and operation phase will have negative impacts to the surrounding environment to some extent. The proposed site is quite rich from ecological point of view. It must be ensured that EMP plan is followed religiously as a compensatory act and an effort to negate the impact to some acceptable extent. BEZA will invest in land and related off-site infrastructure development so as to make zone accessible and resourceful. Thereafter economic zone development will be responsibility of private developers. The off-site facilities proposed to be developed by BEZA includes development of administration building, boundary wall, electrical supply, access roads, super dyke etc. The project falls under Red category as per ECA, 1995 and requires prior environment clearance from DoE, Bangladesh.

## **11.2. Recommendations**

The recommendations made for the project development on the basis of EIA study are given below:

- Construction activities for the development of project should be started after obtaining environment clearance certificate from DoE, Bangladesh
- Proposed environment management plan should be implemented strictly both during development and operation phase of the project.
- Plantation should be carried out within the EZ area as recommended
- Proper training of maintaining environment, health and safety should be given to Project implementing authority in both construction and operation phase
- Provision of drain, thick green belt, ETP, STP, segregated storm water shall be adhered to.
- Environmental monitoring and ecological assessment should be conducted as proposed in environment management plan
- A half-yearly ecological assessment (preferably in winter and monsoon) during site preparation, construction, operation phase should be conducted through specialists to record chronological trend of biodiversity in the project area surrounding
- Wildlife awareness program among the workers (during, construction and operation phase) should be conducted. Workers should report sighting of any uncommon species to the environmental expert, who immediately should inform the incidence to local forest/wildlife authority/ conservationists
- Separate environment impact assessment study is to be carried out by individual industries and clearance from DoE should be obtained prior to setting up any industrial unit.
- As stated by concerned Forest Department, as per the Gazette Notification of Govt. of Bangladesh Dated 30th April'2015, Forest land is present in the Mouzas Bahir Char, Dakkhin Char Khandakar, Char Ram-Narayan and Char Elen. As stated by concerned Forest Department, no Dag Nos are available for the Forest Locations. Even, map with proper delineation of Forest Boundary is not available with the concerned stakeholder. Due to this, it can't be stated whether the project requires acquisition of Forest Land or not. A clarification in this regard may be asked by BEZA to concerned Department.

## Appendix A. - ToR issued by DoE





- 4.2 Air Quality and Noise
  - 4.2.1 Ambient Air Quality of the project site with respect to Standards of ECR, 1997
  - 4.2.2 Ambient Noise level of the project site with respect to Standards of Noise Pollution (Control) Rules, 2006
  - 4.2.3 Air pollutant and noise sources from existing and known sources
- 4.3 Water Resources
  - 4.3.1 Surface Water System
  - 4.3.2 Tropical Cyclones and Tidal Flooding
  - 4.3.3 Salinity
  - 4.3.4 Drainage Congestion and Water Logging
  - 4.3.5 Erosion and Sedimentation
  - 4.3.6 River Morphology
  - 4.3.7 Navigation
  - 4.3.8 Ground Water System
- 4.4 Land Resources
  - 4.4.1 Agro ecological Regions
  - 4.4.2 Land Types
  - 4.4.3 Soil Texture
  - 4.4.4 Land Use
- 4.5 Agriculture Resources
  - 4.5.1 Farming Practice
  - 4.5.2 Cropping Pattern and Intensity
  - 4.5.3 Cropped Area
  - 4.5.4 Crop Production
  - 4.5.5 Crop Damage
  - 4.5.6 Main Constraints of Crop Production
- 4.6 Livestock and Poultry
  - 4.6.1 Feed and Fodder Shortage
  - 4.6.2 Livestock/Poultry Diseases
- 4.7 Fisheries
  - 4.7.1 Introduction
  - 4.7.2 Problem and Issues
  - 4.7.3 Habitat Description
  - 4.7.4 Fish Production and Effort
  - 4.7.5 Fish Migration
  - 4.7.6 Fish Biodiversity
  - 4.7.7 Fisheries Management
- 4.8 Ecological Resources
  - 4.8.1 Bio-ecological Zone
  - 4.8.2 Common Flora and Fauna
  - 4.8.3 Ecosystem Services and Function
- 4.9 Socio Economic Condition
  - 4.9.1 Socio Economic Condition
  - 4.9.2 Quality of Life Indicators
  - 4.9.3 Income and Poverty
  - 4.9.4 Gender and Women
  - 4.9.5 Common Property Resources
  - 4.9.6 Conflict of Interest and Law and Order Situation
  - 4.9.7 Historical, Cultural and Archaeological Sites

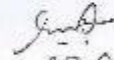
9.4

- 5 Identification and Analysis of Key Environmental Issues (Analysis shall be presented with Scenarios, Maps, Graphics, etc. for the Case of Anticipated Impacts on Baseline)
  - 5.1 Environmental Sensitivity Investigation
  - 5.2 Environmental Asset
  - 5.3 Environmental Hot Spots
  - 5.4 Likely Beneficial Impacts
  - 5.5 Community Recommendations
  - 5.6 Alternate Analysis
- 6 Environmental and Social Impacts
  - 6.1 Introduction
  - 6.2 Impact on Air Quality and Noise
    - 6.2.1 Pre-Construction Phase
    - 6.2.2 Construction Phase
    - 6.2.3 Post-Construction Phase
  - 6.3 Impact on Water Resources
    - 6.3.1 Pre-Construction Phase
    - 6.3.2 Construction Phase
    - 6.3.3 Post-Construction Phase
  - 6.4 Impact on Land Resources
    - 6.4.1 Pre-Construction Phase
    - 6.4.2 Construction Phase
    - 6.4.3 Post-Construction Phase
  - 6.5 Impact on Agriculture Resources
    - 6.5.1 Pre-Construction Phase
    - 6.5.2 Construction Phase
    - 6.5.3 Post-Construction Phase
  - 6.6 Impact on Fisheries
    - 6.6.1 Pre-Construction Phase
    - 6.6.2 Construction Phase
    - 6.6.3 Post-Construction Phase
  - 6.7 Impact on Eco System
    - 6.7.1 Pre-Construction Phase
    - 6.7.2 Construction Phase
    - 6.7.3 Post-Construction Phase
  - 6.8 Socio Economic Impact
    - 6.8.1 Pre-Construction Phase
    - 6.8.2 Construction Phase
    - 6.8.3 Post-Construction Phase
- 7 Public Consultation and Disclosure
  - 7.1 Introduction
  - 7.2 Objectives of Public Consultation and Disclosure Meeting
  - 7.3 Approach and Methodology of Public Consultation and Disclosure Meeting
  - 7.4 Public Consultation Meetings (PCMs)
  - 7.5 Public Disclosure Meetings (PDMs)
- 8 Environmental Management Plan and Monitoring Indicators
  - 8.1 Introduction
  - 8.2 Mitigation Plan
  - 8.3 Enhancement Plan
  - 8.4 Contingency Plan
  - 8.5 Compensation Plan
  - 8.6 Monitoring Plan

### 8.7 Monitoring Indicators

- 9 Cost Estimation for Environmental Mitigation Measures and Monitoring
- 10 Emergency Response Plan & disaster Impact Assessment
- 11 Conclusions and Recommendations

- III. Without obtaining approval of EIA report by the Department of Environment, the project authority shall not be allowed to conduct earth filling or any kind of physical intervention in the proposed project site and also not be able to start the physical activity of the project.
- IV. This approval of the Terms of Reference (TOR) would not mean any acceptance or site clearance of the project.
- V. The proposed EIA study would not establish any claim, right in favor of the proponent for getting site clearance or environmental clearance.
- VI. Without obtaining Environmental Clearance, the project authority shall not be able to start the operation of the project.
- VII. The project authority shall submit the EIA report along with the filled-in application for Environmental Clearance in prescribed form, the feasibility study report, the applicable Environmental Clearance fee in a treasury chalan, the applicable VAT on clearance fee in a separate treasury chalan, the No Objection Certificate (NOC) from local authority, NOC in favor of Cutting/Dressing (if it is required) of Hill/Hillock from the concerned authority and NOC from other relevant agencies for operational activity etc. to the Feni District Office of DOE in Feni with a copy to the Head Office of DOE in Dhaka.

  
09.02.2020

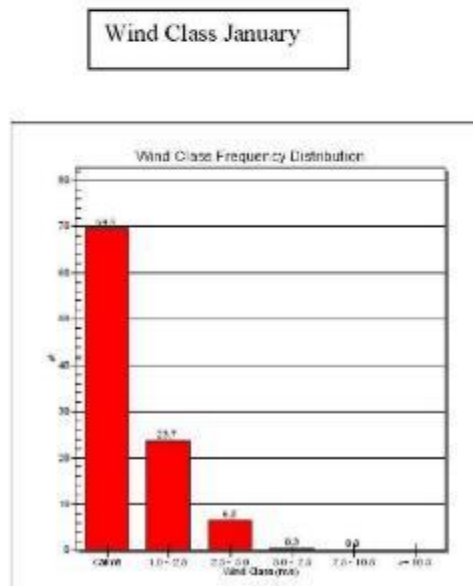
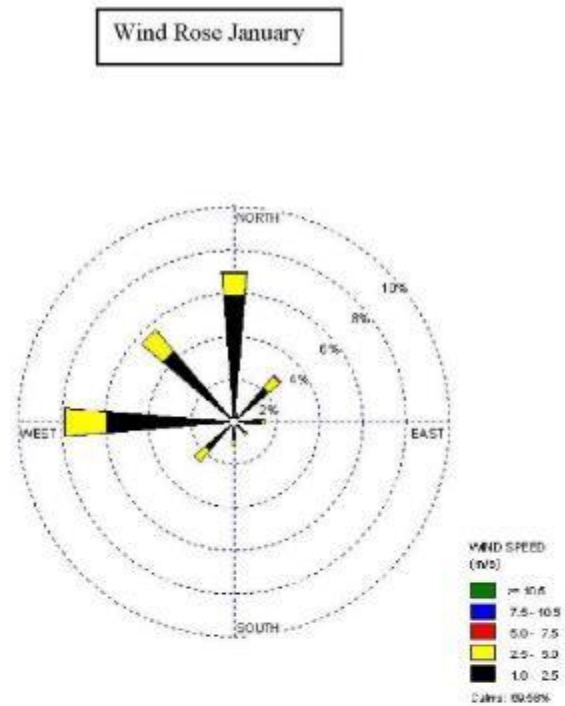
(Syed Nazmul Ahsan)  
Director (Environmental Clearance)  
Phone # 02-8181673

**Managing Director**  
D3L Economic Zone Limited  
Capita South Avenue Tower  
House-50 (6<sup>th</sup> floor), Road-3  
Gulshan-1, Dhaka.

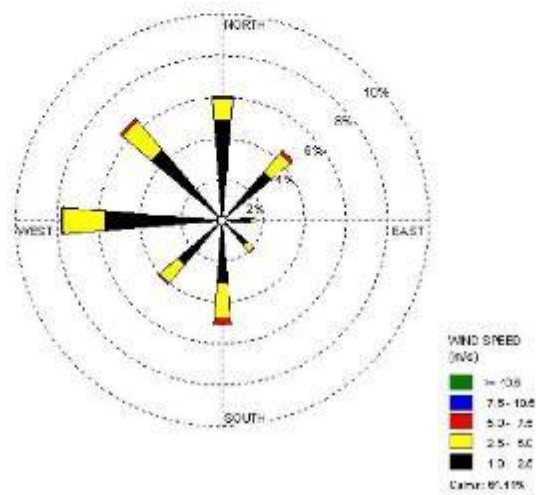
#### Copy Forwarded to :

- 1) PS to Secretary, Ministry of Environment, Forest and Climate Change, Bangladesh Secretariat, Dhaka.
- 2) Director, Department of Environment, Chattogram Regional Office, Chattogram.
- 3) Deputy Director/Office-in-Charge, Department of Environment, Feni District Office, Feni.
- 4) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

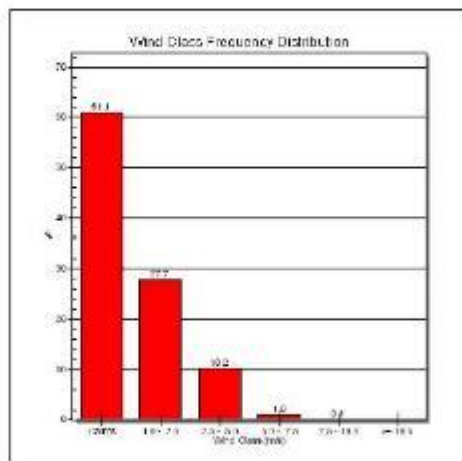
## Appendix B. - Windrose Diagram of Project Area



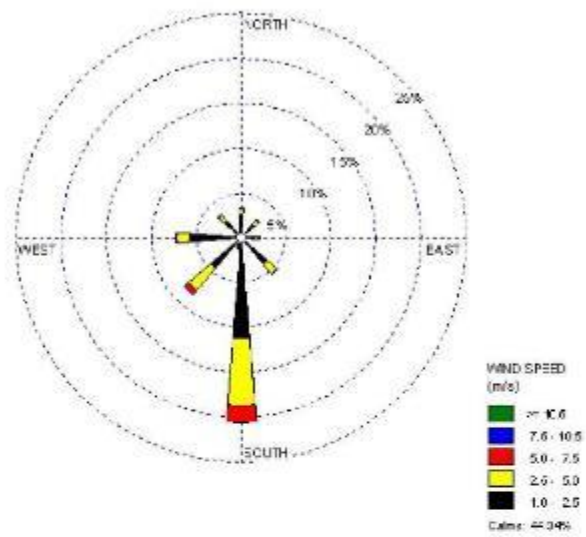
Wind Rose February



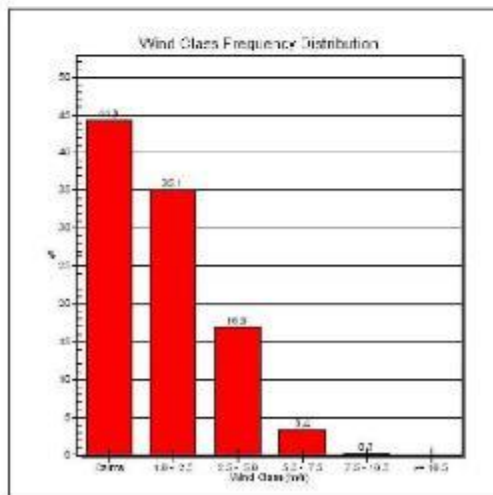
Wind Class February



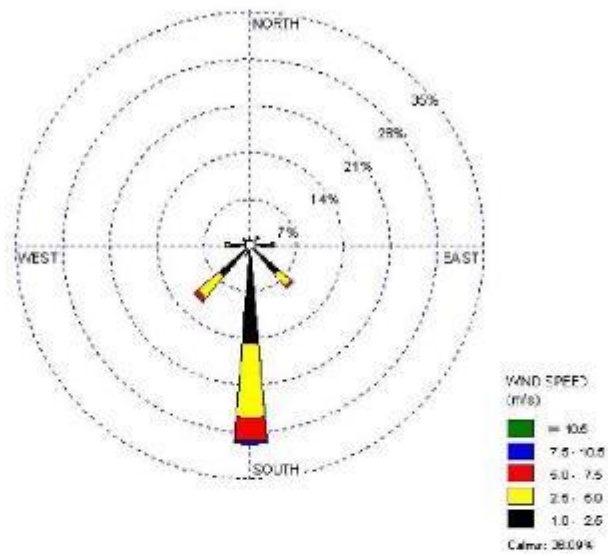
Wind Rose March



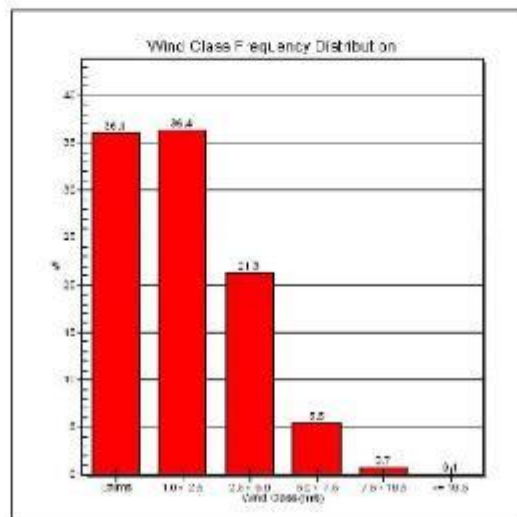
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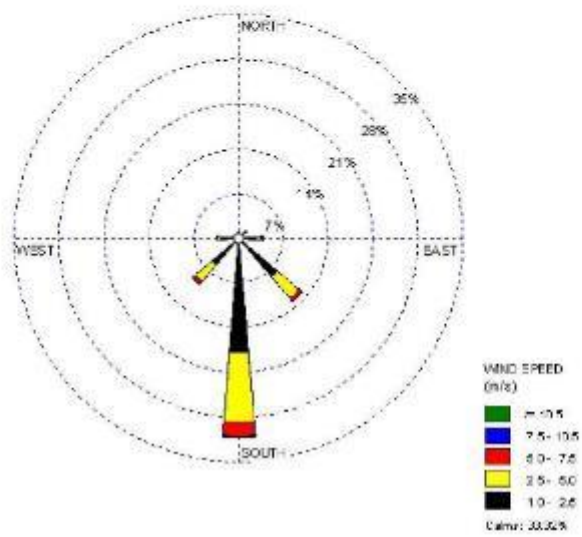
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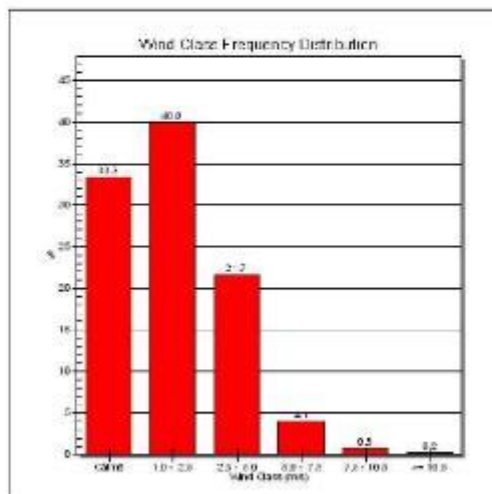
Wind Class April



Wind Rose May

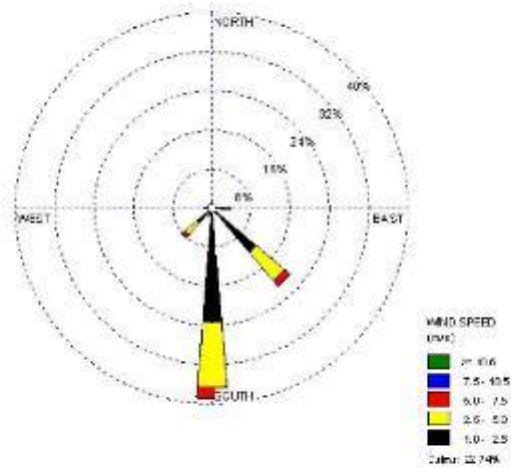


Wind Class May

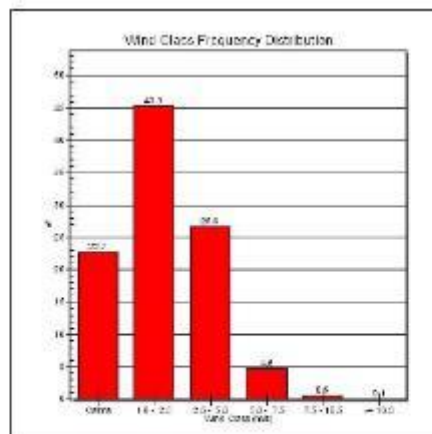




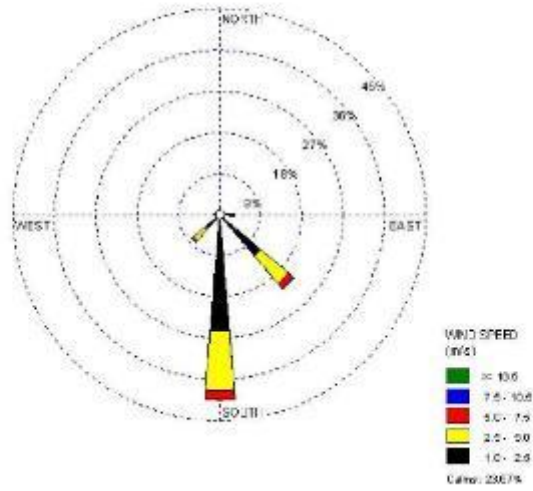
Wind Rose June



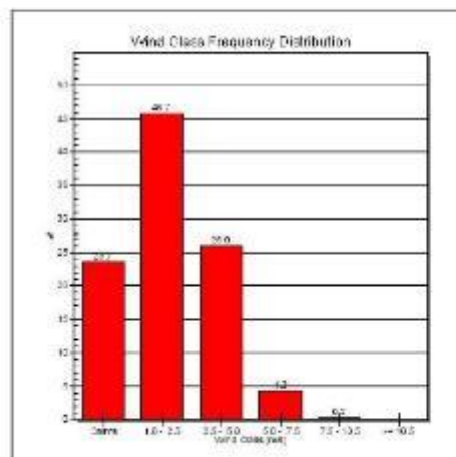
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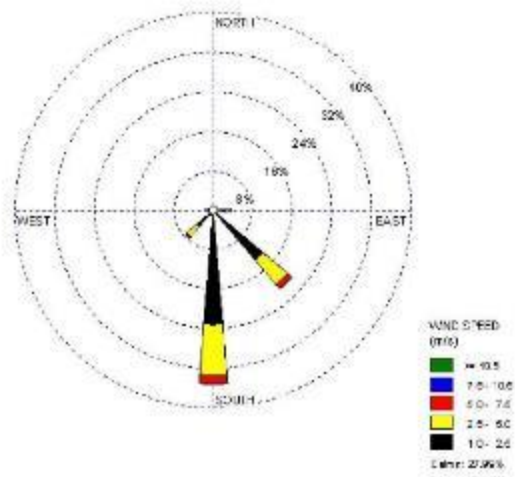
Wind Rose July



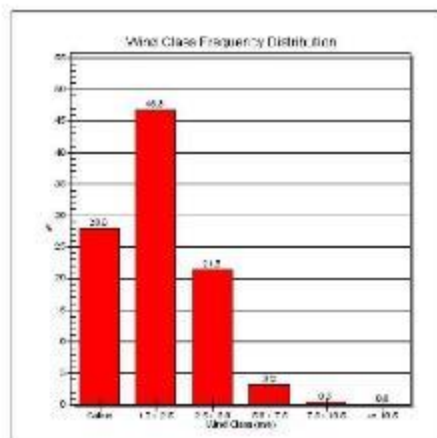
Wind Class July



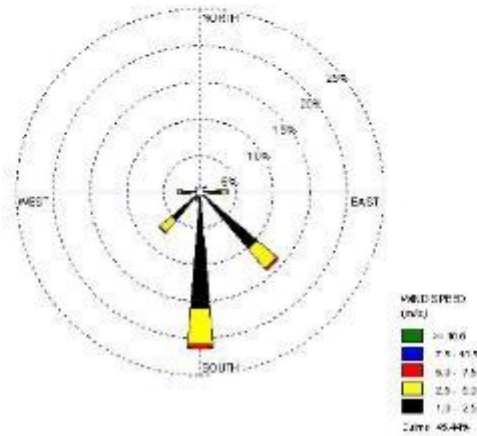
Wind Rose August



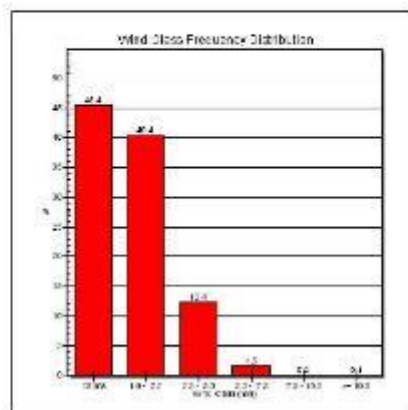
Wind Class August



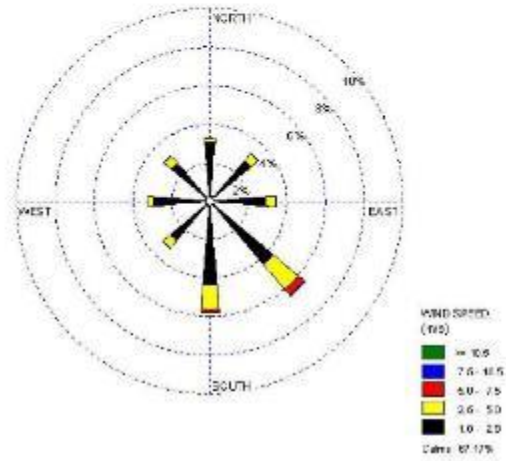
Wind Rose September



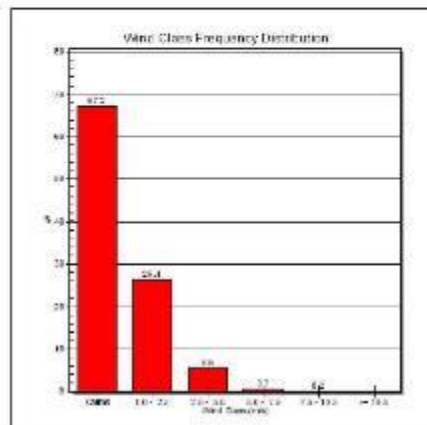
Wind Class September



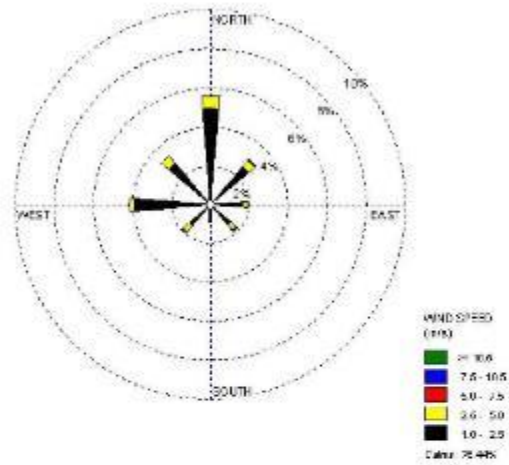
Wind Rose October



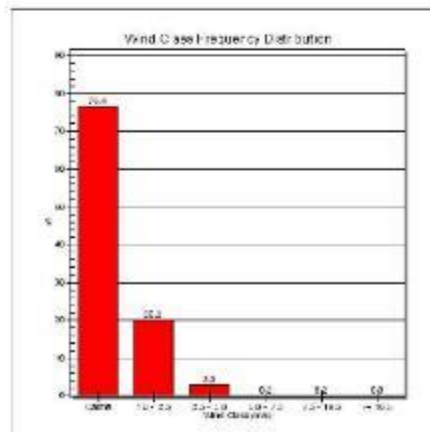
Wind Class October



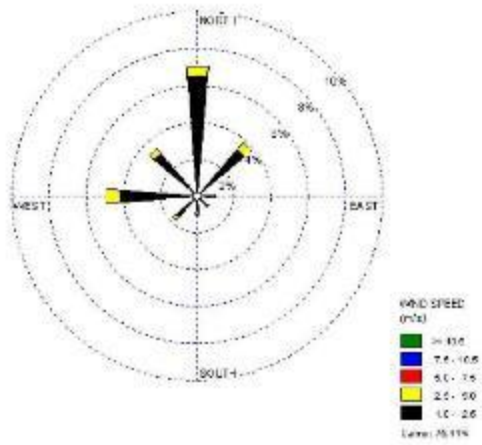
Wind Rose November



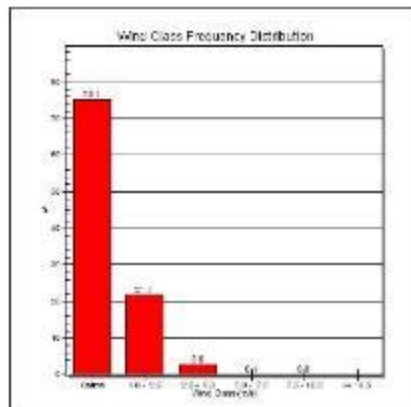
Wind Class November



Wind Rose December



Wind Class December



## Appendix C. - Recorded Highest Water Level

### Bangladesh Water Development Board

Processing and Flood Forecasting Circle

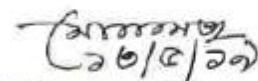
Management and Services Branch

72, Green Road, Dhaka-1205

Phone: 9113605, E-Mail: [analyst.mohi@gmail.com](mailto:analyst.mohi@gmail.com), [msa@dotsilicon.com](mailto:msa@dotsilicon.com)

River	Station_ID	Station_Name	DateTime	RHWL(m)
Feni	SW87	Sonapur	08-19-1974	7.85

RHWL = Recorded Highest Water Level

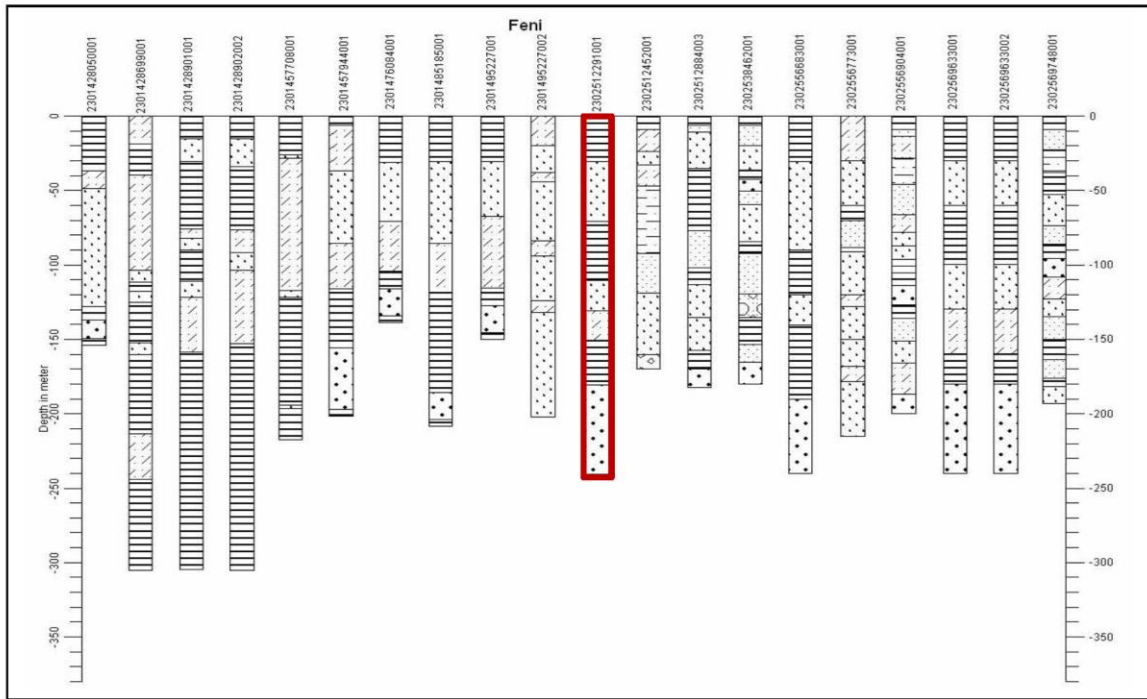


Md. Mohiuddin Alimed  
System Analyst  
Management and Services Branch  
Processing and Flood Forecasting Circle  
BWDB, Green Road, Dhaka.

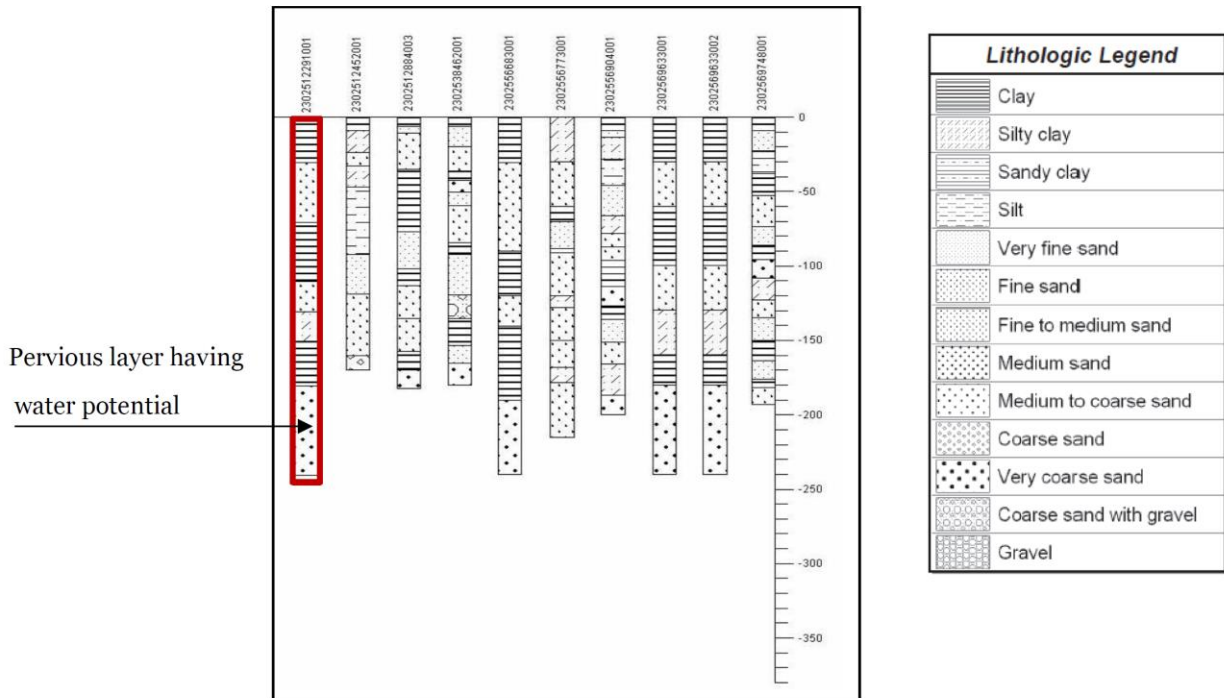


## Appendix D. - Information on Boreholes






**Bore Well Profile of Project Area - 22°47'31.92"N, 91°23'3.48"E**



GeoCode	District	Upazila	Union	Mouza	Village	OwnerName	Year of Installation	Boring Depth (m)	Screen Centre Depth (m)	Long	Lat
2305174490001	Feni	Parshuram	G.M.Hat	Lakshmipur	Lakshmipur	Sayed Munir Hossain	2005	138.68	134.11	91.4616	23.0677
2305147850002	Feni	Parshuram	Mirzanagar		Satyanagar	Haji Mohammad Mostafa	2007	228.60	222.04	91.4167	23.2522
2305147706001	Feni	Parshuram	Mirzanagar	Paschim Saheb Nagar	Paschim Saheb Nagar	Humayun Kabir Mazumdar	2005	201.16	194.15	91.4048	23.2184
2305147593001	Feni	Parshuram	Mirzanagar	Mirzanagar	Mirzanagar	Abul Kalam	2008	229.21	224.18	91.4250	23.2353
2305181447001	Feni	Parshuram	Munshirhat	Karaiya	Karaiya	Md. Mohiuddin Ahmed	2005	245.35	240.48	91.4180	23.1303
2309409005001	Feni	Sonagazi	Amirabad	Bara Ahammadpur	Bara Ahammadpur	Tazul Islam	2005	196.59	190.19	91.4302	22.8870
2309409932001	Feni	Sonagazi	Amirabad	Sonapur (Part-B)		Somod Ali Chaprasi Bari	2005	183.00	267.75	91.4466	22.8633
2309409932002	Feni	Sonagazi	Amirabad	Sonapur (Part-B)	Sonapur	Md. Yasin	2008	203.00	197.80	91.4466	22.8633
2309419031001	Feni	Sonagazi	Bagadana	Arkaim	Arkaim	Fajlur Rahman	2005	187.44	182.57	91.3818	22.9131
2309419062001	Feni	Sonagazi	Bagadana	Baduria		Rajar Baper Bari	2005	187.00	181.96	91.3817	22.9248
2309419580002	Feni	Sonagazi	Bagadana	Gunak	Gunak	Mosharof Hossen	2008	200.00	195.00	91.3918	22.9244
2309428217002	Feni	Sonagazi	Char Chandia	Char Chandia	Char Chandia	Abdulla Sayed	2007	222.50	215.06	91.3802	22.8264
2309428217001	Feni	Sonagazi	Char Chandia	Char Chandia	Char Chandia	Azizul Haque	2005	206.03	199.63	91.3802	22.8264
2309428849001	Feni	Sonagazi	Char Chandia	Purba Baradhali		Nurul Haq Bari	2005	201.00	195.67	91.3843	22.7922
2309428217002	Feni	Sonagazi	Char Chandia	Char Chandia	Char Chandia	Golam Maola	2008	203.00	197.50	91.3802	22.8264
2309438228001	Feni	Sonagazi	Char Darbesh	Char Darbesh	Char Darbesh	Komola Begam	2005	190.80	184.40	91.3476	22.8218
2309438352001	Feni	Sonagazi	Char Darbesh	Char Sahabhikari			2005	195.00	194.01	91.3556	22.8709
2309438352086	Feni	Sonagazi	Char Darbesh	Char Sahabhikari	Char Sahabhikari	Jebal Haque	2008	204.00	190.00	91.3556	22.8709
2309457668001	Feni	Sonagazi	Char Majlishpur	Char Lakshmiganj		Kazi Mazi Bari	2005	202.00	197.00	91.3616	22.9305
2309447860002	Feni	Sonagazi	Char Majlishpur	Raghabpur	Raghabpur	Nurzaman	2008	204.00	200.00	91.3919	22.9358
2309438352002	Feni	Sonagazi	Char Sahabhikari	Char Sahabhikari	Char Sahabhikari	Sankar Das	2007	224.03	219.08	91.3542	22.9256
2309457020001	Feni	Sonagazi	Mangalkandi	Anandipur	Anandipur	Abul Kalam Azad	2005	206.03	199.63	91.3961	22.9124
2309457901001	Feni	Sonagazi	Mangalkandi	Sampur		Md. Idris	2005	305.00	232.55	91.4006	22.9084
2309466487001	Feni	Sonagazi	Matiganj	Daulatkandi		Abdul Goni Dr. Bari	2004	180.00	174.34	91.4060	22.8844
2309466963001	Feni	Sonagazi	Matiganj	Swarajpur	Swarajpur	Shirajul Haque	2005	214.87	210.00	91.4142	22.8906
2309466943003	Feni	Sonagazi	Matiganj	Sujapur	Sujapur	Abu Ahamed	2008	201.00	195.00	91.4067	22.8727
2309476880001	Feni	Sonagazi	Nawabpur	Safrabad	Safrabad	MD. Belayet Hossain	2007	213.36	205.36	90.4542	22.9125
2309476601001	Feni	Sonagazi	Nawabpur	Hajipur	Hajipur	Samsul Huda	2005	185.92	179.52	91.4514	22.9002
2309476865001	Feni	Sonagazi	Nawabpur	Raghunathpur		Miadon Sawagor Bari	2004	181.00	175.86	91.4656	22.9057
2309476694002	Feni	Sonagazi	Nawabpur	Majupur	Majupur	Khuku Rani Bosak	2008	195.00	191.00	91.4444	22.9283
2309485706001	Feni	Sonagazi	Sonagazi	Saraitkandi	Saraitkandi	Shek Farid	2007	210.31	203.12	91.4236	22.8428
2309485279001	Feni	Sonagazi	Sonagazi	Char Khoaz	Char Khoaz	Mr. Ismail	2005	185.92	179.52	91.4329	22.8337
2309485279002	Feni	Sonagazi	Sonagazi	Char Khoaz		Abdus Sukkur Mawlana Bari	2005	168.00	162.76	91.4329	22.8337
2309485279002	Feni	Sonagazi	Sonagazi	Char Khoaz	Char Khoaz	Sakhina Khatun	2008	223.00	219.00	91.4329	22.8337
2464347464001	Khagrachhari	Dighinala	Dighinala	Dighinala	Dighinala	Dighinala High School	1994	305.39		92.0763	23.2807
2514305821001	Lakshmipur	Lakshmipur Sadar	Bangakha	Rajibpur		Sakina	2002	250.00	248.00	90.8501	22.9487
2514310514001	Lakshmipur	Lakshmipur Sadar	Basikpur	Kashipur		Abdul Hoque	2005	261.00	256.00	90.9271	22.9963
2514315121001	Lakshmipur	Lakshmipur Sadar	Bhabaniganj	Bhabaniganj		Mostafa Driver	2001	242.00	237.00	90.8503	22.8826

# Appendix E. - Forest Notification

নির্দেশ নং তি এ-১



**বাংলাদেশ** **গেজেট**

কর্তৃপক্ষ কর্তৃক প্রকাশিত  
 বুধস্পতিবার, এপ্রিল ৩০, ২০১৫

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৬ষ্ঠ খণ্ড

প্রথম খণ্ডে অন্তর্ভুক্ত প্রজ্ঞাপনসমূহ ব্যতীত বাংলাদেশ সুপ্রীমকোর্ট, বাংলাদেশের মহা-হিসাব নির্বাহক ও নিয়ন্ত্রক,  
 সরকারি চাকুরী কমিশন এবং গণপ্রজাতন্ত্রী বাংলাদেশ সরকারের অধাভ্রমণ ও সাংযুক্ত দপ্তরসমূহ কর্তৃক  
 জারীকৃত প্রজ্ঞাপনসমূহ।

জেলা প্রশাসকের কার্যালয়, ফেনী  
 (স্বাক্ষর শাখা)  
 বাংলাদেশ সরকারের ১৯২৭ সনের বন আইনের ২০ ধারার বিধানমতে ইতিহাস  
 প্রকাশন  
 তারিখ, ২২ জানুয়ারি ২০১৫

নং ৩১.২০.৩০০০.০২১.১৮.০০৮.১২-১০০—এরদ্বারা সর্বসাধারণের অবগতির জন্য জানানো হইতেছে যে, ফেনী জেলার উত্তর হইতে ২২°৩৫' উত্তর অক্ষাংশ এবং ৯১°২০' পূর্ব হইতে ৯১°৩০' পূর্ব প্রাথমিক অঞ্চলে নতুন জাদিয়া উঠা চর জমিকে গণপ্রজাতন্ত্রী বাংলাদেশ সরকার ১৯২৭ সনের বন আইনের আওতার "সাংযুক্ত বন" সংজ্ঞানের সিদ্ধান্ত গ্রহণ করিয়া বিজ্ঞপ্তি নং-১/ফর-৮৩-৭৫/৩০৯, তারিখ ২৪-০৩-১৯৭৭ এবং ব্যাবহারিকতার বিজ্ঞপ্তি নং পবন (শা-৩)৭-৯৭/৩৩১, তারিখ ৩০-০৯-১৯৯৯ জারী করিয়াছেন। প্রকাশিত বিজ্ঞপ্তির অন্তর্ভুক্ত নিন্দ্র অফিসিলে কর্তৃক এপ্রকার জন্য ১৯২৭ সনের বন আইনের ২০ নং ধারা মোতাবেক বিজ্ঞপ্তি করণে যোগ্যতার নিমিত্ত অত্র ইতিহাসের জারি করা হইলঃ

**অফিসিল**

ক্রমিক নং	রেঞ্জ/বন বিভাগের সিদ্ধান্তপত্র	জেলা	উপজেলা	মৌজার নাম/ জে. এল. নং	মাপ নং ও অবস্থান	ভূমির পরিমাণ (একর)	মন্তব্য
(১)	সোনাপাড়া রেঞ্জ সামাজিক বন বিভাগ, ফেনী	ফেনী	সোনাপাড়া	বাহির চর	উত্তরে-পূর্ব বড়দলী দক্ষিণে-৪৫ খোন্দাচড়া, ৩৪ মেসোচাচর পূর্বে-৩৪ চরমোক্ষার পশ্চিমে-পূর্ব বড়দলী	৩০০.৪৮ একর	অত্র এলাকা সংলগ্ন পরবর্তী পর্যায়ে যে সকল নতুন চর জাগিয়ে তাহাও "সাংযুক্ত বন" বলিয়া পরিগণিত হইবে।
(২)	সোনাপাড়া রেঞ্জ সামাজিক বন বিভাগ, ফেনী	ফেনী	সোনাপাড়া	পূর্ব বড়দলী	উত্তরে-৩৪ চরদিনা দক্ষিণে-মোট ফেনী নদী পূর্বে-বাহির চর পশ্চিমে-৩৪খোন্দাচড়া	৩৯.২৯ একর	অত্র এলাকা সংলগ্ন পরবর্তী পর্যায়ে যে সকল নতুন চর জাগিয়ে তাহাও "সাংযুক্ত বন" বলিয়া পরিগণিত হইবে।
(৩)	সোনাপাড়া রেঞ্জ সামাজিক বন বিভাগ, ফেনী	ফেনী	সোনাপাড়া	নক্ষিণ চর খোন্দাচড়া	উত্তরে-৩৪ চরদিনা, ৩৪ খোন্দাচড়া দক্ষিণে-বাহির চর, ৩৪ মেসোচাচর পূর্বে-৩৪ চরমোক্ষার, ৩৪ এপ্রেন পশ্চিমে-বাহির চর	১০০.০০ একর	অত্র এলাকা সংলগ্ন পরবর্তী পর্যায়ে যে সকল নতুন চর জাগিয়ে তাহাও "সাংযুক্ত বন" বলিয়া পরিগণিত হইবে।
(৪)	সোনাপাড়া রেঞ্জ সামাজিক বন বিভাগ, ফেনী	ফেনী	সোনাপাড়া	৩৪ চর নারায়ন	উত্তরে-বাহির চর দক্ষিণে-বামনী নদী/খোন্দাচড়ার পূর্বে-৩৪ মেসোচাচর পশ্চিমে-বাহির চর, পূর্ব বড়দলী	২০০.০০ একর	অত্র এলাকা সংলগ্ন পরবর্তী পর্যায়ে যে সকল নতুন চর জাগিয়ে তাহাও "সাংযুক্ত বন" বলিয়া পরিগণিত হইবে।
(৫)	সোনাপাড়া রেঞ্জ সামাজিক বন বিভাগ, ফেনী	ফেনী	সোনাপাড়া	৩৪ এপ্রেন	উত্তরে-৩৪ চরমোক্ষার দক্ষিণে-বামনী নদী/খোন্দাচড়ার পূর্বে-৩৪ চরমোক্ষার পশ্চিমে-৩৪ খোন্দাচড়া	৩৩০.০০ একর	অত্র এলাকা সংলগ্ন পরবর্তী পর্যায়ে যে সকল নতুন চর জাগিয়ে তাহাও "সাংযুক্ত বন" বলিয়া পরিগণিত হইবে।

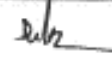
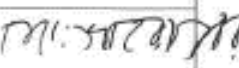
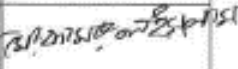
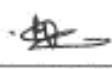
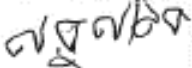
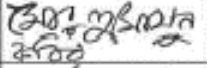
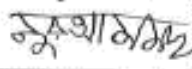
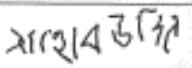
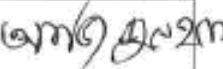
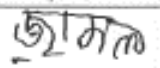
(৩০৯) (মো) ১১৮২/৭৭, ১৮২

## Appendix F. - List of Participants: Stakeholder Consultation

**Bangladesh Economic Zone Authority (BEZA)  
Feni Economic Zone  
Stakeholders Consultation Meeting**

Type of Participants: .....Land.....Owner.....(Farmers Group)

Location: Chur Khondokar Date: 01-7-2019 Mouza: .....

Sl.	Name of Participants	Mobile Number	Name of Village	Signature
১.	শ্রী/শ্রীমতী সোমেন	01816020406	সুপার গ্রাম	
২.	শ্রী/শ্রীমতী	01187731120	চর কুমার -	
৩.	কামাল হোসেন	০১	১১	KAMAL
৪.	কামাল হোসেন	01814958430	সুপার গ্রাম	
৫.	শ্রী/শ্রীমতী সোমেন	01839397862	সুপার গ্রাম	
৬.	শ্রী/শ্রীমতী		চর কুমার -	
৭.	শ্রী/শ্রীমতী	01722384308	সুপার গ্রাম	
৮.	শ্রী/শ্রীমতী	01861065837	চর কুমার -	
৯.	শ্রী/শ্রীমতী	<del>018724</del> 01872477329	৫	
১০.	শ্রী/শ্রীমতী	01830839	চর কুমার	৫   ১   ২
১১.	শ্রী/শ্রীমতী	01815096088	১১	
১২.	শ্রী/শ্রীমতী	01852551791	১১	

**Bangladesh Economic Zone Authority (BEZA)  
Feni Economic Zone  
Stakeholders Consultation Meeting**

Type of Participants: .....Farmers.....Group.....

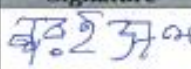
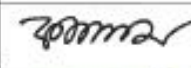
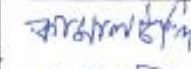

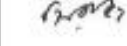
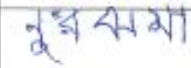
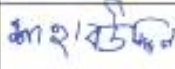
Location: Char Khondokar Date: 01-7-2019 Mouza: .....

SL	Name of Participants	Mobile Number	Name of Village	Signature
১৩	আব্দুল হান্নান	০১৪৬২৩৪০৭২	চর ফরিদা	আব্দুল হান্নান
১৪	আব্দুল মুন্সুর	০১৪১১৬৭১৬৬	চর ফরিদা	স্বাক্ষর
১৫	আব্দুল মঞ্জিল	০১৪৪১৬৬১৬৪	১	স্বাক্ষর
১৬	মা: মতি বেগম	-	মুন্সুরগাঁও	মা: বেগম
১৭	মিঃ হান্নান	-	চর ফরিদা	মিঃ হান্নান
১৮	মা: মতি বেগম	০১৪৬১৭৭৭৫	চর ফরিদা	মিঃ হান্নান

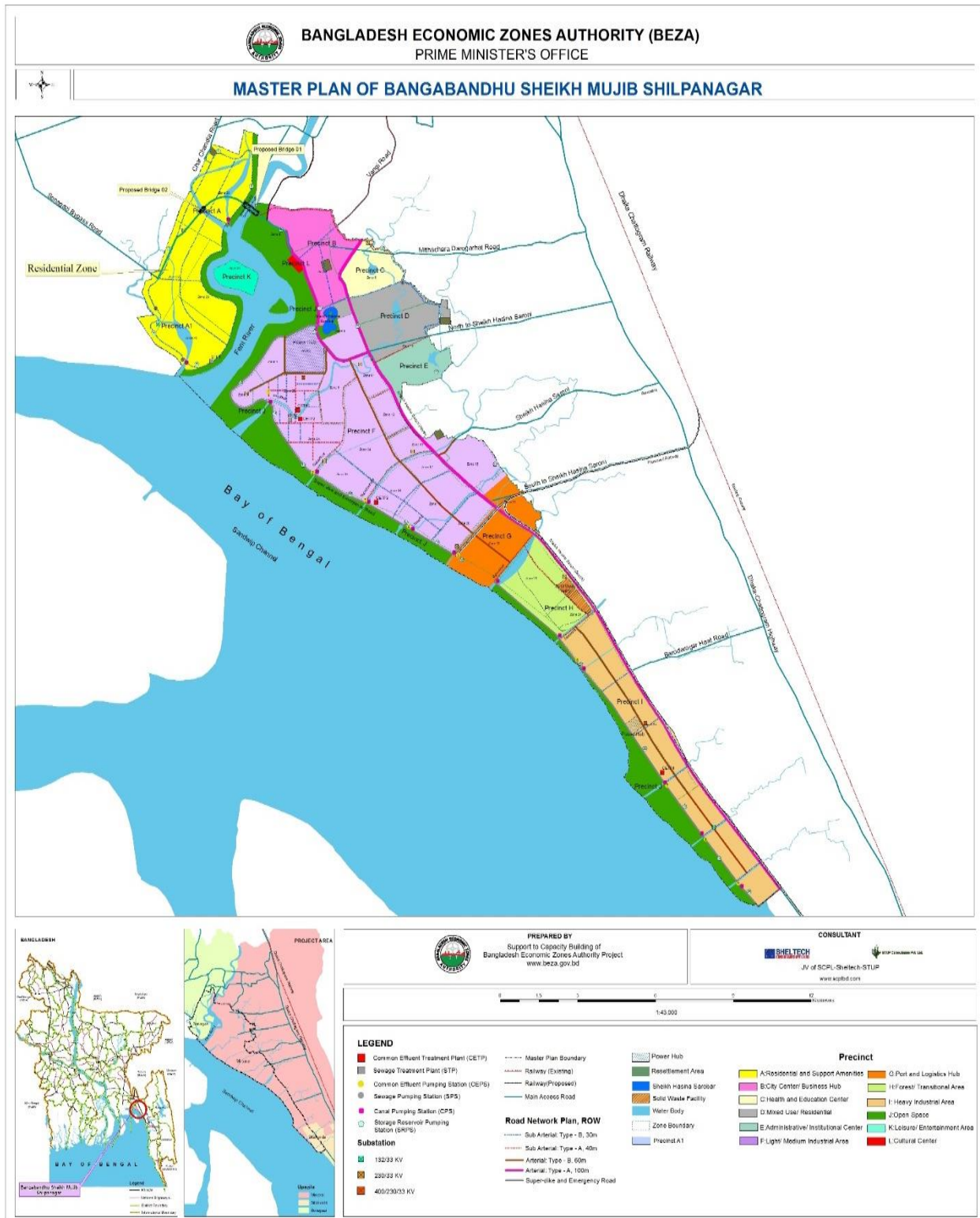
**Bangladesh Economic Zone Authority (BEZA)  
Feni Economic Zone  
Stakeholders Consultation Meeting**

Type of Participants: .... Local..... Elite.....

Location: Char Chandia Date: 30/06/2009 Mouza: .....

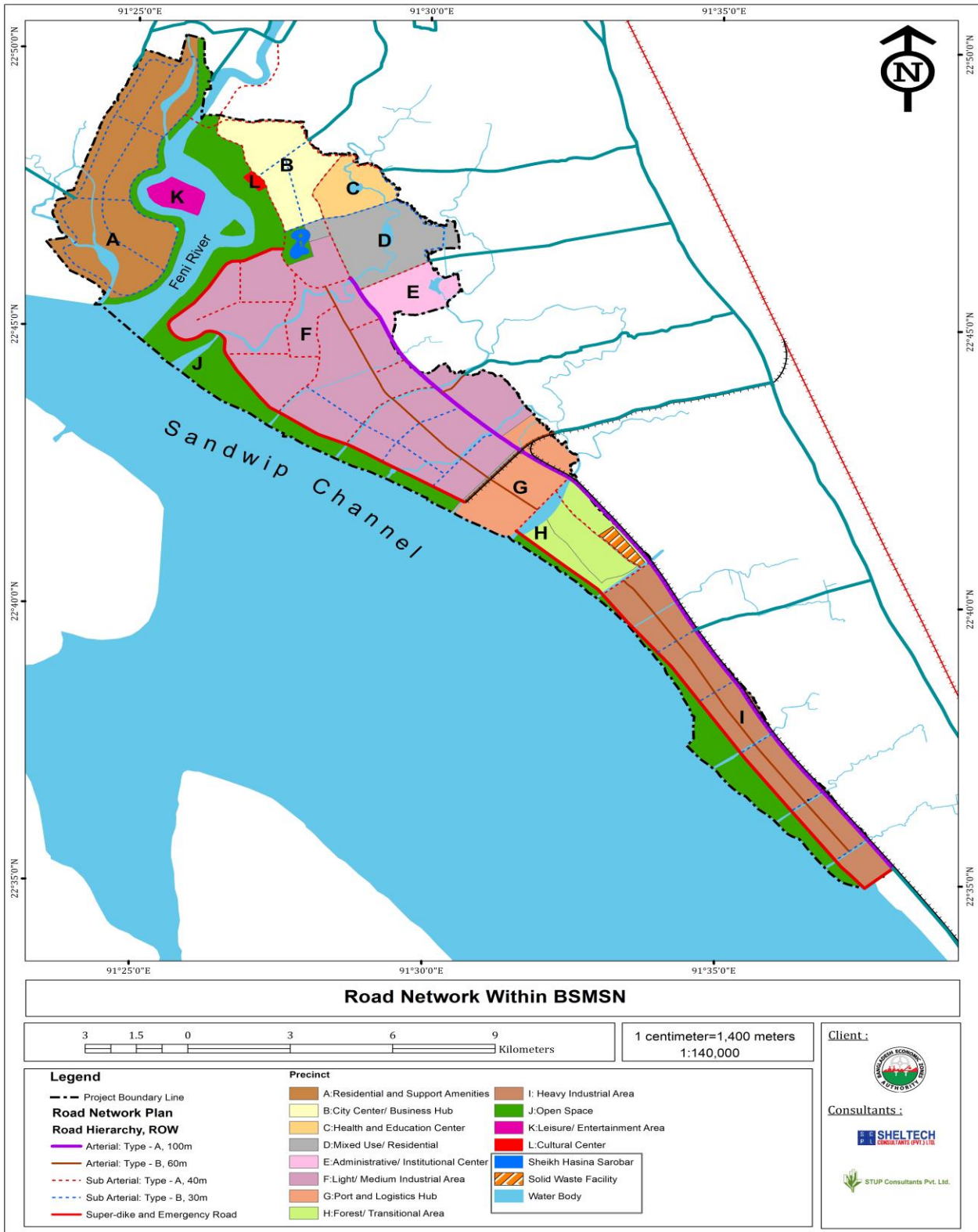
Sl.	Name of Participants	Mobile Number	Name of Village	Signature
1	Nurul Islam Ayub Ali	01829977843	Char Chandia	
2	Abul Kalam	01882921227	Dakhin Char Chandia	
3	Kamel Uddin	01877250083	Dakhin Char Chandia	
4	Nor Karim	01833861164	Dakhin Char Chandia	
5	Sirajul Islam	—	Char Chandia	
6	Noruzzamal	—	Char Chandia	
7	Shahab uddin	01877250083	Char Chandia	

# Appendix G. - List of Maps

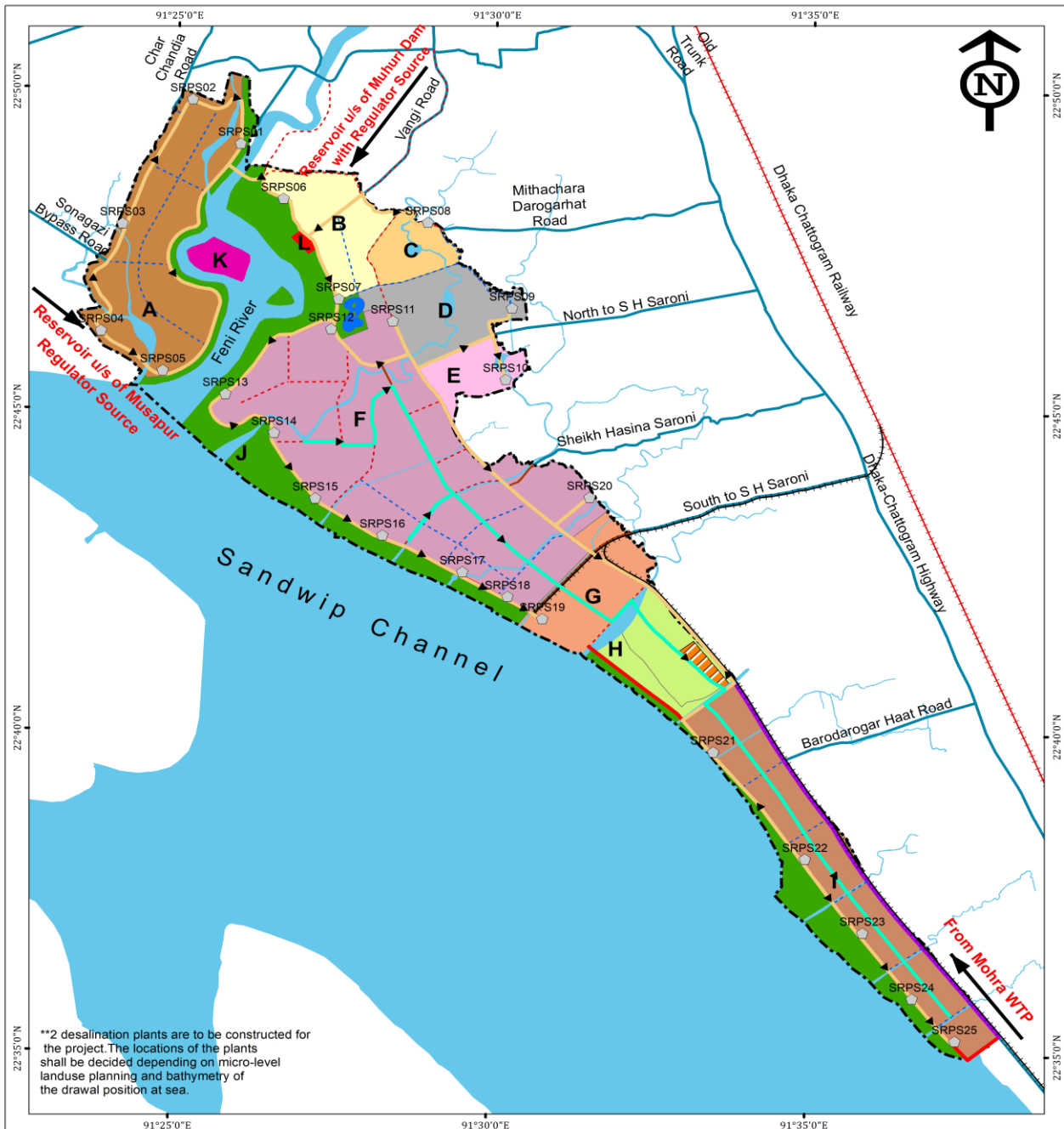


Details Master plan of BSMSN





Details Road network of BSMSN



**Location of Different Water Supply Components of BSMSN**

3 1.5 0 3 6 9 Kilometers

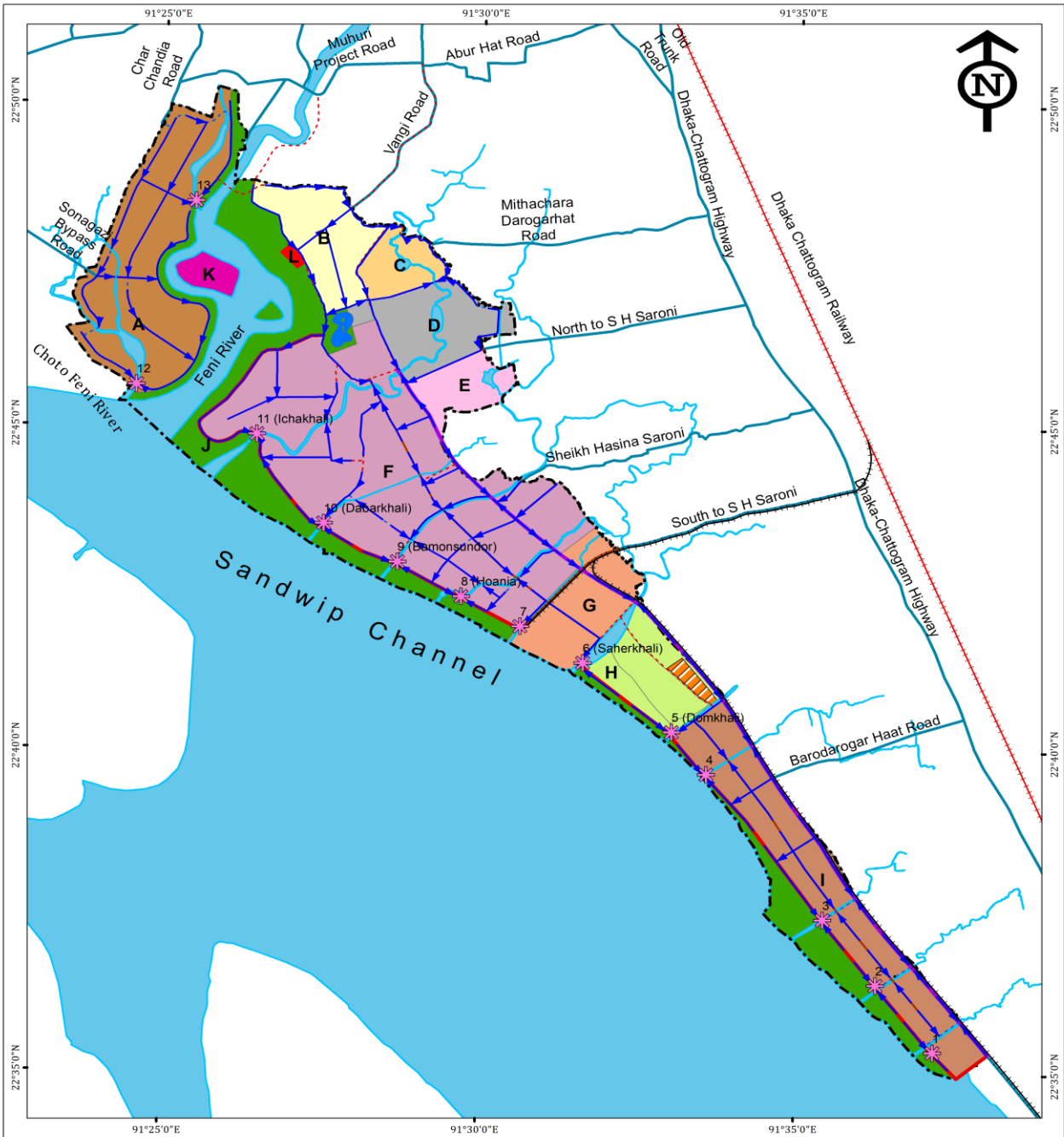
1 centimeter = 1,400 meters  
1:140,000

Client :

Consultants :

Legend	Road Network Plan, ROW	Precinct	
Storage Reservoir Pumping Station	Arterial: Type - A, 100m	A: Residential and Support Amenities	I: Heavy Industrial Area
Trunk Water Supply Main	Arterial: Type - B, 60m	B: City Center/ Business Hub	J: Open Space
Recycled Wastewater Line	Sub Arterial: Type - A, 40m	C: Health and Education Center	K: Leisure/ Entertainment Area
Project Boundary Line	Sub Arterial: Type - B, 30m	D: Mixed Use/ Residential	L: Cultural Center
Main Access Road	Super-dike and Emergency Road	E: Administrative/ Institutional Center	Sheikh Hasina Sarobar
Railway (Existing)		F: Light/ Medium Industrial Area	Solid Waste Facility
Railway (Proposed)		G: Port and Logistics Hub	Water Body
		H: Forest/ Transitional Area	

Location of Different Water Supply Components of BSMSN



**BSMSN Drainage Network Plan**



1 centimeter = 1,400 meters  
1:140,000

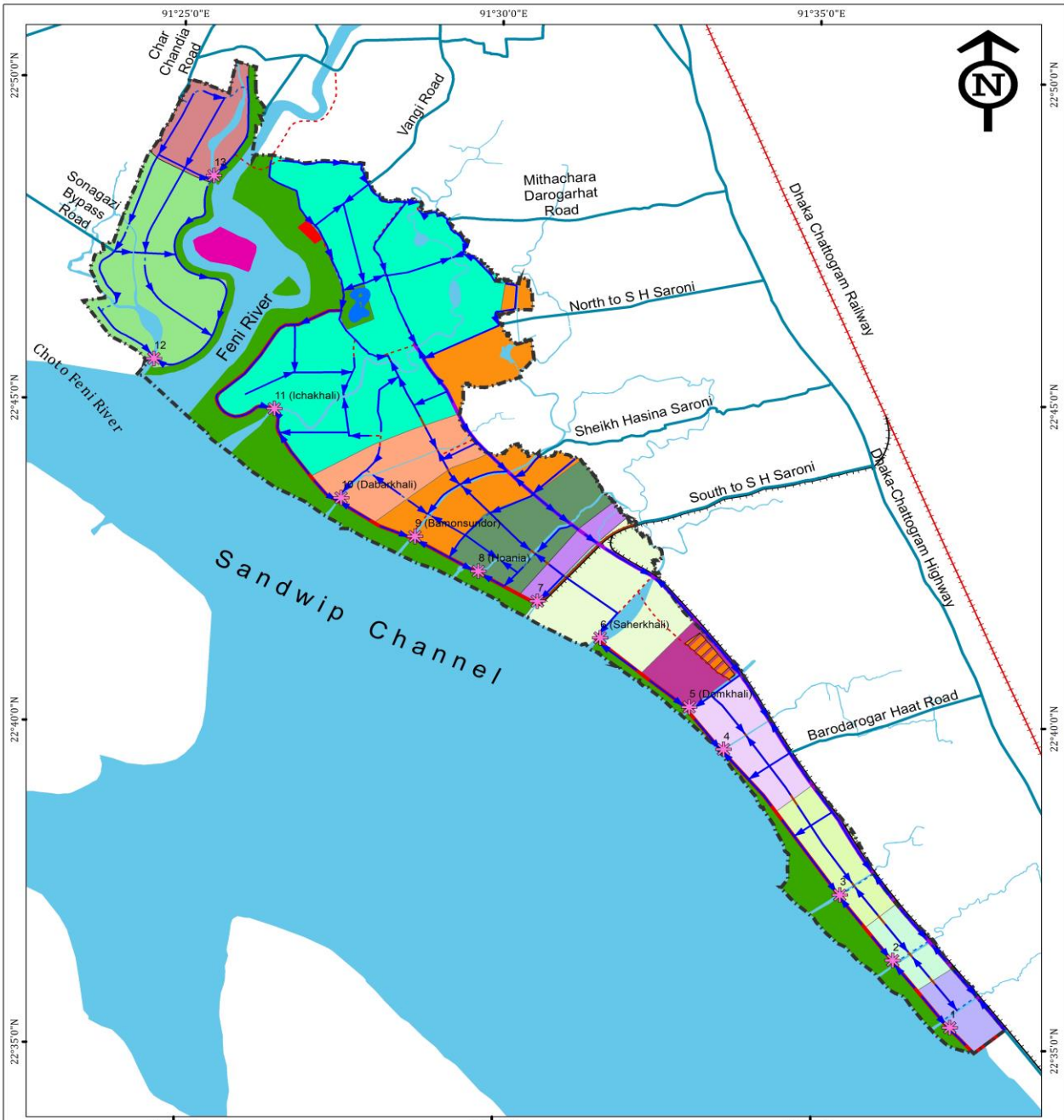
Legend		Road Network Plan		Precinct	
	Canal Pumping Station Storm Water Drainage Network	<b>Road Hierarchy, ROW</b>			
	Project Boundary Line		Arterial: Type - A, 100m		A: Residential and Support Amenities
	Railway (Existing)		Arterial: Type - B, 60m		B: City Center/ Business Hub
	Railway (Proposed)		Sub Arterial: Type - A, 40m		C: Health and Education Center
	Main Access Road		Sub Arterial: Type - B, 30m		D: Mixed Use/ Residential
			Super-dike and Emergency Road		E: Administrative/ Institutional Center
					F: Light/ Medium Industrial Area
					G: Port and Logistics Hub
					H: Forest/ Transitional Area
					I: Heavy Industrial Area
					J: Open Space
					K: Leisure/ Entertainment Area
					L: Cultural Center
					M: Sheikh Hasina Sarobar
					N: Solid Waste Facility
					O: Water Body

**Client :**

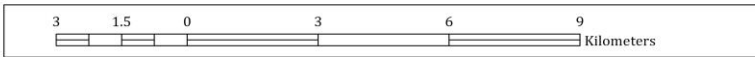
**Consultants :**

STUP Consultants Pvt. Ltd.

*BSMSN Drainage Network Plan*



**Catchment Area of Drainage Channels Across BSMSN**



1 centimeter = 1,400 meters  
1:140,000

Legend		Road Network Plan, ROW		Drainage Catchment		Land Use	
	Canal Pumping Station		Storm Water Drainage Network		Project Boundary Line		Main Access Road
	Railway (Existing)		Super-dike and Emergency Road		J:Open Space		K:Leisure/ Entertainment Area
	Railway (Proposed)		Arterial: Type - A, 100m		EDC1		L:Cultural Center
			Arterial: Type - B, 60m		EDC2		Sheikh Hasina Sarobar
			Sub Arterial: Type - A, 40m		EDC3		Solid Waste Facility
			Sub Arterial: Type - B, 30m		EDC4		Water Body
					EDC5		
					EDC6		
					EDC7		
					EDC8		
					EDC9		
					EDC10		
					EDC11		
					EDC12		
					EDC13		

**Client:**  
  
 Bangladesh Economic Zone Authority

**Consultants:**  
  
 SHELTECH CONSULTANTS (PVT.) LTD.  
  
 STUP Consultants Pvt. Ltd.

*Catchment Area of Drainage Channels Across BSMSN*

The calculation given below is applicable for preliminary design of a landfill.

#### BASIC DATA

Location	:	Periphery of BSMSN
Waste Generation	:	0.35 kg / capita / day (Bangladesh Standard for cities)
Population considered in 2040:		4.41 million (4,415,240 population)
Waste Generation in 2040	:	$0.35 \text{ kg} \times 4.41 \times 10^6 = 500,000 \text{ kg/per day}$ 1544 tons / day
Design Life	:	Active Period = 20 years  Closure and Post Closure Period=25 years
Topography	:	Flat ground

#### Landfill Capacity, Landfill Height, Landfill Area

Total Waste Generation in 20 Years (in 2040) = 1544 ton /day x 365x 20=  $11.27 \times 10^6$  tons

Total Waste Volume (assumed density 0.85 t/cu.m.)

$$V_w = (11.27 \times 10^6) / 0.85 \\ = 13.27 \times 10^6 \text{ cu.m.}$$

Volume of Daily Cover (on the basis of 15 cm soil cover on top and sides for lift height of 1.5 to 2 m)

$$V_{dc} = 0.1 \times 13.27 \times 10^6 \text{ cu.m.} \\ = 1.32 \times 10^6 \text{ cu.m.}$$

Total volume required for components of liner system and of cover system (on the assumption of 1.5m thick liner system (including leachate collection layer) and 1.0 m thick cover system (including gas collection layer) ( $k = 0.25$  for 10 m high landfill, 0.125 for 20 m high landfill and 0.08 for 30 m high landfill)

This is valid for landfills where width of landfill is significantly larger than the height)

$$V_c = 0.125 \times 13.27 \times 10^6 \text{ cu.m. (Considering 20 m height)} \\ = 1.65 \times 10^6 \text{ cu.m.}$$

Volume likely to become available within 10 years due to settlement / biodegradation of waste

$$V_s = m V_w \\ = 0.10 \times 13.27 \times 10^6 \text{ cu.m.} \\ = 1.32 \times 10^6 \text{ cu.m.}$$

( $m = 0.10$  for biodegradable waste;  $m$  will for less than 0.05 for incinerated/inert waste)

#### First Estimate of Landfill Volume

Calculation for the Size of the Landfill for BSMSN

$$\begin{aligned}
 C_i &= V_w + V_{dc} + V_c - V_z \text{ (cu.m.)} \\
 &= (13.27 + 1.32 + 1.65 - 1.32) \times 10^6 \text{ Cu.m.} \\
 &= 14.92 \times 10^6 \text{ Cu.m.}
 \end{aligned}$$

#### Likely Shape of Landfill

Rectangular in plan (length : width = 2:1)

Primarily above ground level, partly below ground level.

Area Restrictions : Nil

Possible Maximum Landfill Height = 20 m

$$\text{Area Required} = (14.92 \times 10^6) / 20$$

$$= 0.746 \times 10^6 \text{ sq.m.}$$

$$= 184.34 \text{ Acres}$$

$$= 184.0 \text{ (Appx.)}$$

Area required for MSW land fill = 184.0 Acres

Total Land requirement :

Land for MSW land fill = 184.0 Acres

Land for other infrastructure = 30 acres

Land for composting plant = 10 acres

Land for industrial hazardous waste storage / management = 40 acres

Land for biomedical waste management = 10 Acres

Total Land for solid waste management = 274.0 Acres of land

#### Landfill Section And Plan :

Landfill Section and Plan is evaluated on the basis of

- (i) 4:1 side slope for the above-ground portion of the landfill.
- (ii) 2:1 side slope for the below-ground portion of the landfill.
- (iii) Material balance for daily cover, liner and final cover material through excavation at site.
- (iv) Extra space around the waste filling area for infrastructural facilities

Calculation for the Size of the Landfill for BSMSN