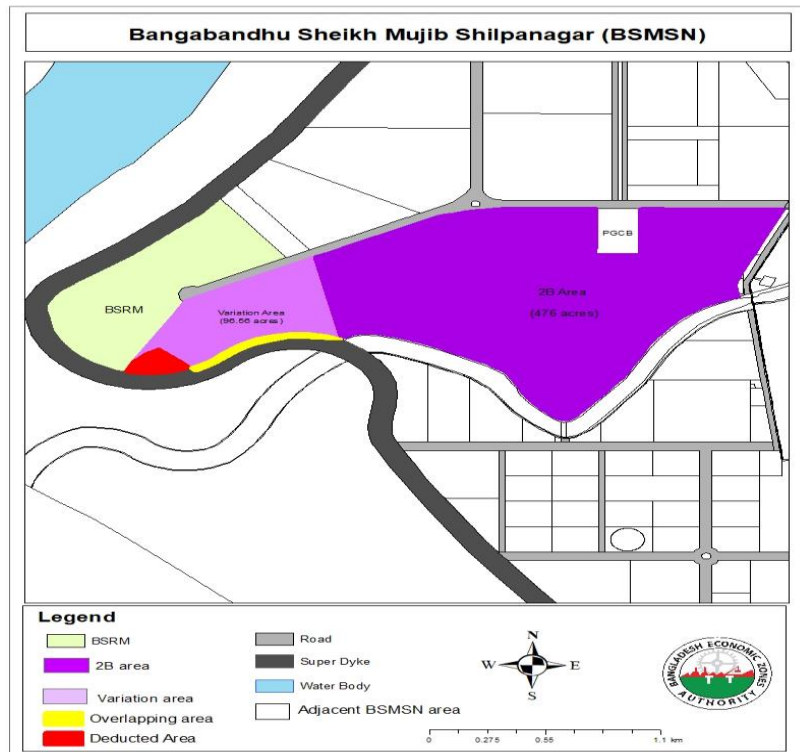




Addendum to Environmental Impact Assessment Report

For

Additional 96.56 acres landfilling adjacent to the
Existing Mirsarai EZ-2, Private Sector
Development Support Project (PSDSP)



Bangladesh Economic Zones Authority (BEZA)

Prime Minister's office

Executive Summary

The Bangladesh Economic Zone Authority (BEZA) is developing Mirsarai Economic Zone-2 on 1311 acres of land located at the Eastern side of the Bay of Bengal along the coast of Chattogram District under the World Bank-financed Public Sector Development Support Project (PSDSP). Mirsarai EZ-2 comprises of two pieces of land, EZ-2A and 2B. The eastern side of the area is bounded by an old embankment while a new super dyke at the western side along the sea has been constructed to protect the area from tidal storm surges. Project activities under PSDSP include land filling using materials dredged about 2.5 km offshore from EZ-2 and some on-site and off-site infrastructure such as internal roads, water supply network, administration building and access road. Once developed, land would be leased out to the private investors to set up industries. Government has also planned to set up a large industrial city namely Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) in phases on an area of on 30,000 acres of land which would include Mirsarai EZ-2.

Due to large demand for such developed land, BEZA has planned to develop additional 96.5 acres of land adjacent to Economic Zone 2B that lies inside the super dyke. An Environmental Impact Assessment was conducted for Mirsarai Economic Zone-2 in 2016. As this additional 96.5 acre area was not included in that assessment, this addendum has been prepared to assess the environmental and social risks and impacts of proposed additional work.

Baseline environmental and social data derived from the PSDSP ESIA and the ESIA for the PRIDE¹ Project were analyzed as part of the assessment. Air quality data from three different locations in EZ-2 collected in March 2020 shows that, air quality of the area is good, and all the parameters are within the acceptable ambient standard except PM₁₀ and SPM. Out of three locations, value of PM₁₀ at one location was found slightly higher than the national ambient standard. Values of SPM at all the three locations were found slightly higher than the ambient standard. This appeared to be mostly due to some ongoing land development and other construction works. Sound levels measured during March 2020 shows that values are slightly higher than the national ambient sound level standard. An investigation carried out by the Department of Public Health Engineering (DPHE) in 2015 identified two ground water aquifers in the area. A shallow aquifer exists at a depth of around 50 to 60 m from the ground level which is saline and contaminated by arsenic. A deep aquifer exists at a depth of around 180 m. Most of the water quality parameters of this deep aquifer meet national drinking water quality standard.. A number of canals exist in and around the EZ-2 site and the proposed area which plays important role in natural drainage. Feni River is close to the project location. Surface water quality analysis shows that most of the parameters of these water bodies are higher than the national ambient standard. Fish habitats in the area of influence are creeks, canals, rivers, aquaculture ponds and natural ponds. Water in these bodies varies from fresh to brackish. The Feni River estuary has moderate species diversity. Species diversity is higher

¹ ESA of PRIDE project, which is the successor of PSDSP, was conducted in February 2020. PRIDE project would support construction of the some basic and common infrastructure on the land being developed under PSDSP i.e 2A, 2B and proposed additional area.

in the estuarine mouth compared to that of its upstream direction. Various trees like Akashmoni, Jhao, coconut trees, etc. exists on the side of the access road. There are no major forests within 10 km radius area of EZ-2 site. Cows, goats, dogs, cats, mule, horse, monkey, fox, deer are found in the nearby area. No significant wild fauna was found in study area. Apart from the mammals, reptiles like chameleon, garden lizard & Gohar Saanp were also observed during the field visit. There is no ecologically sensitive area or biological hotspot in or around the EZ-2 or the proposed additional area. The dredging location is around 2.5km away from the shore. Due to turbidity of water and soft bottom strata, this part of the Bay of Bengal is not suitable for growth of seaweed.

Administratively, the Mirsarai EZ-2 and proposed additional area is located within the Mirsarai Upazila. Project adjacent unions of Mirsarai Upazila are Ichhakhali, Mogadia & Saherkhali. There is no settlement within the original project area or in the proposed additional land. According to the Census 2011 report, the total population in Mirsarai Upazila is 3,98,716. Total households of the Upazila is 7,954 & total land area is 119,324 acres. The population density per sq. km of the area is 826 persons. The 2011 Census data reveals that the decadal population growth rate for the Upazila is 8.07% in comparison to the 2001 Census data. The majority of the population in Mirsarai Upazila is dominated by Muslims (86.12 %), followed by Hindus (12.36%), Buddhists (1.22 %) and Christians (0.018 %). The floating population of Upazila is 0.04% of the total population. There is no historical, cultural and archaeological site within the project area.

The proposed additional work would include dredging operation and filling the additional area using the dredged material. About 1.36 million cubic meters of sand would be required for filling up this additional area up to the desired level. Impact on air quality, noise level, surface and ground water quality would not be significant due to the proposed additional work. The dredging operation would be carried out from the same location as was done for the EZ 2A and 2B. The dredging location is around 2.5 km from the shoreline and was selected as per the direction of Bangladesh Water Development Board (BWDB). A cutter suction dredger with a capacity of 15,000 cubic meter per day would be used for the purpose which lifts the dredged material through a suction pipe. This would not increase the turbidity of the water column at the dredging location significantly. Seaweeds are not found in the dredged location as the bottom strata is not suitable but also because of high water turbidity. The project location is close to the estuary of the Feni and Meghna Rivers and receives large quantity of sediment every year. The area was formed through deposition of large quantity of sediments that builds up over the years through the process of erosion and accretion of land due to the influence of the upstream river system and tidal effect. The dredged material would be transported to the filling area by pipelines. Analysis of dredged material indicates presence of a number of heavy metals. However, the concentrations of these heavy metals were found acceptable to be used as clean fill material as per internationally accepted standards. The low salinity and other chemical properties such as pH value makes the sediment less prone to heavy metal leaching and less susceptible to increase of salinity of the shallow aquifer.

However, as the leaching of heavy metal is a possibility in the long run, this parameter in ground water should be regularly monitored during the operation phase. Influx of labor and construction activities may pose risks to community health and safety and security of women and girls which should be strictly monitored using the project GRM.

A rapid cumulative impact assessment was also undertaken to assess the cumulative impact of the proposed additional works. Based on a review of baseline information and the determination of key environmental and social issues, five VCs were selected; air quality, water quality, water quantity, sediment quality and employment. The impacts of land development and nearly completed and ongoing construction activities in and around the proposed area were considered. Operation phase impacts were not considered as the operational details and industry descriptions are not available in sufficient detail at this time for the purpose of the RCIA; this will form part of the full CIA as part of the regional environmental and social assessment (RESA) of the Private Investment and Digital Entrepreneurship (PRIDE) project. The RCIA considers the potential contribution of additional landfilling activities, the construction of super dyke around the EZ-2 and ongoing construction work of a power plant approximately 3km away towards the east to cumulative impacts on the selected VCs based on a scoping of potential cumulative impact issues. It does not include consideration of cumulative impacts of the future proposed projects and activities during operation phase for which sufficient information are not available currently. The RCIA concludes, providing that mitigation measures are employed, that there are no anticipated adverse cumulative impacts of project activities during the construction phase. Some localized impacts of short-term duration are expected on air quality and risks exist to water quality if proposed mitigation measures are not fully implemented. Monitoring of project and control site conditions should be conducted throughout the construction phase. During the anticipated operation phase of PRIDE, including additional project activities associated with Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN), there is a potential for cumulative impacts on selected VCs, the extent of which will be dependent upon definition of proposed projects and activities in the industrial park. A set of recommendations have been made which should be considered in a full CIA to be completed as part of the proposed RESA under PRIDE project.

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1. Introduction

The Government of Bangladesh (GoB) has taken up an initiative to provide industrial land and infrastructure to increase private and foreign investments to support its development goals. The Government plans to create 100 economic zones over the next decade. Bangladesh Economic Zone Authority (BEZA) is the overall agency responsible for establishments of Economic Zones (EZs) and it aims to establish EZs in all potential areas of Bangladesh including backward and underdeveloped regions with a view to encouraging rapid economic development through increased and diversified industries, employment, production and export enhancement. The Bangladesh Economic Zone Act 2010 was passed by GoB to make provisions for the establishment of Economic Zones (EZs). With an ambit of enhancement of economic development in the country, GoB with support from World Bank has been developing EZs at various potential locations in Bangladesh through Private Sector Development Support Project (PSDSP). One of such sites under development is the Mirsarai EZ-2, located at Mirsarai Upazila of Chattogram district.

2. Background Information

Bangladesh Economic Zone Authority (BEZA) is establishing the Mirsarai Economic Zone-2 on an area of about 1311 acre through land reclamation with financial support from the ongoing WB financed Public Sector Development Support Project (PSDSP). The area is located at the eastern side of the Bay of Bengal along the coast of Chattogram District. The project is developing the land in areas where gradual natural landfiling through deposition of sediments by the shore of the Bay of Bengal through sedimentation by rivers and tributaries occurred. A super dyke has been constructed along the shoreline and the sedimented low land inside the super dyke has been reclaimed by filling up the area using dredged material. Some off-site and onsite infrastructure such as administration building, widening of access road, construction of internal roads, sluice gate etc. are also being financed through the project. Once developed, land would be leased out to the private investors to set up industries in this EZ.

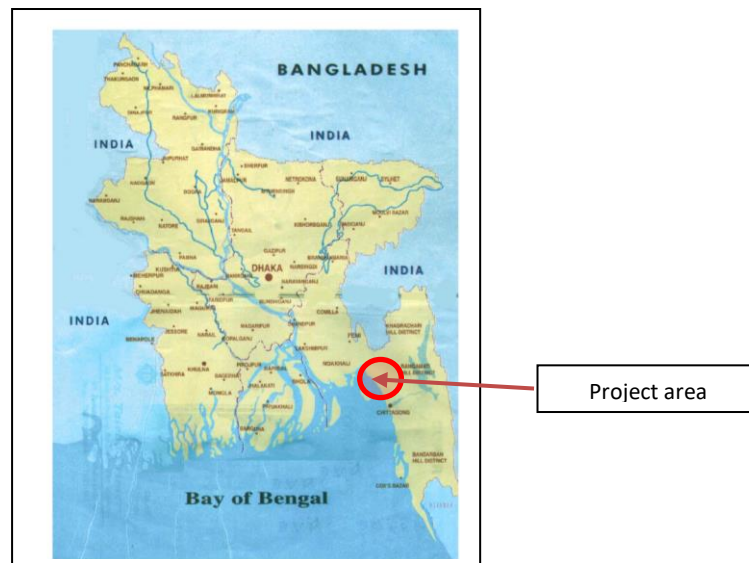


Fig-2-1: Location of the PSDSP

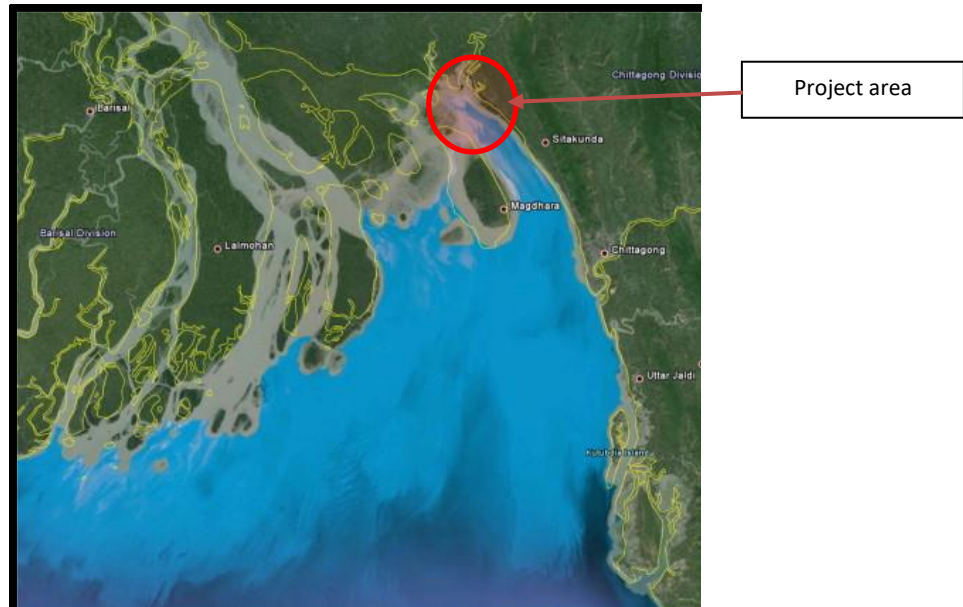


Fig-2-2: Location of the PSDSP

Mirsarai Economic Zone-2 comprises of two pieces of land, EZ-2A (880 acre) and EZ-2B (420 acre) and some land required for construction of Super dyke and other ancillary facilities as shown in Fig-2-3.



Fig-2-3: Location of Mirsarai EZ-2 (Zone EZ-2A and 2B) under PSDSP

3. Proposed additional work under PSDSP

Considering the high demand of developed land from the private investors, BEZA plans to develop an additional 96.56 acres of land adjacent to the existing EZ-2B as shown in Fig-3-1. This work will be executed by the same contractor who has developed land for EZ-2A and EZ-2B under PSDSP in the form of a variation order to the original contract agreement.



Fig-3-1: Proposed additional area for development

4. Objective of the Study

PSDSP is classified as Red category as per Environmental Conservation Rules, 1997 of Bangladesh and Category A project as per OP 4.01 of the WB safeguard policy. An Environmental Impact Assessment (EIA) was conducted for Mirsarai EZ-2 in 2016 as per the requirement of the WB and GoB and environmental clearance certificate was obtained from Department of Environment (DoE). As the proposed additional area was not included in the EIA for Mirsarai EZ-2, this assessment report has been prepared as an addendum to the original EIA report. The main objective of this addendum is to assess the likely risks and impacts of undertaking this proposed additional work.

5. Description and Location of Proposed Additional Activity

As mentioned earlier, the PSDSP project area is located at the eastern side of the Bay of Bengal along the coast of Chattogram District. The area is formed through accretion of land by sediment deposition. The proposed additional area is adjacent to the newly developed EZ-2B as shown in Fig-3-1. The area is under Mirsarai Upazila of Chattogram district near Abu Torab Village. The site is around 10 Km west to the national Highway (Dhaka-Chattogram Highway) with Chattogram City 60 Km south of this location. Bartakia Railway station and Mirsarai Railway station is 9.5 & 10.0 km respectively towards south to the site.

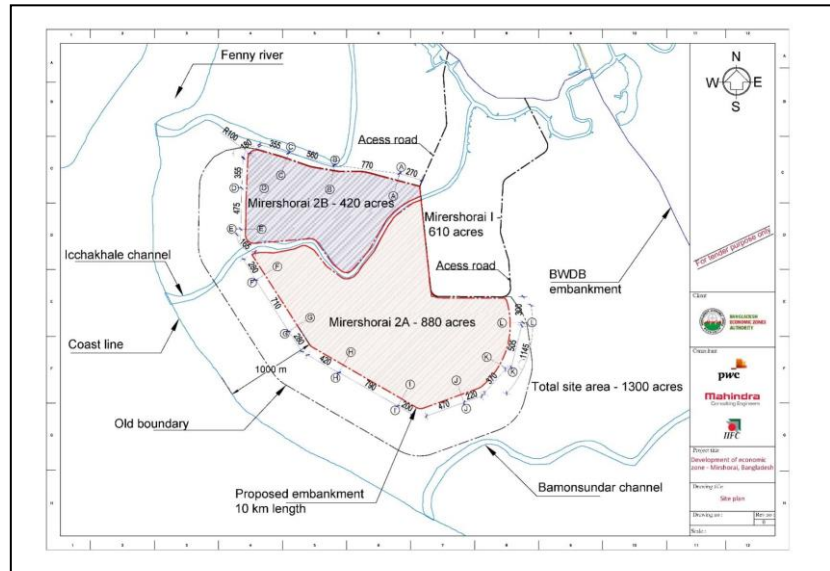


Fig-5-1: Location of the proposed PSDSP area

An embankment was constructed by BWDB along the coast of Chattogram District running north south parallel to Dhaka Chattogram Highway to protect Chattogram District from the tidal water and storm surges. Now, a new super dyke has been constructed about 3km away from this old embankment along the shoreline. The location of PSDSP project site as well as the proposed additional area lies in between these two embankments.

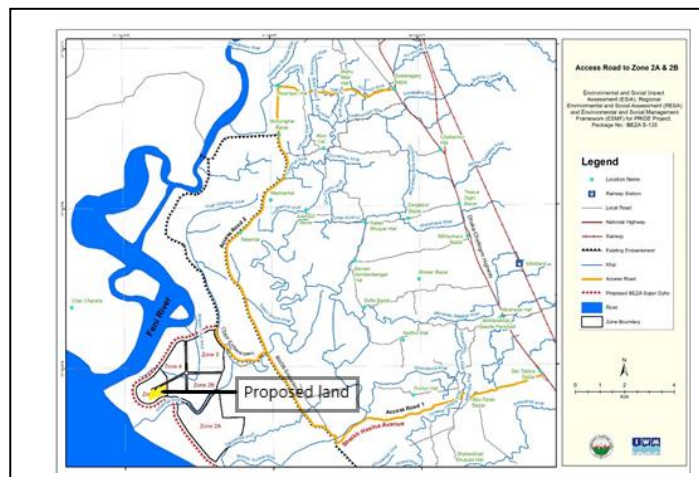


Fig-5-2: Location of the proposed area

6. Environmental and Social Baseline

Bangladesh is a big delta and geographically situated in the area of the deltaic GBM (Ganges-Brahmaputra- Meghna) system, having the Himalayas in the north and the Bay of Bengal in the south. Most of the country is formed by a low lying plain with a gentle slope from north to south, where the land meets the Bay of Bengal. Every year, the Ganges, the Brahmaputra and the Meghna river discharge about $1 \times 10^{12} \text{ m}^3$ of sediment laden water into the estuary of Lower Meghna. Bangladesh coastal zone includes coastal plains, island, tidal flat, estuaries, neritic and offshore waters. The coast of Bangladesh can be broadly divided into three distinct geo-morphological regions: western, central

and eastern region. The western region includes the Sundarban, world's largest patch of naturally occurring mangroves. The central region is situated between eastern and western region from Tetulia river to Big Feni river estuary, including the mouth of Meghna river. The eastern region extends from big Feni River to Badar Mokam, the southern tip of the mainland. This part is characterized by muddy flat and sandy beaches. The project site of PSDSP and the proposed additional area is located in this region at the eastern coast of the Bay of Bengal near the estuary of Feni river. It is also within the influence of the estuary of the mighty river Meghna. The Lower Meghna River has one of the highest sediment discharges of all the river systems in the world. A recent study revealed that about 700 M.tons of sediment enters the lower part of the estuary, forming new lands through accretion either laterally or vertically of the shelf and islands area. One third of the sediment load is deposited in the flood plains of the upper estuary while the rest is deposited in the bay (Mohammad and Paolo 2013). Due to high sediment input from upstream and high tidal energy, Meghna estuary is very dynamic in nature and characterized by erosion and accretion on the scale of several thousand hectares of land per year (Sarker, Akter et al. 2009).

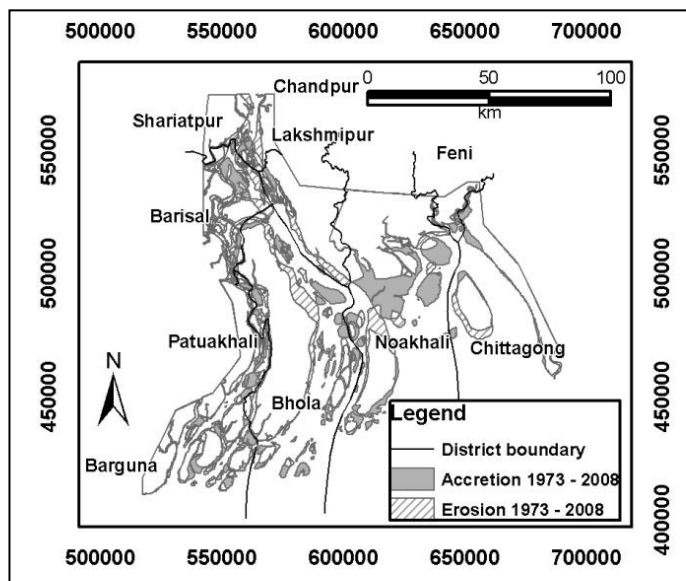


Fig 6-1: Erosion and accretion in the Meghna Estuary during the period 1973–2008

Reference: (Sarker, Akter et al. 2009)

The environmental baseline information of the project area was captured during the environmental impact assessment of Mirsarai EZ-2 prepared in 2016². The updated baseline information was also captured while that EIA report was updated for preparation of Environmental and Social Assessment (ESA) report for the Private Investment and Digital Entrepreneurship (PRIDE) project³ in February

² The EIA for Mirsarai EZ 2A and 2B were conducted in 2016 and reviewed and cleared by the WB.

³ ESA of PRIDE project was conducted in February 2020. PRIDE project is the successor of PSDSP. Once land development of EZ 2A and 2B would be completed under PSDSP, several basic and common infrastructure such as CETP, solid waste management system, desalination plant etc. would be constructed through the PRIDE project to ensure sustainable development and to attract the private investors.

2020. Data from environmental monitoring report of PSDSP collected in March 2020 were also used in preparing this report.

Environmental Baseline

Mirsarai Upazila in Chattogram District, where the project site is located, falls in the exposed coastal zone. The project area lies in the South-Eastern climate zone of the country and shows three main seasons. The Southwest Monsoon lasts from May to October with a 90% of the annual rainfall and high humidity. The annual average rainfall is 3419mm. The Northeast Monsoon lasts from November to March. The hottest season extends from late March to May. The average maximum and minimum temperature are 36°C and 7.5°C respectively. Air quality monitoring data from at three locations in PSDSP project area recorded in March 2020 shows that overall air quality of the area is good and most of the parameters meet national ambient AQ Standard though the SPM and PM₁₀ values were found higher than ambient standards mostly due to some ongoing construction works.

Table:6-1 Air quality Monitoring Data

Parameter	Unit	Concentration Present			Bangladesh Standard**	Duration (hours)	Method of Analysis
		AAQ_01 22.75357° N 91.45262° E	AAQ_02 22.74132° N 91.46050° E	AAQ_03 22.74412° N 91.44687° E			
PM ₁₀	µg/m ³	159.27	147.39	149.20	150	24	Gravimetric
SPM	µg/m ³	288.781	211.11	214.90	200	24	Gravimetric
PM _{2.5}	µg/m ³	58.23	52.21	53.19	65		Gravimetric
SO ₂	µg/m ³	40.45	27.34	30.56	365	24	West- Geake
NO _x	µg/m ³	76.21	65.23	70.34	100	Annual	Jacob and Hochheiser
O ₃	µg/m ³	11.34	08.39	10.45	NSY	8	Photometric
CO*	ppm	1	1	1	9	8	CO-Meter
Weather Condition	-	Sunny	Sunny	Sunny	-	-	-

Note:

* CO concentrations and standards are 8-hourly only.

** 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.

NYS: Not Yet Standardized



Photo 6-1: Ongoing work at PSDSP site

Major water bodies in and around the PSDSP project site and the proposed additional area are Feni River, Ichhakhali canal, Daborkhali canal and Bamon Sundar canal. Ichhakhali canal passes by the East side of the proposed additional area. As per inundation risk map, inundation depth varies from 5 m to 6 m. The area is highly prone to cyclone and has faced severe cyclones in the past. Flow in Feni River varies from 20.5 cu m in February to 164.3 cu m in August. Water level of the river varies from 3.47 m to 4.146 m. HFL level during the 1974 flood in Feni River at Mirsarai was +7.3 m above mean sea level (AMSL). Water of Feni River is fresh in upstream and saline in downstream. Salinity in downstream varies with season. Maximum salinity recorded in the River is 21.2 ppt. Tidal surge during the cyclone at the site is +5.4 m AMSL and maximum surge level in Chattogram was recorded to be maximum +8.8 m AMSL. Most of the water quality parameters of the nearby waterbodies were found higher than the national ambient standard.

Noise Level was measured at five locations within the PSDSP project area. The locations along with GPS coordinates are summarized with results in Table 6-2. Measurement was conducted from 13th and 14th March, 2020. Noise measurement at each location was conducted continuously for 15 minutes both at day and night time. The test result shows that the values are higher than the national ambient standard at four locations both during day and night time.

Table 6-2: Ambient Noise level in the project area

Sample ID	Sample Location	GPS Location	Land Use Category	Time		Noise Level (dBA) (LAeq)		ECR 1997 Standard	
				Day	Night	Day	Night	Day	Night
NM_01	In front of Energypac Project	22.75357° N 91.45262° E	Silent	15.56	22.10	57.81	41.56	45	30
NM_02	Base Camp Area	23.75097° N, 91.45688° E	Residential	12:41	19.57	55.98	46.09	50	40
NM_03	Back Side of the Base Camp Area	23.74980° N, 91.45568° E	Silent	16.42	20.09	51.22	39.21	45	30
NM_04	Sub-station Area	22.75253° N, 91.45908° E	Mixed	10.38	20.39	51.19	49.43	60	50
NM_05	Bridge Construction Area	22.75160° N, 91.45908° E	Mixed	12.04	21.05	61.09	49.19	60	50

Groundwater samples were collected from the deep aquifer from four locations within the PSDSP project area of 2A and 2B on 14th March, 2020. The locations along with results are shown in Table 6-3. The test result shows that all the tested parameters meet the national drinking water quality standard set by government of Bangladesh.

Table-6-3: Ground water quality test results

Sl no	Parameter	Concentration				Unit	ECR 1997 Standard
		GW-1 (Near Energypac Project)	GW-2 (Near Labor Shed)	GW-3 (Sub-station Area)	GW-4 (Base Camp Area)		
1	pH	7.8	8.30	8.29	7.40	-	6.5-8.5
2	Turbidity	0.31	0.66	0.27	0.52	NTU	10
3	Dissolved Oxygen (DO)	9.20	8.06	8.13	8.90	mg/L	6
4	COD	<3.0	<3.0	<3.0	<3.0	mg/L	4
5	Total Dissolved Solid (TDS)	189.7	106.0	82.5	74	mg/L	1000
6	Total Suspended Solid (TSS)	26	15	16	32	mg/L	150-600
7	Temperature	24	25	23	23	°C	20-30

The project area is free from tidal flooding due to the recent site development work. Moreover, the area will be protected from storm surges by the super dyke which has already been constructed. Within the project site, there is natural drainage system e.g. water falls into the Ichhakhali canal which is finally drained out into the sea.

The area falls under seismic Zone-II on the earthquake map which means that earthquake load should be taken into consideration in designing the infrastructure.

There are a number of canals in and around the EZ-2 site. The Feni River is also close the project area. Fish habitats in the area of influence are creeks, canals, rivers, aquaculture ponds, natural ponds. Water in these bodies varies from fresh to brackish.

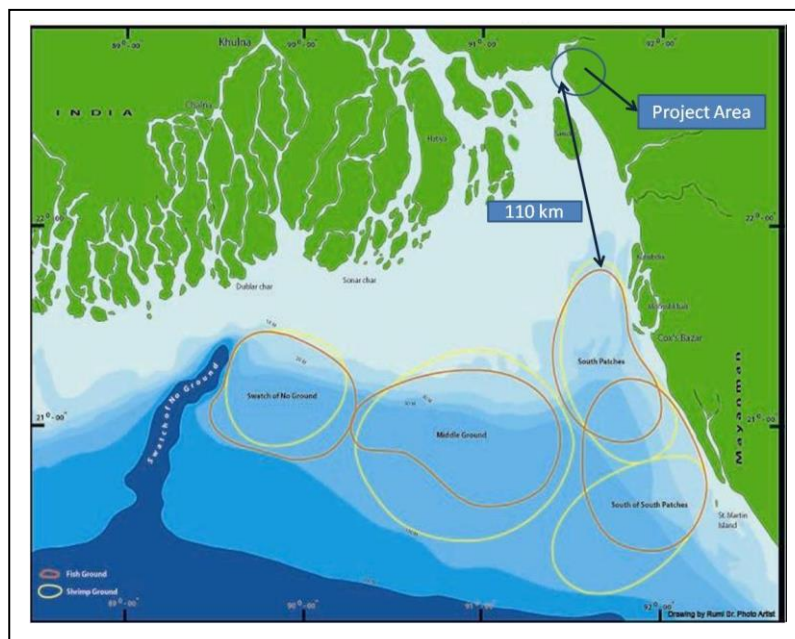


Figure 6-2: Fishing Grounds and marine reserves in Bay of Bengal

The Feni River estuary has moderate species diversity. Species diversity is higher in the estuarine mouth compared to that of its upstream direction. Fish species occurring in canals & ponds are: Golda chingri, Bagda chingri, Chiring, Pangash fish, Coral fish, Promphet fish, Catla, Ruhi, Hilsa, Bata fish, Gulla, Pua, Riksha, Lorka, Senuwa, Loitta, Nylostika, Mud crabs, Holona, mrigal, silv er carp, gras carp, karpio, barbs (putis), Chitol, Folai, catfish (Tengra, Singi, Magur, Boal, Pungus), Snakehead (Shol, Taki), bele etc. The proposed site is approximately 800 m towards south from the Feni River Estuarine system. As per the field survey & study of different secondary data sources, different fish and shrimp species are found in the Feni River.

Various trees like Akashmoni, Jhao, coconut trees, etc. exist beside access road of the Economic Zone-2. Native Tree species are also noticed in the homestead areas.

There are no major forests within 10 km radius area of EZ site. Flora in area of influence mainly comprises of the trees which were found along the access road mentioned above. Apart from the trees, trees existing in area are: Deodara (*Cedrus deodara*), yellow bell (*Tecoma stans*), Hibiscus (*Hibiscus rosa sinensis*), Chikrashi (*Chukrasia tabularis*), Telsur (*Butea monosperma*), Jarul (*Lagerstroemia speciosa*), Kadam (*Neolamarckia cadamba*), Dhakijam (*Syzygium grande*), Davana (*Artemisia pallens*), Lotkon (*Baccaurea ramiflora*), money plant (*Epipremnum aureum*), Toon (*Toona ciliate*), Bokain (*Melia azedarach*) and Banyan (*Ficus benghalensis*).

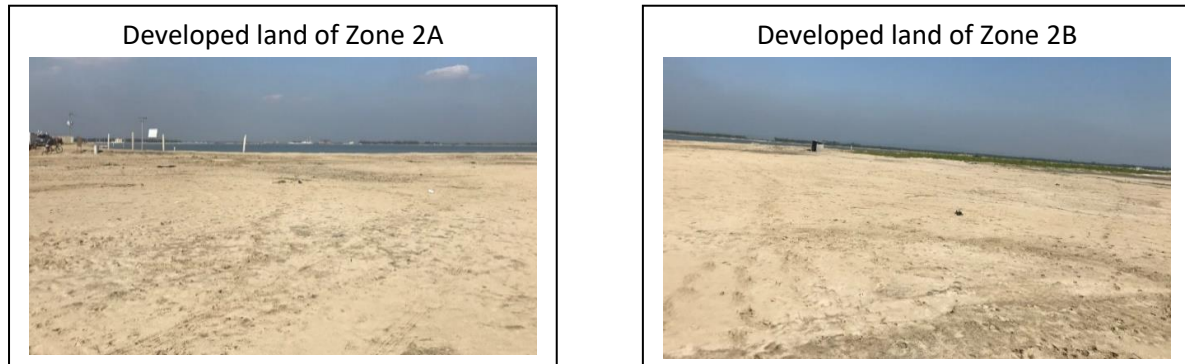


Photo-6-2: Current status of Zone 2A and 2B

Cows, goats, dogs, cats, mule, horse, monkey, fox, deer were found in the nearby area. No significant wild fauna was found in study area. Apart from the mammals, reptiles like chameleon, garden lizard & Gohar Saanp were also observed during the field visit. Apart from this villager informed that cobras and python also present in this region.

Avifaunalike Gugu/Dove (*streptopelia chinensis*), Paira/Pigeon, Doyal (Magpie Ribbon), House sparrow/Choroi, Parrot/Tiya, Crow (*Corvus splendens*), Myna/Shalik, Babui/Baya Weaver (*Ploceus philippinus*), Dhooli Bawk, Sarosh/Eastern Great Egret (*Ardea modesta*), Kaali Bawk, Machranga/Kingfisher (*Halcyn smyrensis*), Eagle, Koyal/Kokil (*Eudynamys scolopaceus*), Baali, Dhanesh/Indian grey hornbill(*Ocyrceros birostris*), Baijja hash, blue throated barbet (*Megalaima asiatica*), Duck (*Anatidae anatinae*), Dhar Bawk/Egret, Konch Bawk/Pond Heron (*Ardeola grayii*) are found in the study area. Some aquatic birds like Northern Pintail, etc. were also seen during visit.

Fishing activities are carried out in the nearby rivers & canals. There is no ecologically sensitive area or biological hotspot in or around the EZ-2 or the proposed additional area. Due to turbidity of water and soft bottom strata, this part of the Bay of Bengal is not suitable for seaweed. A favorable strata for sea weed is available near St.Martin Island which is around 260 km away towards the South (Quader 2010).



Photo-6-3: Present condition of the proposed additional land which is submerged due to entrapped rainwater



Photo-6-4: Present condition of the proposed additional land which is submerged due to entrapped rain water

The dredging location is around 2.5km away from the shoreline. A study carried out by NGO YPSA (Shipbreaking Activities in Bangladesh and collision of Marine Biodiversity by Prabal Barua) is available for Sandwip which is app. 18 km from proposed EZ site. The study mentioned that major phytoplankton in these waters are *Aanabena*, *Clostratrum*, *Coscinodiscus*, *Euglena* & *Zygnema*. Out of these *Aanabena* (30.41%) dominates during monsoon and *Coscinodiscus* (97.5%) dominates during post monsoon. Abundance of the phytoplanktons in the area is 411 cells/l in monsoon season and 190 cells / l in post monsoon season. Major zoo-planktons in these waters are *Calanoida*, *Cyclopedia*, *Sagitta*, *Lucifer*, *Zoea*, *Acetes shrimp* & *Cladocera*. Out of these *Calanoida*, *Cylplcpedia*, *Sagitta* and *Zoea* dominates during monsoon and *Calanoida*, *Acetes shrimp*, *Lucifer*, *Cladocera* and *Zoea* during post monsoon.

Among the macro benthos *Amphipod*, *Polychaete*, *Nemertina*, *Fish egg*, *Cladocera*, *Calanoida* and *Polychaete* are found. Out of these, presence of *Amphipod*, *Polychaete*, *Nemertina*, *Fish egg*

dominates during the monsoon and Cladocera, Nemertina , Calanoida and Polychaetedominates in the post monsoon season. Abundance of the macro benthos can be thus said to be 368.28 ind./ m3 in monsoon season and 14204.41 ind./ m3 in post monsoon season.

Social Baseline

Administratively, Mirsarai EZ-2 is located within the Mirsarai upazila. EZ-2 adjacent unions of Mirsarai Upazila are Ichhakhali, Mogadia & Saherkhali. There is no settlement within the original project area or in the proposed additional land. The Upazila consists of 2 Pourashava, 18 wards, 41 mahallas, 16 unions, 109 populated mauzas and 208 villages. The average size of population of each ward and mahalla are 1546 and 679 respectively. On the other hand, the average size of population of each union, mauza and village are 23181,3403 and 1783 respectively according to the 2011 Census (District Statistics Chattogram, BBS 2011).

According to the Census 2011 report, the total population in Mirsarai Upazila is 3,98,716. Total households of the Upazila is 7,954 & total land area is 119,324 acres. The population density per sq. km of the area is 826 persons. The 2011 Census data reveals that the decadal population growth rate for the Upazila is 8.07% in comparison to the 2001 Census data. According to the Census 2011 report, the total population in Ichhakhali Union is 27,980, Moghadia Union is 23406 and Saherkhali Union is 16912. Land area of these unions are 15754 ,2626 and 8609 acres respectively. In Mirsarai Upazila, Ichhakhali, Moghadia and Saherkhali, majority of the population fall within the age group of 15-49. The percentage of young population is quite high than the dependent population implying that the majority of the population belongs to the employable age group, which is vital for fueling the economic growth of the local area.

The majority of the population in Mirsarai Upazila is dominated by Muslims (86.12 %), followed by Hindus (12.36%), Buddhists (1.22 %) and Christians (0.018 %). The floating population of Upazila is 0.04% of the total population. The majority of the population in Ichhakhali Union, Maghadia Union and Saherkhali Union are dominated by Muslims (87.017 %), followed by Hindus (12.89%) and Buddhists (0.1 %). The floating population of the Union Parishad is 0.06 percent of the total population. Further, there are no indigenous people (tribal or ethnic minority) within these areas.

There is no historical, cultural and archaeological site within the area of Mirsarai EZ-2 . Influx of labor and construction activities may pose risks for community health and safety due to noise and dust pollution and security of women and girls. Moreover, potential conflicts may arise between local communities and migrant workers.

7. Master Plan of BSMSN

BEZA has prepared a draft Master Plan for Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) for next 20 years focusing on Land Use Plan, Zoning Plan, Phasing Plan, Urban Design Guidelines, Infrastructure/ Utility Plan, Development Management Plan, etc. Mirsarai EZ-2 and the proposed additional area is located within this larger BSMSN. The final draft report of the Plan includes among other the following:

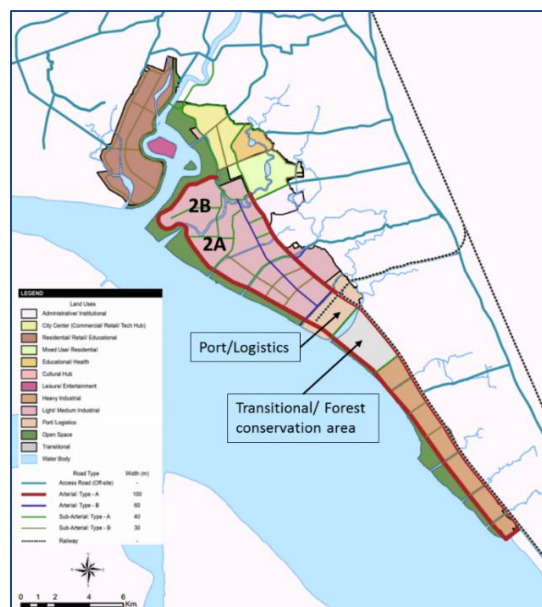
- revision/validation of development programs of BSMSN

- population projection for the next 20-year period including work force and amenities requirements
- industrial land demand for next 20 years
- projection of utility and infrastructure requirements for the entire industrial city for next 20 years
- assessment of existing transport infrastructure and facilities within and offsite areas

In general, the report made assessment and evaluation of available on and off-site infrastructures and services including the transport infrastructure and services. The report also made projection of population and work force for the next 20 years who will be the recipients of amenities and services to be provided.

The core of the master plan is the land use plan where land has been sub-divided for different uses of the industrial city, like industry, housing, commerce, utility services and green and open areas including water body. A phasing plan will follow for industrial city expansion commensurate with the market demand for industrial lands spanning over next 20 years.

The Part III of the Master Plan provides the site plan and the land allocations being made and the on-going infrastructure and utility services development programs. The recommended land use plan in Part III of BSMSN has been presented in Fig-7-1. To consider a holistic approach in assessment and management of environmental and social risks associated with the full-scale operation of the industrial city, a Regional Environmental and Social Assessment (RESA) will be conducted under the recently approved PRIDE project to be financed by the WB.



Source: Adapted from BSMSN Master Plan

Figure 7-1: Proposed Land Use Plan of BSMSN

8. The allotted plots in EZ 2A & 2B

While land development is going on, many plots have already been leased out to the potential private investors. Figure 8-1 and 8-2 would provide an idea about the industry types for which land has been leased out so far.

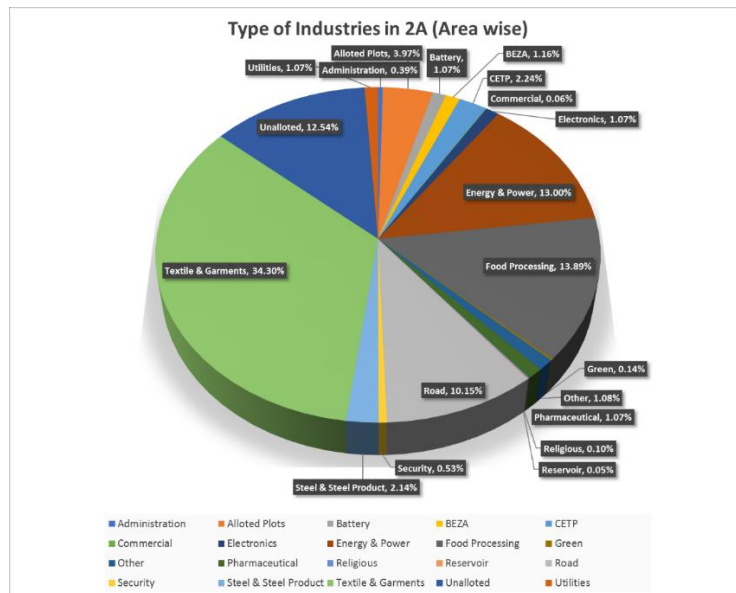


Figure 8-1: Type of Industries in 2A (Area wise)

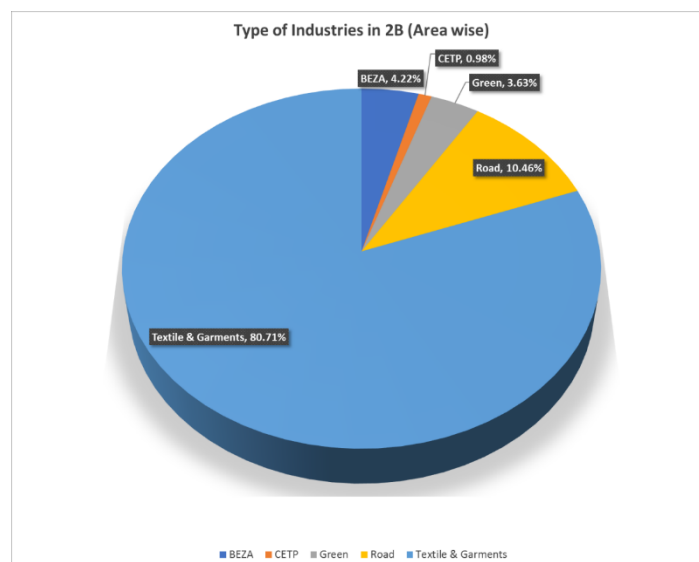


Figure 8-2: Type of Industries in 2B (Area wise)

9. Environment and Social Impacts of the Project and Proposed additional work

Environmental and Social impact assessment for the Mirsarai EZ-2 was carried out in 2016. Potential impacts associated with each of the project activity are classified as: (i) impacts during design and construction phase and ii) impacts during operation phase/Post-construction phase. Sensitive environmental and social components were identified during preparation of the original EIA report based on primary and secondary data. Site visit and qualitative and quantitative techniques were applied for direct and indirect assessment of impacts on the identified environmental and social sensitive components. Some of the important impacts were associated with land use (land acquisition), land stability (soil erosion), soil compaction and contamination, water availability, water quality of river/stream/canal, ground water contamination, waste and wastewater disposal, ambient air quality, ambient noise levels, vegetation, tree cutting (including social forestry tree), fauna (terrestrial and aquatic), drainage pattern, hydrology, climate change, socio economic issues, places of social/cultural importance (religious structures, community structure), construction material sourcing and occupational health and safety. Adequate mitigation measures were devised to mitigate/minimize all likely environmental impacts.

The additional area is adjacent to the EZ-2B. It is inside the super dyke and within the master plan of BSMSN. The current proposal is landfilling of this additional area using the dredged material.

Detailed stakeholder consultations were undertaken during preparation of the EIA for Mirsarai EZ-2. In addition, extensive consultations following participatory approach were conducted during the preparation of ESA for the PRIDE project in 2020. Consultations were held with communities, local school teachers, businessmen and social elites. Key Informant Interviews (KIIs) with concerned government officials were also carried out. This proposed additional area is adjacent to the original site. The same stakeholder group is associated with the proposed additional work. As the location is almost same and nature of work is similar, it is expected that the proposed additional work would not affect any new stakeholder group. Moreover, more stakeholder consultation would be undertaken during regional environmental and social impact assessment going to be undertaken shortly covering the whole area of BSMSN including this additional area.

9.1 Impacts during Construction Phase

9.1.1 Impact on Air Environment

The original project involves construction activities like site development, civil construction, construction material handling and stocking. Construction vehicle movement generates fugitive dust and vehicular emissions. The likely emission from construction vehicle, machinery, and generators was insignificant as the pollutant emission activities (point and area sources) was limited within the project boundary and the activities were short term (only for construction period). Mitigation measures adopted include sprinkling of water at construction site and haul roads, provision of face mask to workers to minimize inhalation of dust particles, regular servicing and checking for pollution control of construction vehicles and machinery, use of low Sulphur diesel for running construction equipment and vehicles, providing adequate parking space for the construction vehicles so as to prevent idling of the vehicles and the emissions generating from them.

The proposed additional work mostly involves dredging operation and filling up the additional area using dredged material. Operation of dredger would have some impact on the air quality but would

not be significant due to dispersion by sea wind. Construction vehicle movement will generate fugitive dust and vehicular emissions. The likely emission from construction vehicle, machinery, and generators is likely to be insignificant as the pollutant emission activities (point and area sources) will be limited within the project boundary and the activities will be short term (only for construction period).

9.1.2 Impact on Noise Environment

Main source of noise from the activities of the original project was from the operation of different machineries and equipment for construction activities, running of heavy load traffic for construction materials transportation. Regular traffic movement generated noise during construction period. But as there are no human settlement near the project site, this impact was not significant. However, adopting measures like machinery to comply with the noise standards prescribed by DoE, acoustic treatment of DG set, banning noise generating activity at night, putting temporary noise barriers near the high noise generating areas and use of PPE (ear plugs) by workers working in high noise area helped in further reducing the impact.

In case of the proposed additional work, operation of dredger and other ancillary machineries and equipment for construction activities, running of heavy load traffic for construction materials transportation, and regular traffic movement may generate noise during construction period. Considering the remoteness of the site from human settlement, this impact would be insignificant. However, similar mitigation measures as in case of original project activity would be adopted to avoid any impact from the noise.

9.1.3 Impacts on Water Resources

Impacts on Ground & Surface Water Resources:

Water was required for various construction activities & domestic purposes to carry out the activity of the original project. Source of water for these activities were Feni River and ground water. Shallow water aquifers in the area are saline and fresh water is available at the depth of around 180m. Use of rain water was encouraged in various construction activities.

The proposed additional work is site development by dredged material and thus would not put stress on the surface or ground water resources.

Impacts on Surface Water Quality

The original work of the project involved various construction work and there was possibility of contamination of surface water by the run-off from the construction site which might carry the higher quantity of sediments and oil and might pollute the surface water and impact the aquatic life. As the base line surface water parameters were higher than the national standard, the following measures were followed to minimize the surface water pollution:

- 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 sand bags as partition as barrier for direct flow of run off to river.

- Collection & Reusing of curing over flow, tire wash water etc. within the site
- Construction of adequate number of toilets and proper sanitation system to prevent open defecation along the river banks/water supply lines
- Construction of soak pits/septic tanks to dispose-off the domestic wastewater generated from labor 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
- No debris/construction material should enter the aquaculture ponds and other water body in the area

The proposed additional work is mostly land filling by dredged material. The location of the dredger would be around 2.5 kilometer away offshore. The placement area of dredged material is bounded by embankment and super dyke and hence no significant impact on surface water quality of the nearby rivers and canals is expected. The dredger to be used is a cutter suction dredger which would lift the dredged material by a suction pipe. The material would be transported to the filling location by closed pipeline. Hence, increase of turbidity of sea water at the point of dredging operation would not be significant.

Impacts on Ground Water Quality

Ground water is saline in shallow aquifer of the project area. Use of ground water was discouraged for the activity of the original project. Rain water was adopted in the construction works by harvesting rainwater and hence no significant impacts were anticipated on the ground water quality due to the activity of the original project. Moreover, no sewage or wastewater was allowed to accumulate in any unlined structure and timely disposal of the construction/chemical/hazardous waste so as to prevent leaching of any pollutant to ground helped in preserving ground water. The impact on ground water has been further discussed in section 9.1.11.

Impacts on Drainage Pattern & Hydrology

Original project area is bounded by existing EZ-I and CDSP bund in North & NE direction. Storm water from villages in up streams is drained through Ichhakhali canal and Bamon Sundar canal. These canals will be retained in existing condition. A sluice gate is being constructed at Ichhakhali canal at point of entry of canal at sea side to control the flow of water. A zone of 30 m will be left on each side of the Ichhakhali canal as 'No Development Zone' and thereafter embankment will be developed along the canal. It will prevent direct exposure of the canal to the industrial area. The 7.8 km long super dyke will prevent entry of water in to the EZ site during flooding and cyclone.

The proposed additional area would be reclaimed/filled up by dredged material sourced 2.5km offshore. Once the site is developed, adequate storm water collection & harvesting system will need to be provided.

9.1.4 Impacts on Land resources

Impact on Land Use

The activity of the original project area is spread over an area of 1311 acres. Also, the existing single lane road is being widened. 1311 acres of the EZ is Government land and thus did not involve any acquisition. However, a change in land use from char land to Industrial area occurred.

The proposed additional area is also Government owned land and thus will not involve any land acquisition. No resettlement and rehabilitation would be involved for development of this additional area. No major impact is anticipated on social sensitive receptors due to the proposed activity. No agricultural land is proposed to be acquired for development of proposed additional work.

9.1.5 Impact on Top Soil & Soil Quality

Development of the structures and construction of the bund, widening of access road and proposed additional land filling might disturb the soil profile of the area. Site will be filled up with sea sand and compacted after filling. The soil type of the additional area is mostly sandy and would be filled up by sand and thus no significant change in top soil is expected.

9.1.6 Impact on landscape and scenic beauty

All construction activities of the EZ *including the proposed additional land filling* will be carried out within economic zone site/BSMSN and will not cause any impact on landscape and scenic beauty. A green buffer of 30 m (minimum three rows of trees) will be planted all around the project site and along Ichhakhali canal which will enhance the scenic beauty of the area. Buffer of 1000 m will be developed between the sea and EZ as green belt. Also, avenue plantation and landscaping will be developed all along the internal roads, widened access roads and bund/road

9.1.7 Impact on Land Use

At present there are no significant infrastructure at the EZ site and nearby areas. Major land use type of the surrounding area include agricultural land, wetland and mangrove plantation area.

9.1.8 Impacts on Agriculture resources

No agricultural land is proposed for the development of the economic zone. The proposed additional land filling would be done on a low lying area and no agricultural land would be destroyed.

9.1.9 Impacts on Fisheries

No significant impacts on fisheries due to project activity and development of the proposed additional area is anticipated during construction phase. However, these waterbodies can be polluted during the operation phase if proper mitigation measures are not adopted. As the Ichhakhali canal and Bamun Sundor canal would be retained, and as a 30m 'No Development Zone' would be maintained to protect Ichhakhali canal from direct exposure to the future industries, it is expected that water quality would be maintained and fishing in the water bodies would not be impacted significantly.

9.1.10 Impacts on Eco-system

Impact on Terrestrial Flora & Fauna at EZ Site

There is no significant vegetation at the economic zone site area. Mud crabs were observed near the canal area. However, it has been proposed to leave zone of 30 m as '*No Development Zone*' along the Ichhakhali canal which is passing through the site. This '*No Development Zone*' will be developed as green buffer and will continue to serve as habitat for the mud crabs to reduce the impact. This '*No Development Zone*' will prevent the canal from direct exposure to the industries.

Impact on Avifauna (Birds at EZ Site)

During FGDs (EIA of PSDSP in 2016 and ESA of PRIDE in 2019) with the local people, it was learned that some migratory birds are seen occasionally on EZ site along the canal area during winter season. But no such published evidence like journal/publication/book is obtained through the secondary published data which establishes presences of migratory birds in Mirsarai. But presence of migratory birds is reported in other regions of Chattogram District like near Karnaphuli River. Thus, the presence of migratory birds in the region could not be confirmed but various measures/safeguards were proposed which would ensure that there is minimal impact of project on any avifauna.

Buffer area of 30 m will be maintained all along the Ichhakhali canal which will continue to remain habitat for the birds visiting the canal. Furthermore, a lake is proposed to be developed within EZ site which covers approximately 100 acres of area which would serve as additional habitat for the birds. Green buffer of 30 m width will be developed all along the boundary of EZ which will continue to serve as habitat for the avifauna. As per the planning, it is proposed to plant the area between EZ site and Sea with the Mangroves. This mangrove planted area will serve as landing site for the birds and other ecological species. Following are the summary of mitigation measures recommended:

- A zone of 30 m is to be left along the canal & periphery of the proposed EZ zone
- Plantation in 30 m buffer along the periphery and canal should be developed by planting the native species only including the Mangroves
- Embankments planned to be developed should be provided with grass which can survive in saline water also.
- No tree cutting is proposed. If any tree is to be cut, permission will be obtained from forest department and compensatory plantation should be undertaken in minimum ratio of 1:2.
- Development of a lake/water body of approximately 100 acres within the EZ site
- Area between EZ site and sea will be planted with Mangroves

Impact on Aquatic Flora & Fauna of EZ Site

Run-off from construction site may contain sediments or contaminant which may pollute water quality of Ichhakhali canal which has potential to impact the aquatic life if measures for minimizing the impact are not undertaken. The following mitigation measures were recommended:

- Diesel, paints, cements etc. should not be stored near the canal/water bodies
- No solid or liquid waste shall be discharged in water bodies
- Septic tanks/soak pit should be provided to treat sewage to be generated from labor camps and prevent its disposal in water body
- Toilets should be provided at site to prevent contamination of water due to open defecation in nearby areas.
- Vehicle washing/equipment cleaning should not be allowed near canal/drains in EZ site
- Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose
- Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration

- Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area
- All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off

Impact on Mangroves Plantation in Buffer Area (Bund Construction)

Mangroves were planted all along the coastline of Chattogram district and along the canals by forest department mainly to protect the inland area from cyclone. The project footprint did not contain any Mangrove plantation area. No Mangrove tree cutting will be undertaken for development of the EZ and *not for the proposed additional work*. However, following measures were recommended:

- No Mangrove cutting should be undertaken without prior permission of forest department
- ‘No Development’ buffer zone along the periphery and canal should be planted with native species and mangroves species.
- No wastewater, construction waste and municipal waste should be dumped within the Mangrove area or nearby areas.

Impact on Nearby River & Marine Eco-System

Development of EZ site and ancillary facility of 2A and 2B involves excavation, filling, storage of raw material, storage of debris, establishment of site for machinery and equipment etc. These activities might lead to contamination of rainfall run-off due to mixing with excavated material, debris, raw materials like paints, fuel, rusting of iron etc. Site being in close vicinity to river and sea, rainfall-runoff water from site will directly enter river & sea. This might impact the quality of the river & sea water and aquatic life. Thus, it was required to minimize contamination of rainfall run-off to minimize impact on water quality & aquatic life supported by the water bodies. There are no marine protected areas within 10 km radius area of EZ site. No sensitive aquatic species like dolphins are also reported in the Feni River stretch within 10 kms radius of the EZ site. The following measures were adopted:

- No solid or liquid waste shall be discharged in river, sea and any other water body
- Septic tanks/soak pit should be provided at construction site & labor camp to treat sewage to be generated from labor camps and prevent its disposal in water body
- Toilets should be provided at construction site & labor camp to prevent contamination of water due to open defecation in nearby areas.
- Vehicle washing/equipment cleaning should not be allowed near water bodies
- Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose and should not be allowed to enter the water bodies
- Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration
- Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area
- All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off

9.1.11 Impact Due to Deep Sea Dredging

Average filling of 1.15m was required for filling up EZ 2A and 2B i.e. 1311 acres for which approximately 6.10 million cum of sand was required. Being large amount of sand requirement, it was difficult to obtain the sand from dredging the river & other water bodies and excavation of land. Thus, deep sea dredging was opted to obtain sand. The dredging location was selected as per the direction of Bangladesh Water Development Board (BWDB) which is around 2.5km away from the shoreline as shown in Fig-9-1. The proposed additional area would also be filled up by dredged material to be obtained from the same site as the original project.

Dredging from the same location would be carried out to fill up the proposed additional area. The dredger used is a cutter suction dredger with a capacity of 15,000 cubic meter/day. Water Depth at

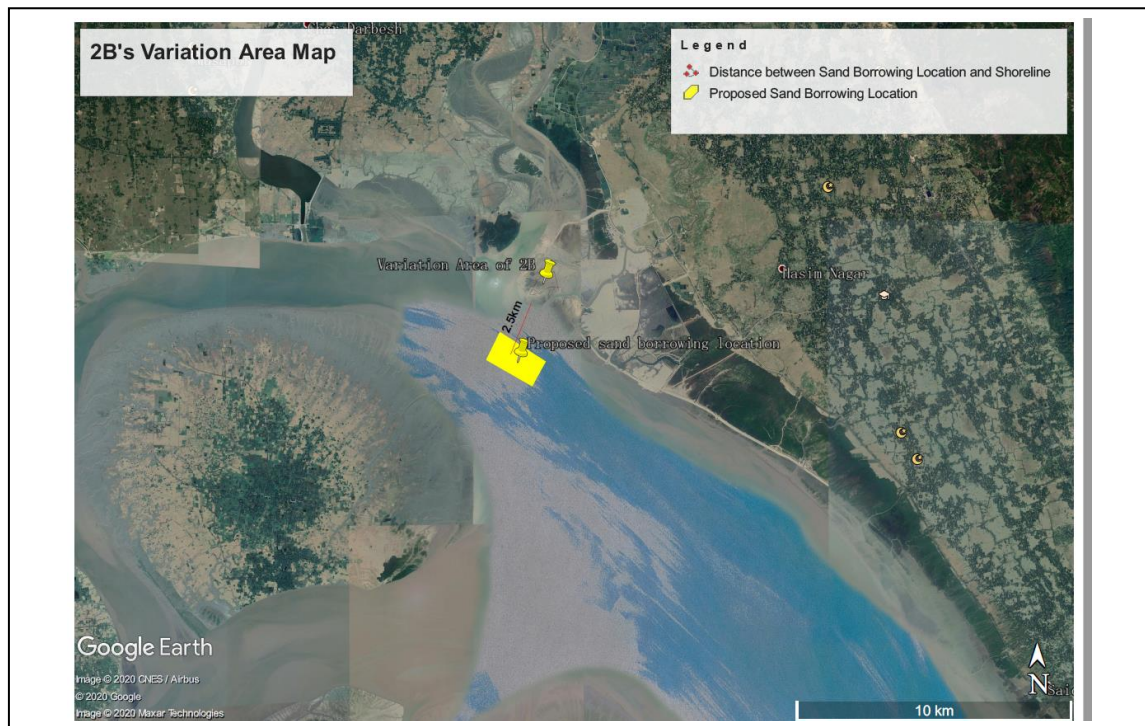


Fig-9-1: Distance of dredging location

the point of dredging is around 8-10 M. The dredger is fitted with global positioning system (GPS) receiver and a computer completed with electronic graph control system, the design coordinate points on each region are input into the computer and displayed in on-screen graphics to ensure construction accuracy.



Photo-9-1: The cutter suction dredger

The main activity in the proposed additional area would be land filling by dredged material. It has been estimated that average filling of about 3.5 m will be required for the proposed additional area for which approximately 1.36 million cum of sand will be required.

The bottom strata of the dredging location comprise of loose sediment. Secondary information shows that a suitable bottom strata for sea weed is only available near St. Martin Island which is around 260 km towards the South (Quader 2010). Sediment laden water also deters light penetration at the bottom of the dredging location. The dredger used is cutter suction type dredger and sediment would be lifted by a suction pipe and would be transported to the filling area through closed pipe. This also minimizes spillage of sediments/dredge materials that may contribute to further turbidity in the dredging point/area.



Photo-9-2: Pipe line for transporting dredged material



Photo-9-3: Pipeline for transporting dredged material

Deep sea dredging can impact the marine eco-system by disturbing the benthos (dwelling on sea floor) especially to sessile organisms attached to sea floor/other physical structures. Also dredging sometime releases sediments causing high turbidity in the surrounding waters. High turbidity may impact the visibility of marine organisms, may choke gills of fishes and other aquatic organisms and impact the oxygen level of surface layers by forming barrier between the water and the atmosphere. As the sediment would be lifted through suction pipe, increase in turbidity in the water column would not be altered much. However, this construction phase impacts are expected to affect the environment for a relatively short period, and these are expected to cease soon after the completion of construction. Hence it is expected that impact on marine ecology would not be significant for this additional work.

The dredged material would be placed on the proposed area by transporting it through pipeline. The construction of the super dyke has already been completed and this additional area lies within the boundary of the super dyke. Hence the dredged material would be contained within the bounded area and would not spill over to nearby adjacent areas.



Photo-9-4: Photo showing the Super dyke

Study undertaken by Department of Public Health Engineering in the Mirsarai Economic Zone-2 area in 2015 (Department of Public Health Engineering 2015) confirms presence of two ground water aquifer in the area. The upper one layer lies within 50-60m from the surface which is saline and is contaminated by arsenic and iron (Department of Public Health Engineering 2015). A deeper aquifer exists at a depth of around 180 m. Salinity and concentration of arsenic in water sample from this deeper aquifer meet the national drinking water quality standard.

The sediment analysis of the dredged material of the dredging location which would be used for filling up the additional area shows presence of some heavy metals among which, Cadmium is absent whereas Nickel and Chromium are present. However, the concentrations of the heavy metals meet international standard for clean filling (see Table-9-1 and Annex-4, Bray 2008). Research shows that pH value of the sediment plays important role leaching of heavy metals. Hieu, Swennen et al. (Hieu, Swennen et al. 2012) showed that leaching of heavy metal from dredged material is dependent on pH value. They showed that sediment is more prone to leaching if the pH value is highly acidic (pH-2) or highly alkaline (pH 11) and least leachable in neutral pH (pH 6-8). Baran et al. (Baran, Tarnawski et al. 2015) in an experiment showed that The leachability of the studied metals in relation to their total contents in bottom sediments fluctuated from 1 to 5.5% for Zn, 0.9 to 0.4% for Cu, 3.3 to 4.5% for Ni, 1.6 to 6.9% for Pb, 0.9 to 19.2% for Cd and 0.8 to 6.3% for Cr. It means that approximately 97% of Zn, 94% of Cu, 96% of Ni, 0.95% of Pb, 90% of Cd and 96% of Cr may be bound to the organic or residual fractions.

Table 9-1: Sediment quality

	EC (DS /m)	pH	OM (%)	TN (%)	K (meq / 100 gm soil)	P (pp m)	Cu (pp m)	Zn (pp m)	Pb (pp m)	Cd (pp m)	Ni (pp m)	Cr (pp m)	Texture			
													% Sand	% Silt	% Clay	Textural Class
Concentration in the dredged material	1.7 (NS)	8.0 (SA)	0.2 (VL)	0.010 (VL)	0.30 (O)	5.21 (VL)	0.16 (L)	0.46 (L)	3.3161	0.000	9.5070	8.1631	89	10	1	Sandy Loam
Lowest effect level (below this level material is suitable to use as clean fill ⁴)							16	120	31	0.6	16	26				

Note: SS= Slightly Saline, NS = Non-Saline, VSS = Very Slightly Saline, SA = Slightly Alkaline, VL = Very Low, M= Medium, VH = Very High, L = Low, O = Optimum

Data from sediment quality analysis shows that electric conductivity (EC) of the dredged material is 1.7DS/m which indicates that the material is non-saline according to Soil Salinity Management-Non-irrigated, US Department of Agriculture-NRCS Conservation Practice Standard (USDA-NRCS 2002) The pH value of the dredged material is 8 which makes it less prone to leaching.

9.1.12 Impacts on Socio-Economy

Loss of Livelihood & Displacement of Families

As the development of the EZ-2 is being conducted in re-claimed uninhabited land, the taking of land will not cause any adverse impacts on the communities and their livelihoods. Detailed social baseline data were collected during the preparation of the ESA for the PRIDE project. The field visits adopted a participatory approach, which involved discussions with local people in order to identify the perceptions and priorities of the stakeholders in and around the study area. Apart from the local people, information was also obtained from the local school teachers, businessmen and social elites. Key Informant Interviews (KIIs) with concerned government officials were also carried out. The data collected through such consultations confirmed that the additional land filling will not cause adverse livelihoods and economic impacts.

No Resettlement and rehabilitation or land acquisition is involved for development of the proposed additional work.

Impact on Health, Aesthetics and Hygiene

Construction activities lead to generation of dust, unpleasant view, obstruction in access of public properties due to excavation etc. which might impact the society. Adequate waste management plan, air, soil, noise and water pollution controls are required to be adopted to prevent any impact on

⁴ Provincial sediment quality guidelines for metals and nutrients for Canada. Bray, R. N. (2008). *Environmental Aspects of Dredging*

society. Also, various health hazards are associated with construction activity which may impact the workers if not taken care.

Impact on Utilities & Traffic

No sensitive feature like school, hospital etc. are located near the proposed footprint. No major impact was anticipated on social sensitive receptors due to development of the additional land. Traffic movements would not generate any significant vibrations which can affect integrity of any structure. Further there could be impact on the utilities if resources used by local communities would be diverted for development of EZ e.g. ground water, roads etc. Thus, recommendation not to use ground water for construction purpose was made as this is the source of water for villagers. Recommendation was also made to construct temporary roads for transportation of material in place of using existing village roads. If village roads are used, transportation should be carried in non-peak hours and regular maintenance should be carried out so as to minimize the impact.

Furthermore, during construction phase, traffic on existing Abu Torab road and single lane road on BWDB/CDSP bund is expected to increase. Increase in traffic would not be more than 10 trucks in a day which were recommended to be managed in off-peak hours to prevent the congestion and traffic jams. Traffic safety will be ensured as per the traffic management plan.

Impact on Demographic structure

The demographic profile of Mirsarai Upazila would not undergo any changes during the construction phase of the project activity *including the proposed additional work* because the inflow of daily laborer would be mainly from Mirsarai Upazila or from some other nearby areas. However, during the commissioning phase, a large number of inward migrations are expected. The inward migration along with the infrastructure development in Mirsarai Upazila may lead to changes in the demographic profile of Mirsarai Upazila

Generation of Employment

The project has created employment opportunity in the local area. It was recommended to ensure employment opportunities through three channels (i) direct employment for unskilled labor, (ii) indirect employment to the local community; and (iii) employment of female workers. Direct employment includes site clearance, excavation, loading and offloading of materials and deliveries, mason and construction works. Further, the construction labor force will be requiring food and other items, which is expected to be supplied by the local eateries, retail shops and the local community. The local community members can take advantage of these opportunities. Employment generation benefits would improve the quality of life of the laborer and enhance their productivity and living standards. Employment generation, both direct and indirect, through Mirsarai EZ will have a tremendous impact on human development and poverty reduction in the Mirsarai area.

Furthermore, as an enhancement measure, it was recommended that equal employment opportunities should be given to women in the EZ, especially those who were unemployed or working in the service sector as daily wage workers. These were recommended to include as a requirement in the contract to be prepared by BEZA for the construction works. EZs further create an important avenue for young women to become part of the formal economy at better wages compared to agriculture and domestic services. Employment opportunities within the EZ would increase their employability and position in the household. In addition, Mirsarai EZ is expected to assist women in changing their occupation pattern and accessing better job opportunities and wages. But the child

labor should not be encouraged in the area. Thus, it was recommended that BEZA would make strict rules for industries and contractors for not employing child labor and there should be imposition of heavy fine, if anybody is found guilty.

Skill Enhancement of Local people

Both skilled and un-skilled labor will be required during both construction and operation phase of the EZ. But Mirsarai and nearby area lack the skilled labor due to low literacy rate. It was recommended that BEZA would provide the skill enhancement training to locals to carry out specific tasks and enhance the skill of local people so that they can be given employment. Following measures were suggested:

9.2 Impacts during Operation Phase

After development of economic zone, which is outside the scope of PSDSP and this additional development, it is expected that industries will start coming up in this region and EZ may reach its full capacity within 4-5 years. As per the planning for Mirsarai EZ-2 (Zone 2A & Zone 2B), it is anticipated that industries like food processing, textile, petrochemical, steel and steel product and light engineering will come up in the Zone 2A, 2B and in this additional area after land development with utility support. These industries are not heavily polluting ones like tanneries, distilleries, etc. But these industries would generate both hazardous and non-hazardous wastes which can pollute the environment if not managed properly. A number of infrastructure such as construction of central effluent treatment plant, sanitary landfill for solid waste management, bio gas plant etc. would be supported by the PRIDE project. Moreover, BEZA would put in place a good system for assessment of management of environmental and social risks during operation of the industries. This has been addressed in ESA of PRIDE project.

Following environmental attributes might be impacted due to operation of the EZ:

- Impacts on Air Quality
- Impacts on Noise Level
- Impacts on Water Quality
- Impacts on Ground Water Resources
- Impacts on Socio-economy
- Impact on Land Use
- Impact on Agriculture Resources
- Impact on Fisheries

After development of economic zone with industries, disposal of industrial and domestic waste may contaminate soil, water and degrade noise quality, air quality and ecology of the site and the nearby areas. Mentioned industries would generate a wide variety of solid and chemical waste. These wastes may include spent catalyst, storage tank sediments, packaging waste, metal pieces, damaged electrodes and rods, ends of coils, wires and spools, greased clothes/cotton, metal dust, dust found from filter ventilation systems/air pollution control devices, floor sweepings, resins, fabrics, apparel, dye, discarded machineries, etc. Beside these inorganic wastes, food processing industries will generate organic solid waste like rinds, seeds, skin, and bones from raw materials, resulting from processing operations. These components may affect soil quality if not disposed properly.

Industrial development will involve generation of emissions and increased vehicular movements. These altogether may have overall negative impact on the air quality of the site and the nearby areas by releasing hazardous air emission like particulate matter, sulphur dioxide, metals and other criteria pollutants like ozone, oxides of nitrogen and carbon monoxide from the operation of light-engineering industries. Food processing and pharmaceutical industries will release volatile organic material. No significant air emissions will be generated from textile industries.

Noise will be generated from the operation of industrial units, running DG sets and traffic movement within Zone 2A and 2B. Noise pollution is related to several industrial manufacturing phases, including raw material extraction; grinding and storage, intermediate and final product handling and transportation and operation of exhaust fans.

Industries are likely to generate domestic and industrial effluent. Liquid waste which can be generated from industries may include waste acid, waste alkali, grease, used/spent oil, liquid metal, spent solvents etc. In addition, domestic and cleaning waste is likely to be generated. These effluents will contribute high COD and TDS in the receiving waterbody (Ichhakhali canal and Bamon Sundar canal). If these effluents are discharged in the receiving waterbody, these will pollute the water and will be potential threat to the aquatic life. In addition, storm water runoff in most cases carries pollutants like chemicals, oil and grease, heavy metals. Such contaminated runoff would make the receiving water bodies contaminated if proper mitigation measures are not adopted.

Industrial development will involve generation of emissions, effluents and increased vehicular movements. These altogether may have adverse impact on the eco-system of the site and the nearby areas as the air pollution will impact the existing vegetation and avifauna in the area.

50 MLD and 30 MLD of water will be required for Zone 2A and 2B respectively during operation phase for both the consumption and industrial operation purpose (Source: Water Demand and Water Availability Assessment Report, IWM, 2019). However, no fresh water source except ground water is available in the area to meet this demand. Ground water in shallow aquifers is highly saline. Non-saline water has been found at higher depths (Deep Tube wells). Thus, extraction of ground water may affect the ground water resources.

After development of Zone 2A and 2B with onsite facilities, there will be no issues about labor influx unless industrialization is taken place at the Zone 2A and 2B premises. However, it is predicted that when Zone 2A and 2B will go into operation with industries, this would generate huge labor influx that could trigger social conflict, community health and safety issue, GBV, labor unrest etc. if BEZA fails to develop an effective management system.

So if the future industries run in the EZ without any pollution and emission prevention measures, it would result in high risk to the surface water quality and aquatic life, air and noise quality and other physiochemical and socio-economic components of the project site and its nearby area.

BEZA would be required to prepare a project preparation and operating guideline for Developer and Private investors to be followed to ensure compliance of various E&S safeguard issues. Individual ESIA study for each industry needs to be conducted before commencement of any industrialization at Zone 2A and Zone 2B. Afterward it needs to be reviewed by BEZA and approved by DoE, GOB.

9.3 Cumulative Impact Assessment

A rapid cumulative impact assessment (RCIA) of site preparation (landfilling) and construction activities associated with the addition of 96.5 acre of land is assessed following Appendix 3 of the IFC Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (International Finance Corporation, 2013).⁵

9.3.1 Previous Cumulative Impact Assessment of EZ-2

A cumulative impact assessment of EZ-2 was prepared in 2016 identifying 16 VECs (valued environmental components, herein referred to as valued components). The assessment however does not refer to the guidance of the IFC (2013) for the assessment of cumulative impacts. The assessment concluded that development of the EZs and other induced developments are expected to potentially impact all the baseline environmental and social components, but no further details are provided. Information was also lacking on the type of projects expected and production details required to assess the potential for cumulative impacts, as this information was not available. Mitigation measures were presented including cooperative approaches towards mitigating cumulative impacts. This document however was useful as an input into the RCIA.

9.3.2 Summary of Key CIA Issues of Additional Landfilling Activities

To assess the contribution of landfilling and preparation of an additional 96.5 acres, key cumulative impact issues are summarized from existing baseline documentation as previously presented in Section 6 of this report as follows:

- SPM and PM₁₀ values on site are above the national standard because of construction activities. Otherwise, air quality parameters in the surrounding area are all within acceptable limit set by DoE.
- Most of the water quality parameters of Bamon Sundar canal are higher than the surface water quality standard of Bangladesh. In case of Ichhakhali Khal, the surface water is saline, whereas Feni River water quality is non-saline. Moreover, BOD levels of all surface water samples is higher than the national ambient surface water quality standards.
- There is currently heavy use of groundwater for irrigation which is used to support the shortfall of surface water. Shallow groundwater is available within 50-60m below the ground surface in the project area, but its' quality is not good, and availability is variable.
- The total water requirement during operation phase of Zone 2A & 2B has been estimated about 50MLD and 30MLD respectively. No anticipated abstraction volumes were presented for the construction phase.
- The fill material for the project site is dredged sand derived from the seabed. Only licensed dredgers will be sourced for sand procurement. Concentrations of the heavy metals are found suitable to be used as clean fill as per international standards.
- There are erosion issues on site which is within the coastal tidal surge prone area.
- The site is devoid of vegetation and there are no faunal biodiversity issues. There are no rare, endangered, or threatened species present at the site and in buffer area. None of the species recorded are listed in Red book of IUCN.

⁵ See: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_handbook_cumulativeimpactassessment

- Tree species are present along access roads (Sheikh Hasina Avenue, BWDB road embankment & CDSP embankment) of the Economic Zone. Native tree species are also present in the homestead areas.
- There are no major forests within 10 km radius area of the EZ-2 site.
- Mangrove was planted along the coast of Chattogram District.
- Development of the EZ-2 site will restrict fishing activities in the Ichhakhali canal section within the EZ-2 site to prevent direct exposure of industries to the canal.
- The Feni River estuary has moderate species diversity. Species diversity is higher in the estuarine mouth compared to that of its upstream direction. The project site is approximately 800 m from the Feni River Estuarine system.
- Fishing is done in the Feni River and the sea. Fishing is done in Ichhakhali canal and Bamon Sundar Canal during high tides and the monsoon season.
- Shrimp culture (Bagda and Golda) is also practiced on a large scale.
- A major marine fishing area is located 110 km south of the project site.
- There are no archaeological sites or cultural resources in the project site.
- There is no settlement within the project area.
- A total of 14 HHs (Squatters) and 5 temporary mosques were affected by development of the site access road.
- In the Chattogram district, the service sector is the major source of employment providing employment to around 36% of the population. The non-agricultural sector accounts for 30% employment, while 20% comes from the agricultural sector.
- The employment status clearly shows that most local people are dependent on agriculture related activities.
- Scarcity of safe drinking water is an acute problem faced in the Upazila.
- Women outnumber men in Ichhakhali Union, Maghadia Union and Saherkhali Union. Gender based violence is considered a substantial risk.
- There are no ethnic minorities present adjacent to the project site nor in its zone of influence.
- Transport is a major problem in the project area as there is no public transit service connectivity.
- The quality of housing in the area shows that 79.2% people in Mirsarai Upazila have “kutcha” houses, (made up of mud, straw, wood and dry leaves) indicating their low social and economic status. The kutcha houses are vulnerable to natural disasters such as floods or cyclones.
- A super dyke has been constructed to protect Mirsarai EZ-2 covering the proposed additional area.
- A 150 MW dual fuel (gas and furnace oil) thermal power plant is being constructed approximately 3 km towards the east from the proposed additional area. This power plant is not funded by the project and is being carried out by the Government from their own resources.

9.3.3 Rapid CIA of Additional Landfilling Activities

Based on the foregoing assessment of key issues, the following five valued components (VC) were considered in the RCIA:

- Air quality
- Water quality

- Water quantity
- Sediment quality
- Employment during the construction phase

Selection of Valued Components for the RCIA

Based on a review of baseline information and the determination of key environmental and social issues, five VCs were selected as shown below in Table 9-2. This number was reduced from a larger list of key environmental and social issues, based on the following considerations:

- Of the 16 VCs in the EZ-2 EIA, some were not relevant, and others were impacted, and consequently not considered as valued components.
- As there were no identified impacts to vegetation or fauna as a result of construction activities in the EZ-2 site and the additional 96.5 acres, no biodiversity valued components were selected. However, they should be included in the full CIA, once more information becomes available on project activities during the operations phase.
- The five VCs presented below for inclusion in the RCIA as shown in Table 9-2 are impacted potentially by the completed and ongoing activities in and around the proposed additional area. Other key issues, such as soil quality, mangroves, agriculture, social equity, and human health, were considered important but as they are not expected to be impacted by the activities, and they are not included in the RCIA. Rather they should be included in the full CIA to be completed as part of the RESA (see Section 9.3.4).
- Due to timing and COVID-19 considerations, no public consultation regarding VC selection was conducted at this time. This should be done as part of the full CIA to be done during the regional environmental and social assessment.

Table 9-2: Valued Components selected for the RCIA of additional landfilling activities

VC	Rationale	Current Status	Construction	Operation
Environment				
Air Quality	This has been selected as a VC due to the potential for air pollutants to be released during the operation of the various facilities and subprojects included within the Project.	Ambient air quality at Moghadia Nurul Absar Chowdhury High School is within the allowable Bangladesh standards. In zones 2A & 2B, SPM and PM ₁₀ values are above the Bangladesh standard (attributed to ongoing construction activities).	✓	✓
Water Quality	This has been selected as a VC due to the potentially harmful quality of surface and water quality.	All surface waters exceeded the water quality standards (ESA, 2020) Shallow Aquifer (50 -60m): Mostly saline water with sweet water pockets. Deep Aquifer (180m): Fresh water. Parameters such as arsenic, iron and manganese level are above the acceptable drinking water quality in the 2A and 2B zones. No data for the proposed extension	✓	✓
Water Quantity	This has been selected as a VC due to the potential for strain on water resources from extraction from aquifers.	Currently, there is heavy use of groundwater for irrigation to support the shortfall of surface water. Groundwater deposits are not favorable aquifers for extensive withdrawal (ESA, 2020)	✓	✓
Sediment Quality	Sediments were sourced from an area 2.5 km from the EZ site. Included because of potential for contamination of the site	Analysis of the dredged material shows presence of nickel and chromium. Concentrations are within international standards for clean filling	✓	
Social				
Employment	Included due to the impact the Project will have on jobs in the area and the potential for labor influx.	Local laborers are not receiving job opportunities in the EZ preparatory activities. Influx of laborers for preparatory activities.	✓	✓

Assessment of Cumulative Impacts

Construction Phase

The assessment of cumulative impacts of various completed and ongoing activities in and around the proposed additional area on each selected VC is discussed in Table 9-3 below. The following assumptions of additional landfilling activities were made for the RCIA:

- Only the impacts of site development work and construction work that has already been completed or being carried out in and around the proposed area were considered. Operational details and industry descriptions are not available in sufficient detail as this time for the purpose of the RCIA; this will form part of the full CIA as part of the RESA for the PRIDE project.
- Proposed additional work of land filling by dredged seabed material and other completed and going works such as super dyke and Power Plant have been added.
- The five selected VCs are included as they could be impacted by the project and other activities..
- The temporal boundary of the assessment is only during the construction phase.
- The spatial boundary of the RCIA is the entire 2A/2B site plus the additional 96.5 acre.
- The impact of storm surge was considered as a natural stressor and considering the installation of a super dyke around the site.
- The RCIA only considers the potential contribution of additional landfilling activities and other completed and ongoing works in the proposed RCIA area to cumulative impacts on the five selected VCs.. It does not include consideration of cumulative impacts of future proposed projects and impacts during the operation phase for which sufficient information are not available currently.
- No public consultation was conducted regarding the selection of VCs. This however should be an integral component of the full CIA.
- Impacts were assigned in three categories: low, moderate and high (descriptions are provided on the following page) following the process outlined in Section 9.

Table 9-3: Cumulative Impact Assessment of Project and Other Activities on Valued Components

Activity	Valued Component					Natural Stressor	Overall Cumulative Impact
	Air Quality	Water Quality	Water Quantity	Sediment Quality	Employment	Storm Surge	
Addendum Project Activity							
Dredging of bottom sediments							
Transport of dredged material by pipeline to shore							
Drying of dredged material							
Grading and leveling of dredged material							
Compaction of surface							
Other Activities							
Widening of access roads							
Construction of a super dyke around the site							
Construction of an administration building							
Sluice gate installation to manage flow of Ichhakhali Channel							
Revegetation and establishment of green buffers							
Construction of Power Plant							

Categorization of Impact

	L	Impacts are localized, of short duration and are expected to have an insignificant effect on the valued component
	M	Impacts are more widespread, of moderate duration and are expected to have a limited to moderate effect on the valued component
	H	Impacts are widespread, of longer duration and are expected to have an adverse effect on the valued component

Table 9-4: Summary of Potential Cumulative Impacts of Additional Landfilling Activities on each VC

VC	Indicator	Potential for Cumulative Impact	Contribution to Cumulative Impact
Air Quality	PM 10, SPM, NOx, Sox, VOC	Particulate emissions may exceed standards for short period at the construction site and along access roads.	Impacts are expected to be localized, of moderate duration in the construction phase and no adverse cumulative impacts are anticipated.
Water Quality	Surface water parameters - pH, temp, BOD, Cl, TDS, TSS, EC, oil/grease, coliform, metals	Surface water quality may be affected from potential leaks of fuel or oil from machinery for construction. Potential for contamination from sanitary waste if proper toilet facilities are not installed for workers.	Impacts are expected to be localized and no adverse cumulative impacts are anticipated.
	Groundwater parameters to be selected – pH, Cl, TDS, TSS, EC, oil/grease, coliform, metals (e.g. arsenic)	Fuel, oils, and chemicals may seep into groundwater from leaks or the inadequate disposal of waste.	Impacts are expected to be localized and no adverse cumulative impacts are anticipated.
Water Quantity	Volume extracted – l/d	Other than domestic water supplies for the construction camp and site watering for dust control, no large volumes of water abstraction are expected.	Localized and no adverse cumulative impacts are anticipated.
Sediment Quality	Concentrations of nickel and chromium	Run off from the site may introduce contaminants into adjacent drainages	Localized impacts on marine water quality are expected. Fill quality of dredged material meets international standards. No adverse cumulative impacts expected.
Employment	Workforce numbers	Construction will result in additional but limited job creation for the area. The project should ensure that local people are given employment opportunities. Labor influx to the area is not expected at the construction stage.	Localized and no adverse cumulative impacts are anticipated.

Operation Phase

There is not enough detail at the current time to assess potential cumulative impacts of the operations phase of PSDSP nor PRIDE due to insufficient information about potential industrial clusters, operating conditions and detailed project footprints and discharge specifications to air, soil and water. This will be done as part of the full CIA as discussed below in Section 9.3.4.

9.3.4 Scoping of Full CIA Requirements for BSMSN

The foregoing is a rapid assessment of the potential for cumulative impacts of the additional 96.5 acre added to the EZ-2 phase and concludes, providing that mitigation measures are employed, there are no anticipated adverse cumulative impacts of project activities during the construction phase. Some localized impacts of short-term duration are expected on air quality and risks exist to water quality if proposed mitigation measures are not fully implemented. Monitoring of project and control site conditions should be conducted throughout the construction phase to ensure application of mitigation measures.

During the anticipated operation phase of PRIDE, including additional project activities associated with Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN), there is a potential for cumulative impacts on selected VCs, the extent of which will be dependent upon definition of proposed projects and activities in the industrial park.

These following considerations are presented as to how a full CIA should be completed as part of the proposed regional environmental and social assessment (RESA).

- Extensive public consultation should be undertaken with a variety of stakeholders to participate in the selection of VCs and to determine their involvement during CIA preparation and dissemination of results.
- There is a need to evaluate the existing EZ-2 and PRIDE environmental and social baseline and complete a gap analysis to identify if additional information need collection to assess cumulative impacts.
- The list of valued components that could be affected by project activities, will likely increase during the operations phase. This could include for example environmental VCs such as soil quality, sediment quality, biodiversity (mangroves or impacted faunal species), fisheries (with selected indicator species), agriculture, aquaculture, and social VCs such as social equity (human rights and equality inclusion), human health and others as expressed by stakeholders.
- Identification of all projects and activities is required within the boundaries of affected valued components that could give rise to cumulative impacts. This not only includes the PSDSP and BSMSN sites but also other activities and projects within the defined spatial boundaries of the full CIA.
- Full project descriptions of all projects and activities are needed including detail process information, project footprints, expected discharges to air, soil and water, water volumes needed, employment/staffing needs, associated and ancillary facilities.
- It may be useful to consider industry “clusters” of similar industry types to assess multiple industry impacts.
- Spatial boundaries must be delimited to assess what other projects and activities are to be included in the full CIA beyond the PRIDE site and BSMSN.

- Temporal boundaries of the CIA must be clearly defined – identifying how many years should be considered into the future and what is the level of certainty associated with proposed project development proposals.
- Project mitigation and management measures should be fully detailed as part of the impact assessment process.
- It is important to develop an institutional model for cooperative actions to monitor and manage cumulative impacts that includes a coordinating organization to oversee implementation and ensure responsibility for individual and collective actions.
- A detailed term of reference will be required for the full CIA including selection of competent consultants and institutions with experience in conducting cumulative and regional impact assessments.
- A capacity building assessment is required to determine practitioner proficiency cumulative impact assessment including understanding of CIA methodology, assessment of cumulative impacts, determination of impact significance and development of cumulative impact management models.

9.4 Summary of the Environmental and Social Impact

It is evident from the above that no significant environmental and social impacts are expected from the proposed additional activity. There might be some impact on surface water quality due to the dredging operation in the form of increase in turbidity in the water column. As suction pipe fitted with the dredger would be used for lifting the dredged material, such impact is not expected to be high and would be limited to the construction phase. Chemical analysis of the dredged material shows presence of a few heavy metals. But the concentrations were found acceptable as per the international standards for clean landfilling. However, the concentration of heavy metals in the ground water should be regularly monitored during the operation phase. Moreover, the ESMP for dredging operation need to be followed during implementation of this additional work as shown in Annex-1.

Private investors would set up industries once the land is developed and there would be environmental impacts from the construction and operation of those industries. However, the area is included in the master plan of BSMSN for which a detailed Regional Environmental and Social Assessment (RESA) would be carried out soon under the WB funded PRIDE project. RESA would take care of the operation phase impact of BSMSN.

A rapid cumulative impact assessment was also undertaken to assess the cumulative impact of the proposed additional work. The RCIA concludes, providing that mitigation measures are employed, that there are no anticipated adverse cumulative impacts of project activities during the construction phase. Some localized impacts of short-term duration are expected on air quality and risks exist to water quality if proposed mitigation measures are not fully implemented. Monitoring of project and control site conditions should be conducted throughout the construction phase. During the anticipated operation phase of PRIDE, including additional project activities associated with Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN), there is a potential for cumulative impacts on selected VCs, the extent of which will be dependent upon definition of proposed projects and activities in the industrial park. A set of recommendations have been made which should be considered in a full CIA to be completed as part of the proposed RESA under PRIDE project.

10. Environmental and Social Management Plan (EMP)

The additional landfilling will be guided by the project's EIA report and environmental management plan prepared for Mirsarai EZ-2. The additional work will be done by the same existing contractor and using the existing labors. The measures shown in Table A 1.1 describes the mitigation measures which has already been taken for the management of environmental and social risk related to the labor camp, sanitation, OHS etc. Dredging would be the main activity in the additional area and for managing the dredging operation properly, an ESMP for dredging operation has been included in Table A1.2. The monitoring plan has been shown in Table A 2.1

REFERENCES

Mohammad, M. U. and C. Paolo (2013). Sediment characteristics and Coastline Change of a Low-lying Island (Sandwip) in the Eastern GBM Delta, Bangladesh. ANDROID Residential Doctoral School Work Package III, Limassol, Cyprus.

Baran, A., et al. (2015). "Assessment of metal leachability and toxicity from sediment potentially stored on land." Water SA **41**.

Bray, R. N. (2008). Environmental Aspects of Dredging

Department of Public Health Engineering (2015). GROUNDWATER INVESTIGATION IN MIRSHARAI ECONOMIC ZONE.

Hieu, H. H., et al. (2012). "Potential release of selected trace elements (As, Cd, Cu, Mn, Pb and Zn) from sediments in Cam River-mouth (Vietnam) under influence of pH and oxidation." Science of the Total Environment: 487-498.

Mohammad, M. U. and C. Paolo (2013). Sediment characteristics and Coastline Change of a Low-lying Island (Sandwip) in the Eastern GBM Delta, Bangladesh. ANDROID Residential Doctoral School Work Package III, Limassol, Cyprus.

Quader, O. (2010). Coastal and marine biodiversity of Bangladesh (Bay of Bengal). International Conference on Environmental Aspects of Bangladesh, Japan.

Sarker, M. H., et al. (2009). Sediment dispersal processes and management in coping with climate change in the Meghna Estuary, Bangladesh. Sediment Problems and Sediment Management in Asian River Basins, Hyderabad, India.

USDA-NRCS (2002). Soil Salinity Management-Nonirrigated, USDA-NRCS Conservation Practice Standard, Code 571.

ANNEX-1

Environmental and Social Management Plan (ESMP)

Table A1.1: ESMP for Site Development & Construction works being followed in original work and continue to be followed for additional work

Activity/Impact	Mitigation Measures	Time Frame	Implantation of Mitigation Measures	Supervision & Monitoring
Setting up of construction camps/labor camps	<ul style="list-style-type: none"> • The living accommodation and ancillary facilities for labor has been erected and maintained to standards and scales approved by the resident engineer • All sites used for camps are adequately drained. They will not be subject to periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water unless such water surface can be subjected to mosquito control measures. • The camps have been located such that the drainage from and through the camps will not endanger any domestic or public water supply. • Construction camps have been provided with sanitary latrines (1 per 25 pax), bathing facility and urinals. • Construction camps have elective connection and well ventilated • Adequate and suitable facilities for washing clothes and utensils have been provided and maintained for the use of contract labor employed therein. • Drains and ditches are treated with bleaching powder on a regular basis. • The sewage system for the camp was properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. • Clean potable drinking water facility have been provided at the site and the water quality is monitored regularly • Store house for hazardous material like diesel has been located at distance from construction labor camps. • First aid facilities are available at construction camp. First aid box contains small, medium and large 	Pre-construction phase	Contractor	BEZA

Activity/Impact	Mitigation Measures	Time Frame	Implantation of Mitigation Measures	Supervision & Monitoring
	<p>sized sterilized dressings, sterilized burns dressings, 2 % alcoholic solution of iodine, bottle containing salvolatile, snakebite lancet, bottle of potassium permanganate crystals, scissors, Ointment for burns & surgical antiseptic solution</p> <ul style="list-style-type: none"> • 1 first aid box has been made available per 50 labor 			
Soil Erosion and Sedimentation control	<ul style="list-style-type: none"> • To avoid soil compaction along the transportation routes, only identified haul roads are used for transportation. 	During Construction	Contractor	BEZA/PMC
Disposal of Debris and any waste generated	<ul style="list-style-type: none"> • Waste from construction camp is segregated at site. Food/wet waste is composted in pit at the site, recyclable is sent to authorized recyclers and rejected waste is disposed regularly through responsible agency in the area • Dustbins have been provided at the site and construction camps to prevent littering of waste • Storage area of minimum 2 days have been provided at construction camp for storage of the waste generated from labor camps • Construction debris is stored under covered sheds on paved surfaces to prevent leaching • Hazardous waste generated during construction activity is stored at suitable place and then disposed off in consultation with city corporation. • Contaminated runoff from storage areas shall be captured in ditches with an oil trap at the outlet. • Utmost care is taken to ensure that the Municipal Corporation norms are met for the safe collection, transport and disposal of construction waste and debris. 	During Construction	Contractor	BEZA/PMC
Dust Generation	<ul style="list-style-type: none"> • Routes for transportation of material within the site has been covered with brick bed so as to minimize the dust generation • Raw material stored including debris and excavated soil are kept covered. • Cement and sand should be stored under covered sheds only 	During Construction	Contractor	BEZA/PMC

Activity/Impact	Mitigation Measures	Time Frame	Implantation of Mitigation Measures	Supervision & Monitoring
	<ul style="list-style-type: none"> • Vehicles delivering materials are covered to reduce spills and dust blowing off the load. • In high dust areas, workers are provided with and encouraged to use masks. • Regular maintenance, servicing of the vehicles and periodic emission check for equipment and machinery are carried out in conformity with country law • Water is be sprayed on the haul road. • Air quality monitoring is carried out during construction phase as per plan. 			
Contamination of surface & ground water	<ul style="list-style-type: none"> • Ichhakhali canal at site has been retained and no waste is disposed off in the canal • Material mixing, material storing, washing of equipment and vehicles and other activities close to water bodies is avoided • Car washing / workshops near water bodies are avoided. • Sanitation facility with septic tank followed by soak pit have been constructed. • Surface run off due to construction activity are not discharged in open surface without treatment. • Temporary storm water drains have been provided for whole site. These drains are connected to Ichhakhali canal. These drains have been provided with stilt trap so as to arrest sediments from run-off before discharging into canal. • Silt are removed periodically from these stilt traps to avoid choking and overflow. 	During Construction	Contractor	BEZA/PMC
Noise from Vehicles, Plants and Equipment	<ul style="list-style-type: none"> • Construction activities are carried out in the daytime only. • The construction equipment have been provided with adequate noise control measures that comply with the noise standards as prescribed by DoE • Regular maintenance of vehicles and equipment are carried out and corrective action taken in case of any deviation. • Earmuff/ear plug are given to the workers working around or 	Throughout construction	Contractor	BEZA/PMC

Activity/Impact	Mitigation Measures	Time Frame	Implantati on of Mitigation Measures	Supervisi on & Monitorin g
	<p>operating plant and machinery emitting high noise levels.</p> <ul style="list-style-type: none"> • Labor working in noise prone area are provided with ear plugs and job rotation is practiced to prevent the prolonged exposure of any workers to high noise levels • Speed limits for vehicles are restricted 			
Accidents	<ul style="list-style-type: none"> • Safety officer have been appointed at site to ensure all the safety guidelines are being followed. • Cautionary signs have been erected at site to aware people about the associated risk with the area. Entry to the fuel storage room or machinery operation room is restricted only to authorized trainer personnel • All Accidents are reported immediately and incident analysis, preventive measures are implemented. • Fuel is stored at site away from construction camps • Adequate lighting has been provided at site especially during night time 	Throughout construction	Contractor	BEZA/PMC
Occupational Health & Safety Plan	<ul style="list-style-type: none"> • Site specific emergency management plan has been prepared following EHS guidelines. • All construction worker are required to wear a safety jacket and other protective equipment like helmet, gloves, gum boots, ear plugs, mask while working at the site • Workers have been made aware about the health issues related with open defecation • Training to workers have been provided for handling the construction equipment and machinery • Training to the workers have been provided to handle the emergency situations like fire, floods etc. • First aid facility and sufficient number of trained personnel have been available at all the time at construction camp 	Throughout construction	Contractor	BEZA/PMC

Activity/Impact	Mitigation Measures	Time Frame	Implantati on of Mitigation Measures	Supervisi on & Monitorin g
	<ul style="list-style-type: none"> • Cautionary signage and notice have been displayed in local language and English at the required places like fuel storage area so that hazards can be avoided. Security guards have been deputed in these areas and entry is restricted 			
Disaster Management	<ul style="list-style-type: none"> • All reasonable precautions are taken to prevent danger of the workers and the public from fire, flood, drowning, etc. • Fire-fighting facility, i.e. sand filled buckets and portable fire extinguishers are available at site • Workers have been trained how to use fire extinguisher • Workers have been made aware of nearest cyclone shelters and measures to be taken by them in case of cyclone or flood. 	During disaster time	Contractor	BEZA/PMC

Table A 1.2 Environmental Management Plan for Dredging Operation

Impacted Environmental Component	Mitigation Measures During Construction Phase
Impact on Soil Quality	<ul style="list-style-type: none"> • Excess dredged material should not be disposed at any location other than the project location
Impact on Water Quality	<ul style="list-style-type: none"> • Dredging should be carried out only by licensed dredgers of Inland Water Authority of Bangladesh • Dredging should be carried out in stretches identified by BWDB • Dredged material extracted should be tested for toxicity & contamination • Dredger should be selected as per the strata to be dredged • To minimize the sediment dispersal during disposal of dredge sediments, cutter should be placed as close to the bed as possible preferable at a level of 1m above the bed to minimize the dispersal of sediments

Impacted Environmental Component	Mitigation Measures During Construction Phase
	<ul style="list-style-type: none"> Regular servicing and maintenance of dredgers should be taken up so as to prevent any leakage of the dredged material. Leakage detection of the sediment transportation pipe should be carried out regularly to prevent any sediment loss and water pollution at leakage location. Corrective actions should be taken immediately after detection of such leaks.
Aquatic Ecology	<ul style="list-style-type: none"> Measures like provision of bubble curtains or creation of agitation in water should be carried out prior carrying out dredging operations so as to provide avoidance time and let the species move away from dredging point and to prevent any injury/mortality. Dredging operations should be halted in case of sighting of RET species, if any. Contractors should submit SOPs and action time chart with risk management plan prior to any dredging work. Dredging contractor should follow the defined safety procedures to avoid accidents and spills, and BEZA should ensure that other vessel users are provided with adequate information and instruction to avoid conflict with the dredgers.
Occupational Health and Safety	<ul style="list-style-type: none"> Log book should be maintained for recording the accidents at site/mortality of the any aquatic mammal should be maintained. Analysis shall be carried out to assess the reason for the accident/mortality and measures should be taken to prevent repetition of the event. Contractors having experience of dredging and well trained staff should only be allowed to carry out dredging. This will help in prevention of spillage of dredged material or any accidents during the dredging operations Dredging plan should be prepared by contractor and submitted to BEZA for approval prior to carrying out dredging operations. Contractors should submit method statement & risk assessment plan prior to carrying out any dredging work. Dredger should follow the defined safety procedures to avoid accidents and spills, and BEZA should ensure that other vessel users are provided with adequate information and instruction to avoid conflict with the dredgers.
Socio-economy	<ul style="list-style-type: none"> Dredging operations should be restricted to day time only, i.e. 6:00 AM-10:00 PM to minimize noise impacts. Dredgers should be equipped with the noise reduction/masking equipment to reduce the noise generation Dredgers should be placed in consultation with the fishermen so as to minimize the impact on their equipment/gears and their fishing activities Timely intimation to fishermen about dredging operation and location can minimize the disturbance to fishermen. Dredgers should be placed in consultation with the fishermen so as minimize the impact on their equipment/gears and their fishing activities

ANNEX-2

Environmental and Social Monitoring Plan

Table A 2.1 : Environmental and Social Monitoring Plan

S. No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency	Executing Agency	Enforcement Agency
1.0	Construction Phase					
1.1	Air Quality	Land filling by sand, Transportation of construction materials, construction of utilities	Test for PM ₁₀ , PM _{2.5} , SO ₂ , NO _x , CO at 3 locations	Once during the implementation of the proposed additional work.	Contractor	BEZA & PMC
1.2	Noise Level	Noise levels compliance with respect to industrial standards	Ambient Equivalent continuous Sound Pressure Levels (L _{eq}) at day and Night time at 3 locations	Once during the implementation of the proposed additional	Contractors	BEZA & PMC
1.3	Quality of dredged sediment	Contamination	For PAHs, heavy metals, PVCs and other toxic chemicals/com pounds	Once during dredging operation	Contractor	BEZA & PMC

ANNEX-3: EMERGENCY RESPONSE PLAN

1. Purpose of the Emergency Response Plan

The initial response to an incident or a disaster is a critical step in the overall emergency response. The purpose of having an Emergency Response Plan (ERP) is to:

- Assist personnel improve their understanding of the plant, equipment, processes and materials, and their possible impacts in emergency situations.
- Assist personnel in determining the appropriate response to emergencies.
- Provide personnel with established procedures and guidelines.
- Notify the appropriate Facility Emergency Response Team personnel and regulatory/ Govt. and external agencies.
- Manage public and media relations.
- Notify the next-to-kin of accident victims.
- Promote inter-departmental Communications to ensure a coordinated emergency response facility wide.
- Minimize the effects that disruptive events can have on facility operations by reducing recovery times and costs.
- Respond to immediate requirements to safeguard the subtending environment and community.

Generally, the initial response is guided by three priorities Ranked in importance of these priorities are:

1. People
2. Property
3. Environment

Emergency Response Procedures will identify who does what and when in the event of an emergency. Responsibility for who is in charge and their coordination of emergency actions shall be identified.

2. Six Steps in Emergency Response

Step-1)

- a) Determine the potential hazards associated with the incident, substance or circumstances and take appropriate action identify the type and qualities of dangerous goods involved and any known associated hazards.
- b) Determine potential hazards stemming from local conditions such as inclement weather water bodies etc. and ensure that the initial response team is aware of these conditions.

Step-2)

Determine the source/ cause of the event resulting to the emergency and prevent further losses.

Step-3)

Conduct an assessment of the incident site for any further information on hazards or remedies.

Step-4)

Initiate redress procedures.

Step-5)

Report the incidence, its nature, cause, impact applied, redress procedures and any further assistance required etc. to the appropriate company, government and/or land owner.

Step-6)

Take appropriate steps with respect to hazards to wildlife, other resources and addressing public and media concerns and issues, as applicable. Response priorities are to protect human lives, property and the environment.

3. Emergency Response for Anticipated Emergencies

Any emergency starts as a small incident and may become a major accident if not controlled in time. An adequate response by emergency response team is absolutely essential. The site coordinator will maintain a list of emergency handling equipment including details of fire extinguishers, protective clothing, and personal protective equipment for emergency handlers etc. In addition, details of the nearest fire management services and hospitals will be available with site controller in his operating checklist. Here are emergency responses for some of the emergencies anticipated at the site during construction and operation:

Emergency Response for Fire

Immediate action is the most important factor in the emergency control because the first few seconds count. Take immediate steps to stop fire and raise alarm simultaneously. As fires develop and spread quickly, so all out efforts should be made to contain the spread of fire.

- Information about the fire should be given to the emergency control personnel immediately
- Fire brigade should be informed immediately about the fire incident
- Personnel trained for fire fighting should use the suitable fire extinguisher to fight the fire in safe manner
- All people should accumulate at emergency assembly point
- All vehicles except those that are required for emergency use should be moved away from the operating area in an orderly manner at pre nominated route.
- Electrical system except the lighting and fire fighting system should be isolated.
- Block all roads in the adjacent area and enlist police support for the purpose, if required.
- Any person injured should be given first-aid immediately and should be taken to hospital immediately in emergency vehicle/ambulance

Fire in Diesel Storage Area

A fire at a small leak in pipeline must be attacked promptly with nearest available fire extinguisher before it has a chance to spread and get out of control. Call for help from all the available employees at the same time.

- Work to keep the fire from spreading.
- Shut off flow of oil in line by closing valves and by stopping pumping.
- Cover the oil pool by sand and build up the pile of sand so as to cover the leak.
- Put foam on the burning oil pool. Apply the foam gently so as not to scatter the burning oil.
- Build earth dykes around the oil pool to prevent spreading of burning oil.
- Do not leave oil trapped in short lengths of pipe exposed to fire between the closed valves, since, oil so trapped and heated often bursts the pipe and spills out spreading the fire.
- Wet down adjacent structures to keep them cool.

Emergency Response for Earthquake

Measures are different for different location in case of earthquake

If in Outdoors

- Response Procedures for workers at site
- Move into the open, away from buildings, streetlights, and utility wires. Once in the open, stay there until the earthquake stops.

If in a moving vehicle:

Stop quickly and stay in the vehicle. Move to a clear area away from buildings, trees, overpasses, or utility wires. Once the shaking has stopped, proceed with caution. Avoid bridges or ramps that might have been damaged by the quake.

After the quake

- After the quake, be prepared for aftershocks.
- Although smaller than the main shock, aftershocks cause additional damage and may bring weakened structures down. Aftershocks can occur in the first hours, days, weeks, or even months after the quake.
- Help injured or trapped persons.
- Give first aid where appropriate. Do not move seriously injured persons unless they are in immediate danger of further injury. Call for help.
- Remember to help those who may require special assistance--infants, the elderly, and people with disabilities.
- Stay out of damaged buildings.
- Use the telephone only for emergency calls.

Response Procedure

- Inform the necessary authorities for aid.
- Ensure no one is stuck beneath any debris, in case of a structural failure.
- Ensure that all the people standing outside or near the buildings are taken to open areas.
- Ensure that the first aid ambulance and fire tender vehicles are summoned if necessary.
- Inform the nearby hospitals if there are any injuries.
- Check the utilities and storage tanks for any damage.
- At the time of the emergency, the site coordinator and other workers along with the security personnel within the group housing shall take position to perform their duties. The following resources should be available with the site coordinator.
- Copies of the local police station
- Layout Plan of the site and fire evacuation plan
- Location of emergency assembly area
- Information regarding Safety Equipment, Fire Fighting material
- List of emergency contact numbers like emergency contact person, fire brigade, nearby hospitals
- Copies of the local Telephone Directories.
- Personal Protective Equipment.
- First-aid Kit.
- Communication system like alarm system for fire, cyclone, flood and earthquake. The communication equipment should be checked periodically to ensure that they are functional.

Emergency Response for Cyclone/Flood

- Site lies in cyclone and fire prone area. Thus necessary measures are required to be undertaken in cyclone and flood conditions to manage the damage during emergency situation
- Regular contact to be maintained with local meteorological department to get the information regarding cyclone and flood
- In case of alert is issued the entire site should be evacuated
- The material which may release pollutants should be removed from site and should be shifted to safe location
- The site should not be occupied or work should not be started unless the danger is settled completely
- Information about the location of nearest cyclone shelter should be given to all the workers at site
- Entry to the site should be closed through barricading in case of flood and cyclones

DESIGN OF ON-SITE EMERGENCY PLAN

Construction Phase

The 'On-site emergency plan' to be prepared by contractor during construction and shall include minimum the following information:

- Name & Address of Contractor
- Updating sheet
- Project Location
- Name, Designation & Contact Numbers of the organization, nearby hospitals, fire agencies etc. and key personnel including their assigned responsibilities in case of an emergency.
- The roles and responsibilities of executing personnel
- Site Layout Diagram showing location of fire extinguishers, emergency collection area and fire alarm
- Identification of Potential Emergencies Situations/ preventive measures / control & response measures
- Location of Emergency Control Centre (or designated area for emergency control / coordination) with requisite facilities.
- Medical services / first aid
- List of emergency equipment including fire extinguishers, fire suits etc.

ANNEX-4: Canadian Sediment Quality Guideline

Provincial sediment quality guidelines for metals and nutrients

Substance	No effect level	Lowest effect level	Severe effect level*
	Below this level material is suitable for open water disposal	Below this level material is suitable to use as clean fill	Below this level material may be placed in a landfill or CDF. Above it, material is subject to hazardous waste disposal
Arsenic	–	6	33
Cadmium	–	0.6	10
Chromium	–	26	110
Copper	–	16	110
Iron	–	2	4
Lead	–	31	250
Manganese	–	460	1100
Mercury	–	0.2	2
Nickel	–	16	75
Zinc	–	120	820
TOC	–	1	10
TKN	–	550	4800
TP	–	600	2000
Aldrin	–	.002	8
BHC	–	.003	12
Chlordane	.0002	.007	6
DDT total	–	.007	12
Dieldrin	.0006	.002	91
Endrin	.0005	.003	130
HCB	.01	.02	25
Heptachlor	.0003	–	–
Hepoxide	–	.005	5
Mirex	–	.007	130
PCB (total)	.01	.07	530
Acenaphthene	–	–	–
Anthracene	–	.220	370
Benzo[a]anthracene	–	.32	1480
Benzo[b]fluorine	–	–	–
Benzo[k]fluoranthene	–	.24	1440
Benzo[a]pyrene	–	.37	2
Benzo[g,h,i]perylene	–	.17	320
Chrysene	–	.34	460
Dibenzol[a,h]anthracene	–	.06	130
Fluoranthene	–	.75	1020
Fluorene	–	.19	160
Naphthalene	–	–	–
Phenanthrene	–	.56	950
Pyrene	–	.49	850
PAH (total of 16)	–	4	10000

Notes:

Values are in mg/kg (ppm) dry weight unless otherwise specified

* The units of this column are mg/kg of organic carbon and require conversion based on the TOC value of the substance in question.

TOC Total Organic Carbon

TKN Total Kjeldahl Nitrogen

TP Total Phosphorus

– Insufficient data